Facet Joint Interventions Guidelines

Updated 2026 Comprehensive Evidence-Based Guidelines for Facet Joint Interventions in the Management of Chronic Spinal Pain: American Society of Interventional Pain Physicians (ASIPP) Guidelines

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From: The American Society of Interventional Pain Physicians

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Disclaimer: There was no external funding in the preparation of the guidelines. Internal funding provided by the American Society of Interventional Pain Physicians (ASIPP) was limited to preparation of the publication.

Conflict of interest: See pp. S194-S195 for this information.

Article received: 03-17-2026
Revised article received: 04-15-2026
Accepted for publication: 04-26-2026

Free full article: www.painphysicianjournal.com

Background: Chronic axial spinal pain is a major contributor to disability and healthcare expenditures, with facet joints recognized as one of the established sources of pain.

Objective: To provide evidence-based guidance in performing diagnostic and therapeutic facet joint interventions.

Methods: A multidisciplinary panel of experts from various medical and pharmaceutical disciplines, convened by the American Society of Interventional Pain Physicians (ASIPP), reviewed the available evidence, considered patient perspectives, and formulated recommendations for facet joint interventions in the management of chronic pain.

The methodology included the development of key questions with evidence-based statements and recommendations. Grading of the evidence and recommendations followed a modified approach described by ASIPP, the Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology, and the Agency for Healthcare Research and Quality (AHRQ) methods for grading strength of recommendations. The evidence review included existing guidelines, systematic reviews, comprehensive reviews, randomized controlled trials (RCTs), and observational studies evaluating the effectiveness and safety of facet joint interventions in chronic pain management.

In the development of consensus statements and guidelines, a modified Delphi technique was utilized to minimize bias related to group interactions. Panelists without a primary conflict of interest voted on approval of specific guideline statements. Each panelist was permitted to suggest revisions to guideline wording and provide additional qualifying remarks or comments regarding implementation of the guidelines in clinical practice. To achieve consensus and inclusion in the final guidelines, each guideline statement required at least 80% agreement among eligible panel members without a primary conflict of interest.

Results: A total of 48 authors participated in the development of these guidelines, of whom

39 participated in the voting process. A total of 37 recommendations were developed, with 100% acceptance for all items. The Summary of Recommendations is presented separately. These recommendations addressed diagnostic, therapeutic, and special considerations related to facet joint interventions. For diagnostic and therapeutic interventions, the level of evidence ranged from II to III, with moderate to strong recommendations. For special considerations and safety assessments, the level of evidence ranged from II to V. The evidence provided recommendations regarding diagnosis, treatment, sedation, concurrent antithrombotic therapy, and precautions required in special clinical circumstances.

Limitations: The limitations of these guidelines include a paucity of high-quality studies in some aspects of diagnosis and therapy.

Conclusion: These guidelines for facet joint interventions were developed through a comprehensive review of the literature, including methodologic quality assessment and determination of the level of evidence and strength of recommendations.

Key words: Chronic spinal pain, interventional techniques, diagnostic blocks, therapeutic interventions, facet joint nerve blocks, intraarticular injections, radiofrequency neurolysis

Disclaimer: These guidelines are based on the best available evidence and do not constitute inflexible treatment recommendations. Due to the changing body of evidence, this document is not intended to be a "standard of care."

Pain Physician 2026: 29:S1-S228

SUMMARY OF EVIDENCE AND RECOMMENDATIONS:

Non-interventional Diagnosis:

1. The **level of evidence is II** in selecting patients for facet joint nerve blocks at least 3 months after onset and failure of conservative management who have axial pain, tenderness over the facet joints, reduced range of motion, exacerbation with extension and lateral rotation, pain reduction with rest, and absence of a radicular pattern, with **strong strength of recommendation** for physical examination and assessment.
2. The **level of evidence is III** for accurate diagnosis of facet joint pain with physical examination based on symptoms and signs, with **strong strength of recommendation**.
3. The **level of evidence is I** with **strong strength of recommendation** for mandatory fluoroscopic or computed tomography (CT) guidance for all facet joint interventions.
4. The **level of evidence is III** supporting the use of SPECT for identifying painful facet joints before diagnostic facet joint nerve blocks, with **weak strength of recommendation**.
5. The **level of evidence is V** with **weak strength of recommendation** for scintigraphy, MRI, and CT for identifying painful facet joints.

Interventional Diagnosis:

6. Lumbar Spine: The **level of evidence is I to II** with **moderate to strong strength of recommendation** for the diagnosis of lumbar facet joint pain by performing lumbar diagnostic facet joint nerve blocks.
7. Cervical Spine: The **level of evidence is II** with **moderate strength of recommendation** for the diagnosis of cervical facet joint pain by performing cervical diagnostic facet joint nerve blocks.
8. Thoracic Spine: The **level of evidence is II** with **moderate strength of recommendation** for the diagnosis of thoracic facet joint pain by performing thoracic diagnostic facet joint nerve blocks.
9. The **level of evidence is II** that interventional diagnostic approaches should be applied in the chronic phase after 3 months from onset and failure of conservative management modalities, including medical therapy, structured exercise programs, and physical therapy, with noninvasive diagnostic assessment leading to diagnostic facet joint nerve blocks, with **strong strength of recommendation**.
10. The **level of evidence is III** for the influence of psychological factors affecting the diagnosis, with **moderate strength of recommendation** to exercise caution in patients with combined depression, anxiety, and somatization disorder.
11. The **level of evidence is II** that intraoperative opioids may affect the diagnostic validity of facet joint nerve blocks, with a **strong strength of recommendation** to avoid opioids.
12. The **level of evidence is II** showing that benzodiazepines do not affect the validity of diagnostic facet joint nerve blocks, with **moderate strength of recommendation** that they may be utilized for mild sedation in low doses based on the patient's physical and medical status.
13. The **level of evidence is III** that mild sedation may be required and utilized during the performance of diagnostic facet joint interventions, with **moderate strength of recommendation** to provide sedation during therapeutic interventions.
14. The **level of evidence is III** that the prevalence of facet joint pain and false-positive results may be higher in patients with involvement of multiple regions, lower in post-surgical syndrome, and higher in the older population, with **moderate strength of recommendation** to consider these factors in providing appropriate diagnosis and therapy.

Therapeutic Facet Joint Interventions:

15. Radiofrequency Ablation:
    - The **level of evidence is II** with **moderate strength of recommendation** for the clinical effectiveness of cervical radiofrequency ablation.
    - The **level of evidence is III** with **weak to moderate strength of recommendation** for the clinical effectiveness of thoracic radiofrequency ablation.
    - The **level of evidence is II** with **moderate strength of recommendation** for the clinical effectiveness of lumbar radiofrequency ablation.

16. Therapeutic Intraarticular Injections:
    - The **level of evidence is III** for short-term improvement and V for long-term improvement, with **weak strength of recommendation** for the clinical effectiveness of cervical intraarticular facet joint injections.
    - The **level of evidence is III** with **weak to moderate strength of recommendation** for the clinical effectiveness of thoracic intraarticular facet joint injections.
    - The **level of evidence is IV** with **weak strength of recommendation** for the clinical effectiveness of lumbar facet joint intraarticular injections.
17. Therapeutic Facet Joint Nerve Blocks:
    - The **level of evidence is II** with **moderate strength of recommendation** for the clinical effectiveness of therapeutic cervical facet joint nerve blocks.
    - The **level of evidence is II** with **moderate strength of recommendation** for the clinical effectiveness of thoracic therapeutic facet joint nerve blocks.
    - The **level of evidence is II** with **moderate strength of recommendation** for the clinical effectiveness of therapeutic lumbar facet joint nerve blocks.

Special Considerations:

18. Repeat Facet Joint Interventions:
    The **level of evidence is II** with **moderate to strong strength of recommendation** for the safety and effectiveness of repeat facet joint interventions, including RFA, with outcomes similar to the initial procedures.
19. Impact of Temperature, Duration of Lesioning, and Size of the Lesion:
    The **level of evidence is II** with **strong strength of recommendation** regarding the impact of temperature, duration of lesioning, and lesion size when performed with an 18-gauge needle in the lumbar spine and a 20-gauge needle in the cervical and thoracic spine, utilizing an active tip of 10 mm in the lumbar spine and 5 or 10 mm in the cervical and thoracic spine.
20. Type of Electrodes and Needles:
    The **level of evidence is IV**, with **no specific recommendation** regarding the use of a particular type of electrode or needle for RFA.
21. Position of the Electrode:
    The **level of evidence is IV**, with **weak strength of recommendation** regarding differential effectiveness based on electrode positioning, either parallel or perpendicular to the nerve.
22. Stimulation Parameters:
    The **level of evidence is II**, with **strong strength of recommendation** to perform motor and/or sensory testing before RFA.
23. Radiofrequency Ablation in Patients with Metallic Implants:
    The **level of evidence regarding safety is IV**, with **weak strength of recommendation** to perform RFA cautiously in patients with metallic implants.
24. Radiofrequency Ablation in Patients with Cardiac Implantable Devices:
    - The **level of evidence is III** with **moderate strength of recommendation** for the safety and effectiveness of RFA, including bipolar RFA, and maintenance of a distance of 15 cm or 6 inches, in patients with cardiac pacemakers who have undergone appropriate pretreatment preparation with all necessary precautions.
    - The **level of evidence is II** with **moderate to strong strength of recommendation** in patients with cardiac pacemakers to treatment with therapeutic facet joint nerve blocks instead of RFA.

Radiofrequency Ablation in Patients with Stimulators and Intrathecal Infusion Systems: Deep Brain Stimulators (DBS), Spinal Cord Stimulators (SCS), and Other Implants:

25. The **evidence regarding safety is III to V**, with **weak strength of recommendations** for the performance of RFA, including bipolar RFA, and maintenance of a distance of 15 cm or 6 inches in patients with implantable stimulators and intrathecal infusion systems using appropriate safety precautions.
26. The **level of evidence regarding safety is V** with **weak strength of recommendation** to perform RFA, including bipolar RFA, in patients with stimulators and pumps implanted in the cervical spine, includ-

ing hypoglossal nerve stimulators, vagus nerve stimulators, and cervical leads, using appropriate safety precautions.

27. The **level of evidence including bipolar RFA and maintenance of a distance of 15 cm or 6 inches is II** with **moderate to strong recommendation** regarding the performance of therapeutic facet joint nerve blocks as a substitute for RFA in managing spinal facet joint pain in patients with stimulators and pumps, including hypoglossal nerve stimulators, vagus nerve stimulators, and cervical leads, specifically in the cervical and thoracic spine.

Antithrombotic Therapy

28. The **level of evidence regarding safety** of facet joint interventions, including intraarticular injections, medial branch blocks, and ablation, is III with **moderate strength of recommendation** that antithrombotic therapy may be continued based on ASIPP Antithrombotic Guidelines.

Sedation

29. The **level of evidence is III** that mild sedation and analgesia may be required and utilized during the performance of therapeutic facet joint interventions, with **moderate strength of recommendation**.
30. The **level of evidence is III** that moderate sedation or monitored anesthesia care may be required for RFA, with **moderate strength of recommendation**.

Index - FACET JOINT INTERVENTIONS GUIDELINES 2026

1.0 Introduction

Chronic spinal pain, whether associated with extremity pain, chest wall pain, or headaches, remains one of the leading causes of disability and healthcare expenditures in the United States and worldwide (1-19). Numerous studies evaluating U.S. health and disability trends (20-23), along with cost analyses related to low back pain, neck pain, and other musculoskeletal disorders (24), continue to demonstrate the increasing burden of disability and escalating healthcare costs. These conditions consistently rank among the most expensive disease categories in healthcare spending.

A 2024 report by the National Center for Health Statistics (NCHS) (25) evaluating chronic and high-impact chronic pain among U.S. adults during 2023 demonstrated that these conditions were among the primary reasons adults sought medical care. Chronic pain has been associated with reduced quality of life, opioid misuse, increased anxiety and depression, and unmet mental health needs. According to this report, 24.3% of adults experienced chronic pain, while 8.5% reported high-impact chronic pain during the preceding 3 months in 2023, compared to 20.5% and 7.5%, respectively, in 2019 (25). Furthermore, a 2026 publication by Zajacova et al (26) evaluated pain prevalence among U.S. adults before, during, and after the COVID-19 pandemic utilizing National Health Interview Survey data from 2019 through 2023 and demonstrated that chronic pain and high-impact chronic pain increased by 13% due to long COVID. The study demonstrated that chronic pain prevalence increased from 20.5% in 2019 to 24.3% in 2023, representing an 18.5% increase over the study period. High-impact chronic pain prevalence, which was 7.5% in 2019, increased to 8.5% in 2023, representing a 13% overall increase. The increases in pain prevalence observed in 2023 were widespread and occurred across all evaluated body sites and population subgroups. The investigators further reported that an estimated 60 million Americans experienced chronic pain and 21 million experienced high-impact chronic pain in 2023, representing the highest prevalence ever recorded in the National Health Interview Survey. These findings suggest a substantial escalation in the population burden of pain, with major implications for public health policy.

Additional contributing factors include increasing obesity rates (27,28) and the adverse effects associated with nicotine use (29). Chronic pain remains one of the most prevalent health conditions associated with nicotine use. The prevalence of combustible nicotine product use among individuals with chronic pain is more than double that observed in the general population, ranging from 28% to 68%. Among patients receiving treatment for chronic pain, dual users of cigarettes and e-cigarettes demonstrated significantly greater levels of anxiety, depression, pain-related disability, and opioid medication use (29).

Pain prevalence varies according to spinal region, with the lumbar spine most frequently affected at 43%, followed by the cervical spine at 32% and the thoracic spine at 13% (30). The one-year prevalence of low back pain and neck pain ranges from 22% to 65%, whereas lifetime prevalence estimates reach 84% for low back pain and 67% for neck pain. Chronic spinal pain may persist for more than one year in up to 60% of patients, even following conservative treatment or surgery (1).

In a 2024 study, Williamson et al (31) evaluated persistent back pain among community-dwelling older adults and reported that 77% continued to experience back pain after 2 years; 25% reported leg pain, and 14% experienced severe back pain interfering with activities of daily living. These findings were consistent with the 2023 NCHS survey data (25,26). In addition, 41.2% of participants reported no change in symptoms over the 2-year period, whereas 17.1% reported worsening symptoms. Five major factors were associated with severe pain-related limitations at follow-up, including pain characteristics, confidence in walking, and attitudes regarding activity in later life.

Individuals with chronic low back pain or neck pain are approximately 3 times more likely to have comorbid conditions compared to the general population (32). These spinal conditions are strongly associated with physical functional decline and increased mental health disorders, including depression, generalized anxiety disorder, somatization, and cognitive impairment (1,3,31,33,34).

Williamson et al (31) also observed that back pain accompanied by leg pain significantly worsened outcomes in older adults, increasing the risk of poor long-term outcomes by approximately 70%. Similarly, the presence of spinal stenosis in patients with combined back and leg pain was associated with adverse outcomes. These findings emphasize the importance of identifying multisite pain and symptom presentation when evaluating the risk of long-term disability in older adults.

Based on the literature, controlled diagnostic blocks have demonstrated that intervertebral discs, facet joints, nerve root dura, and sacroiliac joints are po-

tential sources of spinal and extremity pain (1,5,35-45). Multiple diagnostic and therapeutic modalities have evolved over time for the evaluation and management of spinal pain (1-5,35-61). Comprehensive evidence-based guidelines (1) have demonstrated prevalence ranges of 27% to 40% in the lumbar spine, 29% to 60% in the cervical spine, and 34% to 48% in the thoracic spine utilizing 80% pain relief as the criterion standard, demonstrating **Level I and II evidence** with **moderate to strong strength of recommendations**.

Based on comprehensive evidence-based guidelines, the evidence supporting multiple therapeutic modalities ranged from **Level II to V**, including **Level II** evidence with **moderate strength of recommendation** for lumbar radiofrequency ablation; **Level II** evidence with **moderate strength of recommendation** for cervical radiofrequency ablation; and **Level III** evidence with weak to **moderate strength of recommendation** for the emerging evidence supporting thoracic radiofrequency ablation.

In addition, the evidence for therapeutic lumbar facet joint nerve blocks was determined to be **Level II** with **moderate strength of recommendation**; **Level II** with **moderate strength of recommendation** for therapeutic cervical facet joint nerve blocks; and **Level II** with **moderate strength of recommendation** for thoracic facet joint nerve blocks after diagnosis had been established utilizing controlled diagnostic blocks.

Finally, the level of evidence for intraarticular injections was **Level IV** with **weak strength of recommendation** for lumbar facet joint intraarticular injections; **Level III** evidence for short-term improvement and **Level V** evidence for long-term improvement with **weak strength of recommendation** for cervical intraarticular facet joint injections; and Level III evidence with weak to moderate strength of recommendation for thoracic intraarticular facet joint injections. Multiple systematic reviews and controlled trials published subsequently have largely supported these guidelines (1-5,47-55).

Despite advances in diagnostic understanding, the use of interventional techniques for the diagnosis and treatment of facet joint pain continues to be the subject of ongoing debate. Multiple publications have documented a deceleration in procedural growth patterns across the United States (6-15). Numerous studies have evaluated diagnostic accuracy, clinical effectiveness (1-5,48-72), and cost utility, with many reporting favorable outcomes (49,50,71,73).

Accurate patient selection for the diagnostic and therapeutic management of facet joint pain, ensuring that patients meet appropriate medical necessity criteria and indications, remains crucial. Recent evaluations of the utilization of interventional techniques, particularly facet joint interventions, have demonstrated significant changes in utilization patterns (6-10).

Numerous healthcare policy changes since passage of the Affordable Care Act (ACA) have significantly affected patients with treatable pain conditions (74-85). These changes include the Inflation Reduction Act (IRA) of 2022 (80,82), expansion of Medicare Advantage Plans (6-8), and accelerated regulatory changes under the 21st Century Cures Act (86), combined with rising healthcare costs and declining healthcare utilization (86-114).

Under these circumstances, independent physicians are experiencing increasing difficulty maintaining financial viability (83-85,96,97,114-122). From 2019 through 2024, the number of independent physicians declined by 43%, and more than 40% of independent practices either closed or were absorbed by corporate entities. Despite these transitions, Centers for Medicare & Medicaid Services (CMS) policies continue to adversely affect independent practices (83-85,95-97).

Multiple guidelines have been published regarding the management of spinal pain utilizing various interventional techniques, including regenerative medicine (1,11-15,45,65,66,123). The American Society of Interventional Pain Physicians (ASIPP) published guidelines for facet joint interventions in the management of chronic spinal pain in 2020 (1). ASIPP has remained at the forefront of guideline development for the use of interventional techniques and opioids (1,15-17,45,123), as well as multiple other aspects of interventional pain management (20). The present guidelines represent updated recommendations for interventional techniques utilized in the management of facet joint pain. These guidelines provide an overview of the current literature regarding the use of interventional techniques in the diagnosis and treatment of spinal facet joint pain.

2.0 Methods

2.1 Rationale

The National Uniform Claims Committee (NUCC) defines interventional pain management as the discipline of medicine devoted to the diagnosis and treatment of pain-related disorders, principally through the application of interventional techniques in the management of subacute, chronic, persistent, and intractable pain, independently or in conjunction with other treatment modalities (124). In addition, the Medicare Payment Advisory Commission (MedPAC) defines interventional pain management techniques as minimally invasive procedures that include percutaneous precision needle placement of medications into targeted areas or ablation of targeted nerves; surgical techniques such as laser and endoscopic discectomy; and placement of intrathecal infusion pumps and spinal cord stimulators for the diagnosis and management of chronic, persistent, or intractable pain (125).

Chronic spinal pain is a complex and multifactorial disease process for which numerous treatment modalities are utilized in clinical management. The growing social and economic burden of chronic spinal pain continues to influence medical decision-making. Intervertebral discs, facet joints, sacroiliac joints, ligaments, fascia, muscles, and nerve root dura have all been identified as proven pain generators within the spine (1,5,36,37). Interventional pain physicians are familiar with a wide variety of image-guided interventional techniques utilized in the management of spinal pain.

2.2 Objectives

The objective of these guidelines is to provide a rational and systematic approach for the application of diagnostic and therapeutic interventional techniques in the management of facet joint pain. These guidelines are based on the available evidence regarding the effectiveness and safety of treatments for spinal pain. The literature clearly demonstrates the value of evidence-based guidelines and the necessity for periodic updates to maintain relevance with evolving clinical practice (126-128).

2.3 Application

These guidelines are applicable across multiple specialties; however, they are specifically intended for use by interventional pain physicians and surgical specialties utilizing interventional techniques. The primary objective of these guidelines is to provide patients, practitioners, regulators, and payers with information that enables determination of whether the available evidence supports the medical necessity of facet joint interventions.

2.4 Key Questions

These guidelines focus on the following key questions regarding spinal pain originating from facet joints:

1. What is the impact of chronic spinal pain on healthcare resources?
2. What are the trends in utilization of treatment modalities in the management of spinal pain?
3. What is the pathophysiologic and structural basis of spinal facet joint pain?
4. What is the evidence regarding the diagnostic accuracy and value of non-interventional methods in the diagnosis of facet joint pain?
5. What is the evidence regarding the diagnostic accuracy and value of interventional procedures in the diagnosis of facet joint pain?
6. What is the evidence supporting the effectiveness of commonly utilized therapeutic facet joint interventional therapies, including radiofrequency ablation, facet joint nerve blocks, and intraarticular injections, in the management of chronic spinal pain?
7. Are repeat facet joint interventions, specifically RFA, safe and effective in the management of spinal facet joint pain?
8. What is the impact of temperature, duration of lesioning, and lesion size on outcomes?
9. Is there a difference in outcomes or preference for specific types of electrodes and needles?
10. Is the position of the electrode relative to the nerve, either parallel or perpendicular, clinically relevant and important?
11. Is sensory or motor test stimulation necessary, and is there a preference for sensory stimulation, motor stimulation, or both?
12. Is radiofrequency ablation safe and effective in patients with metallic implants?
13. What safety precautions should be observed in patients with cardiac pacemakers and defibrillators during radiofrequency ablation?
14. What safety precautions should be observed in patients with deep brain stimulators (DBS), SCS, intrathecal systems, and other implants?
15. What is the evidence regarding the cost-effectiveness of interventional techniques in the management of spinal facet joint pain?

16. What are the side effects and adverse consequences associated with facet joint interventions?
17. What precautions should be followed in patients receiving anticoagulant and antiplatelet therapy while performing facet joint interventions?
18. What are the guidelines for diagnostic interventions in the management of spinal facet joint pain?
19. What are the guidelines for therapeutic interventions in the management of spinal facet joint pain?
20. What are the guidelines regarding the type and frequency of diagnostic and therapeutic facet joint interventions in the management of chronic spinal pain?

2.5 Adherence to Trustworthy Standards

In the preparation of these guidelines for facet joint interventions, the Institute of Medicine (IOM) standards and the National Guideline Clearinghouse Extent Adherence to Trustworthy Standards (NEATS) were followed (129-131). The NEATS instrument was developed and validated as a tool for trained staff at the Agency for Healthcare Research and Quality (AHRQ) National Guideline Clearinghouse (NGC) to provide an adherence-focused assessment.

2.5.1 Disclosure of Guideline Funding Source

Comprehensive evidence-based guidelines for facet joint interventions in the management of chronic spinal pain of facet joint origin were commissioned, developed, edited, and endorsed by ASIPP without external funding.

2.5.2 Disclosure and Management of Financial Conflicts of Interests

Potential conflicts of interest for all panel members during the preceding 5 years were evaluated prior to finalization of these guidelines. Conflicts of interest extended beyond financial relationships and included personal experience, practice patterns, academic interests, and promotional activities. Panel members with potential conflicts were recused from discussions or preparation of guideline sections in which conflicts existed, and these members agreed not to discuss any aspect of the guidelines with relevant industry representatives prior to publication of the data.

2.5.3 Composition of Guideline Development Group

A multidisciplinary panel of experts in chronic pain management and interventional techniques from diverse medical disciplines reviewed the recommendations for facet joint interventions. The panel represented both academic and community-based practitioners committed to advancing interventional applications in facet joint interventions. The group included a total of 48 experts including methodologists such as epidemiologists, statisticians, ethicists, and health services researchers experienced in conducting systematic reviews. Editorial safeguards were implemented to prevent influence from authors with industry funding. The panel was both geographically and professionally diverse, including academicians and practitioners. **Of the 48 members participating in the guideline preparation, there were 31 with the primary specialty of anesthesiology, 6 physical medicine & rehabilitation, 3 radiology, 2 internal medicine, 2 statisticians. 1 emergency medicine, 1 neurology, and 1 graduate student.**

2.6 Evidence Review

These guidelines were developed through consensus among panel members following review of all published literature regarding the use and safety of facet joint interventions in patients with chronic spinal pain. The recommendations were developed utilizing principles of best-evidence synthesis derived from the Cochrane Review methodology and incorporating multiple guideline approaches modified by ASIPP (132).

2.6.1 Grading or Rating the Quality or Strength of Evidence

The grading of evidence was based on randomized controlled trials (RCTs), observational studies, and other clinical reports. In addition, systematic reviews and meta-analyses were utilized. The Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework was also applied when appropriate, as it provides a transparent and systematic approach for summarizing evidence and formulating clinical practice recommendations (133,134). GRADE is the most widely adopted tool for assessing the quality of evidence and guiding healthcare recommendations.

GRADE categorizes evidence into 4 levels of certainty, also referred to as quality of evidence: very low, low, moderate, and high, as outlined in Table 1. The certainty of evidence is determined by factors including risk of bias, imprecision, inconsistency, indirectness, and publication bias. These factors may either increase or decrease confidence in the evidence. The reasons for upgrading or downgrading the certainty of evidence are summarized in Table 2. The grading of evidence

based on ASIPP guidelines is illustrated in Table 3 (132), which categorizes evidence into 5 levels, ranging from strong evidence to opinion- or consensus-based evidence.

This grading system specifies levels of scientific evidence and provides an approach for grading the quality of evidence and, secondarily, the strength of recommendations. AHRQ has recommended a similar approach for grading the strength of recommendations (130,131).

2.6.2 Assessment and Recommendations of Benefits and Harms

These guidelines describe the potential benefits and harms of the interventions and explicitly link the information to specific recommendations.

2.6.3 Evidence Summary of Recommendations

Guideline-supporting documents summarize the relevant evidence and link it to the recommendations.

2.6.4 Rating or Grading the Strength of Recommendations

IOM standards require that each recommendation include an assessment of the strength of the recommendation, relative benefits versus harms, available evidence, and confidence in the underlying evidence. To meet these standards, the rating schemes recommended by NEATS were utilized, as shown in Table 4 (130).

2.6.5 Specificity of Recommendations

Evidence and best practices were used in developing recommendations for facet joint intervention.

2.7 Updating Guidelines

The guidelines for interventional techniques in the management of facet joint pain will be updated within 5 years or sooner in response to significant changes in scientific evidence, public policy, or adverse events occurring before 2030.

Table 1. *GRADE certainty ratings.*

Certainty	What it means
Very low	The true effect is probably markedly different from the estimated effect
Low	The true effect might be markedly different from the estimated effect
Moderate	The authors believe that the true effect is probably close to the estimated effect
High	The authors have a lot of confidence that the true effect is similar to the estimated effect

Source: BMJ Best Practice. Evidence-based medicine (EBM) toolkit. Learn EBM. What is GRADE? Accessed 1/27/2026. https://bestpractice-bmj-com.bibliotheek.ehb.be/info/evidence/learn-ebm/what-is-grade/ (134)

Table 2. *Reasons rate certainty in evidence up or down.*

Certainty can be rated down for:	Certainty can be rated up for:
• Risk of bias • Imprecision • Inconsistency • Indirectness • Publication bias	• Large magnitude of effect • Dose-response gradient • All residual confounding would decrease magnitude of effect (in situations with an effect)

Source: BMJ Best Practice. Evidence-based medicine (EBM) toolkit. Learn EBM. What is GRADE? Accessed 1/27/2026. https://bestpractice-bmj-com.bibliotheek.ehb.be/info/evidence/learn-ebm/what-is-grade/ (134)

Table 3. *Qualitative modified approach to grading of evidence of therapeutic effectiveness studies.*

Level I	Strong	Evidence obtained from multiple relevant high-quality randomized controlled trials
Level II	Moderate	Evidence obtained from at least one relevant high-quality randomized controlled trial or multiple relevant moderate or low-quality randomized controlled trials
Level III	Fair	Evidence obtained from at least one relevant moderate or low-quality randomized trial or Evidence obtained from at least one relevant high-quality non-randomized trial or observational study with multiple moderate or low-quality observational studies
Level IV	Limited	Evidence obtained from multiple moderate or low-quality relevant observational studies
Level V	Consensus based	Opinion or consensus of large group of clinicians and/or scientists

Modified from: Manchikanti L et al. A modified approach to grading of evidence. *Pain Physician* 2014; 17:E319-E325 (132).

Table 4. *Guide for strength of recommendations as modified for ASIPP guidelines.*

Rating for Strength of Recommendation	
Strong	There is high confidence that the recommendation reflects best practice. This is based on: a) strong evidence for a true net effect (e.g., benefits exceed harms); b) consistent results, with no or minor exceptions; c) minor or no concerns about study quality; and/or d) the extent the panelists' agreement. Other compelling considerations (discussed in the guideline's literature review and analyses) may also warrant a strong recommendation. ASIPP Adaptation: Consensus was achieved that there is high certainty that the net benefit is substantial providing strong recommendation. Recommendation: Strong
Moderate	There is moderate confidence that the recommendation reflects best practice. This is based on: a) good evidence for a true net effect (e.g., benefits exceed harms); b) consistent results, with minor and/or few exceptions; c) minor and/or few concerns about study quality; and/or d) the extent of panelists' agreement. Other compelling considerations (discussed in the guideline's literature review and analyses) may also warrant a moderate recommendation. ASIPP Adaptation: Consensus was achieved that there is high certainty that the net benefit is moderate or there is moderate certainty that the net benefit is moderate to substantial. Recommendation: Moderate
Weak	There is some confidence that the recommendation offers the best current guidance for practice. This is based on: a) limited evidence for a true net effect (e.g., benefits exceed harms); b) consistent results, but with important exceptions; c) concerns about study quality; and/or d) the extent of panelists' agreement. Other considerations (discussed in the guideline's literature review and analyses) may also warrant a weak recommendation. ASIPP Adaptation: The consensus achieved that there is potential improvement in certain individuals or groups of patients based on individual professional judgement and shared decision making. Recommendation: Weak

Adapted and modified from: National Guideline Clearinghouse Extent Adherence to Trustworthy Standards (NEATS) instrument (130).

3.0 Impact of Chronic Spinal Pain on Health Care

Key Question 1: What is the impact of chronic spinal pain on health care resources?

Chronic spinal pain poses a substantial socioeconomic burden worldwide (1,15,20-26,45). A 2026 publication by Zajacova et al (26) evaluated U.S. adults before, during, and after the COVID-19 pandemic utilizing National Health Interview Survey data from 2019 through 2023. The investigators performed a comprehensive analysis of chronic pain, high-impact chronic pain, and site-specific pain prevalence across the study period and evaluated key contributing factors. They reported that chronic pain prevalence increased from 20.5% in 2019 to 24.3% in 2023, representing an 18.5% increase. In addition, high-impact chronic pain prevalence increased from 7.5% in 2019 to 8.5% in 2023, representing a 13% overall increase. The authors further hypothesized that long COVID accounted for approximately 13% of the observed increase in both chronic pain and high-impact chronic pain. Overall, an estimated 60 million Americans experienced chronic pain and 21 million experienced high-impact chronic pain in 2023. Site-specific pain data demonstrated that 27,369,896 individuals experienced back and neck pain in 2019, increasing by 13% to 30,992,275 in 2023. Back and neck pain represented the second most common pain location, with the highest prevalence occurring in the hip, knee, and leg regions. These findings suggest a substantial escalation in the population burden of pain, with major implications for public health policy, even prior to considering the impact of long COVID and pain as a barometer of population health (26). Monitoring pain levels in the United States has also been identified as a goal of Healthy People 2030 (23).

Economic analyses continue to demonstrate the substantial financial burden associated with spinal pain management. Dieleman et al (24) reported that U.S. expenditures on personal healthcare and public health related to spinal pain totaled $134.5 billion in 2016, representing a 53.5% increase from $87.6 billion in 2013. Similarly, expenditures associated with musculoskeletal disorders increased by 43.5%, rising from $183.5 billion in 2013 to $263.3 billion in 2016.

In the United States, national healthcare expenditures increased significantly by 8.2% in 2024, nearly 3 percentage points greater than the growth in gross domestic product (GDP) at 5.3%, and exceeded $5.263 trillion, compared to $4.866 trillion in 2023 and $4.25 trillion in 2022 (135). This increase occurred despite a substantial reduction in healthcare service utilization, specifically involving interventional techniques (6-10). In addition, physician fee schedules have undergone major reductions over time, with payment cuts of 41% from 2001 through 2025, and these reductions are projected to increase to 45% by 2026 (83-85). This increase in healthcare expenditures reflects sustained growth in the utilization of healthcare services and goods, as well as rising administrative costs and increasing profit margins within the insurance industry (84,85,135), following the muted growth observed during the COVID-19 pandemic. As a result of increased healthcare spending, the healthcare share of the economy was projected to increase to 18% in 2024, compared to 17.6% in 2023. Furthermore, from 2024 through 2033, as the population ages and healthcare demand increases more rapidly than income growth, annual national health spending growth of 5.8% is projected to exceed average GDP growth of 4.3%. Consequently, by 2033, healthcare expenditures are projected to account for 20.3% of the economy. These projections are concerning because increasing healthcare expenses may outpace the financial resources available to purchase appropriate healthcare services.

Pain prevalence varies according to spinal region, with low back pain demonstrating the highest prevalence at 43%, followed by cervical pain at 32% and thoracic pain at 13% (33). Annual prevalence rates for low back pain and neck pain range from 22% to 65%, whereas lifetime prevalence estimates are 84% for low back pain and 67% for neck pain (1,15,45,123). Chronic spinal pain persists for more than one year in approximately 60% of patients, even following conservative treatment or surgical intervention (1,15,45,123).

Chronic spinal conditions are strongly associated with physical disability and mental health disorders, including depression, generalized anxiety disorder, and somatization (1,15,22,24,25,32,33,45,123). Furthermore, chronic spinal pain in parents has been associated with an increased likelihood of similar conditions developing in their children during adulthood (136).

Although some studies have suggested a decline in the prevalence of low back pain, more recent evidence demonstrates increasing prevalence across all chronic pain categories, with low back pain remaining the most predominant condition (25). This increase parallels rising economic and societal costs driven by expanding treatment modalities (2,18,35,40-42,45,47,66,74,76,137-210).

Overall, the burden of chronic pain continues to

be disproportionate and substantial (15,24,30,45,138-162,182-185). Even prior to the COVID-19 pandemic, annual U.S. expenditures related to chronic pain, including direct medical costs and lost wages, were estimated to exceed those associated with cancer, heart disease, and diabetes combined (15,24,45,138-140,144-147). As demonstrated by Dieleman et al (24), low back pain and neck pain constitute the leading category of medical expenditures in the United States. However, despite extensive healthcare expenditures and numerous initiatives aimed at controlling costs (74-78), disability associated with chronic pain continues to increase in parallel with expanding treatment options (15,24,30,45,138-140,144-147,160-162). As illustrated in Fig. 1, Dieleman et al (24) demonstrated expenditures related to musculoskeletal disorders, including back and neck pain, based on healthcare spending data in the United States during 2016.

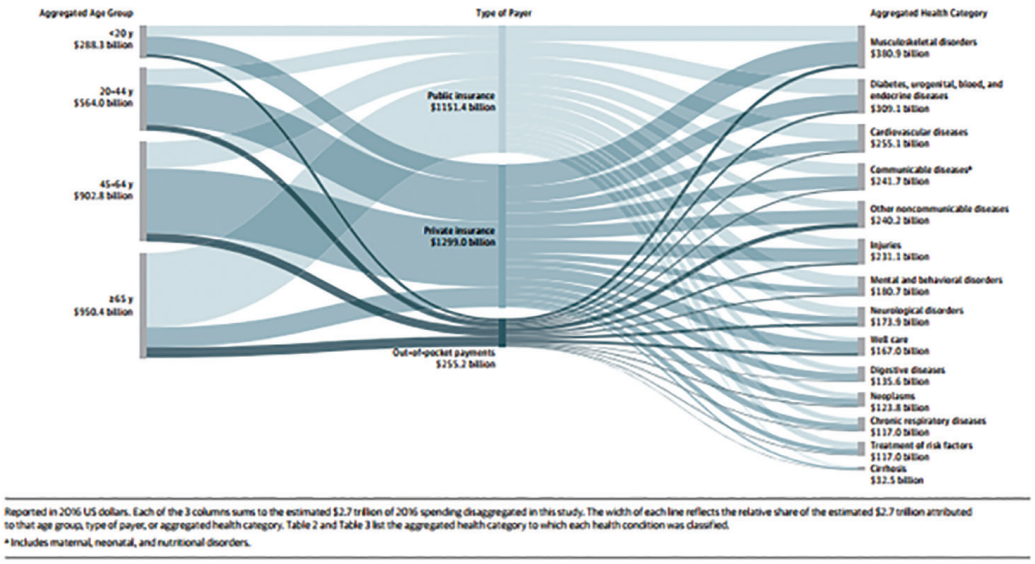


Fig. 1. *Estimated health care spending by aggregated age group, type of payer, and aggregated health category in 2016.*
Source: Dieleman JL, Cao J, Chapin A, et al. US health care spending by payer and health condition, 1996-2016. *JAMA* 2020; 323:863-884 (24).

4.0 Prevalence of Usage of Health Care Modalities in Managing Spinal Pain

Key Question 2: What are the trends in utilization of treatment modalities in managing spinal pain?

There has been a substantial expansion in treatment modalities for musculoskeletal and spinal pain, including physical therapy, pharmacologic therapy, interventional techniques, and surgical interventions (1-5,11-19,45,46,123,162-210).

Because spinal pain is influenced by multiple biological, psychological, and social factors (148), its complexity has limited progress in reducing the high prevalence of spinal pain and its associated impact on disability and quality of life (149-151). Consequently, no single treatment modality or therapeutic approach is capable of alleviating spinal pain in all patients. Variability in patient characteristics and responses contributes to the small to moderate average treatment effects commonly reported in clinical trials (148). Therefore, multimodal approaches addressing biological, psychological, and social contributors have been proposed (152,153). However, systematic reviews have demonstrated only marginal advantages of multimodal treatments compared to unimodal approaches (154). Multiple limitations have been identified, with no clear guidance available regarding the development of individualized multimodal treatment strategies for patients with spinal pain, which represents a central principle of "personalized" medicine. Diverse perspectives regarding implementation of personalized treatment approaches have further limited progress in this area (148). Consequently, single treatment modalities combined with interdisciplinary management strategies continue to be widely utilized in the management of spinal pain.

4.1 Non-Opioid Pharmacologic Therapies

Non-opioid pharmacologic therapies constitute an important component in the management of spinal pain, particularly as the medical community continues efforts to address the opioid crisis. Due to the variability and complexity of spinal pain, multiple non-opioid pharmacologic therapies have been utilized to provide effective and safe pain relief.

Facet joint pain typically responds to multimodal treatment approaches, including non-opioid pharmacologic interventions such as nonsteroidal anti-inflammatory drugs (NSAIDs), muscle relaxants, anticonvulsants, and antidepressants, all of which have demonstrated variable effectiveness in reducing pain and improving function. These therapies provide safer and, in many cases, comparably effective alternatives to opioids in the management of facet joint pain, as supported by emerging clinical guidelines.

Non-opioid pharmacotherapy for facet joint pain offers a broad range of treatment options targeting different mechanisms involved in pain generation. NSAIDs, muscle relaxants, anticonvulsants, and antidepressants each provide distinct advantages in the management of this condition. Clinical guidelines increasingly recommend these agents as first-line therapies because of their effectiveness and lower risk profiles compared to opioids. However, additional research is needed to establish long-term effectiveness and to better identify patient populations most likely to benefit from specific non-opioid pharmacologic interventions.

4.1.1 Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

Non-steroidal anti-inflammatory drugs (NSAIDs), including ibuprofen and naproxen, are commonly utilized in the management of facet joint pain because of their anti-inflammatory properties. Inflammation is a significant contributor to pain associated with facet joint dysfunction, and NSAIDs exert their effects by inhibiting cyclooxygenase enzymes (COX-1 and COX-2), thereby reducing production of pro-inflammatory prostaglandins. Multiple studies have demonstrated the effectiveness of NSAIDs in alleviating facet joint pain, particularly in the short term.

Overall, NSAIDs have demonstrated effectiveness in the management of acute low back pain, reducing both pain intensity and disability. Evidence also suggests that the route of NSAID administration may influence clinical effectiveness in low back pain management. In a randomized trial, Khankhel et al (197) demonstrated that topical diclofenac gel alone was less effective than oral ibuprofen in improving functional impairment. Furthermore, combining diclofenac gel with ibuprofen did not provide additive benefit, suggesting that oral NSAIDs remain the more effective treatment option for acute low back pain in this setting. Additionally, combinations of NSAIDs with paracetamol have demonstrated superior outcomes compared to NSAIDs alone, whereas paracetamol alone has not shown significant clinical benefit in the treatment of acute low back pain (198).

Although NSAIDs have consistently demonstrated

effectiveness in acute low back pain, their efficacy in chronic low back pain remains less clear (199,208). In addition, the safety profile of NSAIDs remains a concern, although some studies have demonstrated relatively low rates of adverse events. However, the addition of myorelaxants may increase the risk of side effects (199). In this regard, COX-2 inhibitors such as Celebrex and mA RCTeloxicam are considered safer compared to nonselective NSAIDs with respect to gastrointestinal bleeding risk and related adverse effects. While NSAIDs remain an important component of pharmacologic management for acute low back pain, their use should be balanced against potential adverse effects.

Studies specifically evaluating facet joint pain are limited. Available investigations, including placebo-controlled and comparative effectiveness trials, have demonstrated relatively small effect sizes, with numeric rating scale (NRS) pain score reductions of 1 to 2 points for less than 3 months, for both topical and systemic NSAIDs (211-213). In addition, pharmacotherapy has not demonstrated superiority compared to other therapeutic approaches.

4.1.2 Muscle Relaxants

Muscle relaxants are frequently utilized in the management of spinal pain, particularly when muscle spasm is a prominent feature. However, their effectiveness and safety remain uncertain. Recent studies have evaluated multiple classes of muscle relaxants, including non-benzodiazepine antispasmodics and benzodiazepines, with mixed findings regarding their efficacy in reducing pain and improving functional outcomes. A meta-analysis by Cashin et al (200) demonstrated that non-benzodiazepine antispasmodics may provide slight reductions in pain intensity at 2 weeks or earlier. However, the magnitude of improvement was not clinically meaningful, and no significant improvement in disability scores was observed. In addition, these medications were associated with a higher incidence of adverse effects, including nausea, dizziness, and headache.

Several studies have evaluated whether combining muscle relaxants with NSAIDs provides superior pain relief compared to NSAIDs alone. Hung et al (201) reported in an RCT that the addition of tizanidine to diclofenac did not improve functional outcomes in patients with acute low back pain and sciatica. In contrast, an RCT by Iliopoulos et al (202) demonstrated that a single intramuscular injection of diclofenac combined with thiocolchicoside resulted in greater pain reduction and improved mobility compared to diclofenac alone, without increasing the risk of adverse effects. Given these conflicting findings, additional studies are necessary to clarify the efficacy of combining NSAIDs with muscle relaxants.

The selection of muscle relaxants may also influence treatment outcomes. In a randomized trial comparing methocarbamol and diazepam for acute low back pain, both agents effectively reduced pain within 60 minutes (203). Compared to methocarbamol, diazepam produced slightly greater pain relief; however, it was associated with a significantly higher incidence of drowsiness.

Overall, the evidence supporting the use of muscle relaxants for spinal pain remains inconclusive. Although some studies suggest short-term pain relief, their impact on long-term functional outcomes remains uncertain. Additional high-quality studies are needed to better define the role of muscle relaxants in the management of low back pain, particularly with respect to medication selection and dosing strategies.

4.1.3 Antidepressants

Antidepressants have been investigated for their potential analgesic effects in patients with spinal pain, particularly in chronic conditions where neuropathic mechanisms may contribute to pain persistence. Multiple studies have evaluated various classes of antidepressants, including tricyclic antidepressants (TCAs) and serotonin-norepinephrine reuptake inhibitors (SNRIs), with variable findings regarding effectiveness and safety.

Although a previous meta-analysis demonstrated that antidepressants provide only modest reductions in low back pain and are associated with higher discontinuation rates, other studies have compared specific antidepressants and antidepressant classes to determine their relative effectiveness in the treatment of low back pain (204). A meta-analysis (205) evaluating the effectiveness of multiple antidepressants in chronic low back pain demonstrated that duloxetine, an SNRI, at a dose of 60 mg significantly reduced pain intensity and improved quality of life. However, higher doses of 120 mg were associated with increased adverse events, suggesting that medication dosage should be carefully considered when prescribing antidepressants. In contrast, other antidepressants, including amitriptyline, escitalopram, bupropion, imipramine, and desipramine, demonstrated only limited or inconsistent benefits (205).

Further supporting these findings, a network

meta-analysis by Ma et al (214) evaluated the comparative efficacy and safety of multiple antidepressant classes for chronic back pain. This analysis ranked TCAs as the most effective class for pain relief, followed by SNRIs. SNRIs were associated with significant reductions in pain and improvements in functional outcomes. However, both SNRIs and noradrenaline-dopamine reuptake inhibitors were also associated with increased risks of adverse events, including nausea, dizziness, and treatment withdrawal due to side effects (214). Given the potential for adverse effects, clinicians should carefully weigh the risks and benefits before prescribing antidepressants for low back pain, particularly in patients without comorbid depression.

4.1.4 Anticonvulsants

Anticonvulsants, particularly gabapentinoids such as pregabalin and gabapentin, have been extensively studied for their potential role in the management of low back pain, especially in conditions with neuropathic components. Although these medications are frequently utilized in clinical practice, evidence regarding their effectiveness remains inconsistent.

A meta-analysis evaluating the effectiveness of gabapentin and pregabalin for acute sciatica found limited support for their routine clinical use (215). While gabapentin demonstrated a statistically significant improvement in leg pain, no consistent benefit was observed for low back pain or functional disability. In addition, pregabalin did not demonstrate significant benefit for sciatica-related pain.

Furthermore, Shanthanna et al (216), in a systematic review and meta-analysis of RCTs evaluating the benefits and safety of gabapentinoids in chronic low back pain, reported that the available evidence is limited and demonstrated a significant risk of adverse effects without clear evidence of benefit. The authors concluded that, given the lack of demonstrated efficacy, associated risks, and costs, gabapentinoids should be used cautiously in chronic low back pain, and emphasized the need for large, high-quality trials to evaluate this issue more definitively. In another systematic review, João et al (217), through an updated meta-analysis of RCTs evaluating gabapentinoids for neuropathic pain following spinal cord injury, demonstrated significant improvements in pain and pain-related sleep interference compared to placebo.

These findings suggest that although gabapentinoids may play a limited role in the management of leg pain associated with radiculopathy (215) or neuropathic pain following spinal cord injury (217), their overall effectiveness for low back pain remains uncertain, and routine use, particularly at high doses, cannot be recommended. A direct comparison of pregabalin and gabapentin in patients with low back pain further highlighted differences between these medications (218). While pregabalin was associated with statistically significant reductions in pain, gabapentin demonstrated greater improvements in anxiety, insomnia, fatigue, and overall well-being. These findings suggest that pregabalin may provide greater analgesic benefit, whereas gabapentin may offer broader benefits in addressing comorbid symptoms commonly associated with chronic pain (218).

With respect to cervical facet joint pain and whiplash injuries, pregabalin demonstrated benefit in acute cases among high-risk patients through 6 months following injury, with an effect size of 4 (-1.72 to 6.2 NRS points - 4) (219). However, long-term follow-up data did not demonstrate sustained benefit.

Overall, the available evidence suggests that anticonvulsants may provide pain relief in selected cases of spinal pain; however, their benefits are inconsistent and are frequently accompanied by adverse effects. Gabapentin may be preferable in patients with significant comorbid symptoms such as anxiety and sleep disturbances, whereas pregabalin appears to exert a more direct analgesic effect. Given the limited evidence supporting their efficacy in spinal pain, clinicians should carefully consider the risk-benefit profile before prescribing these medications.

4.1.5 Local Anesthetics

For decades, local anesthetics have been widely utilized in spinal injections for the treatment of low back pain (220). Epidural injections utilizing local anesthetics with steroids have been administered for the management of low back pain associated with disc herniations and other spinal conditions. Depending on the approach and medication utilized, epidural injections have demonstrated efficacy in the management of multiple chronic spinal conditions, with varying levels of evidence supporting their use in low back pain (221). Transforaminal and interlaminar epidural injections utilizing local anesthetics with steroids have the strongest supporting evidence, whereas injections utilizing local anesthetic alone demonstrate moderate evidence. Caudal epidural injections, with or without steroids, also demonstrate moderate evidence.

In addition, a meta-analysis demonstrated moder-

ate evidence supporting the effectiveness of epidural injections utilizing lidocaine, either alone or in combination with steroids, in the management of spinal pain from multiple etiologies, with similar outcomes observed between both treatment approaches (222). Research has also evaluated the frequency of repeat epidural injections required in the treatment of chronic low back pain. A retrospective study (223) demonstrated that lumbar transforaminal epidural steroid injections utilizing nonparticulate (soluble) steroids resulted in a significantly greater proportion of patients requiring no repeat injections within 12 months compared to patients receiving particulate (insoluble) steroids.

4.2 Non-Pharmacologic and Non-Interventional Techniques in Managing Chronic Pain

Numerous non-invasive and non-interventional techniques are utilized in the management of chronic pain, including exercise programs, physical therapy, acupuncture, massage therapy, transcutaneous electrical nerve stimulation (TENS), biofeedback therapy, and chiropractic treatment.

4.2.1 Exercise Programs

Structured exercise programs play an important role in the management of chronic pain. In fact, essentially all guidelines, local coverage determinations (LCDs), and medical policies require some form of physical therapy and structured exercise program prior to the utilization of interventional techniques or opioid therapy. The Centers for Disease Control and Prevention (CDC) guidelines (224) describe high-quality evidence supporting exercise therapy for back pain, fibromyalgia, and hip and/or knee osteoarthritis, demonstrating reductions in pain and improvements in function immediately after treatment, with sustained benefits lasting at least 2 to 6 months (184,224-228). Multiple previously published guidelines have recommended aerobic, aquatic, and/or resistance exercise programs for patients with various chronic pain conditions, including osteoarthritis of the knee or hip, back pain, and fibromyalgia (208,229-231). In addition, motor control exercise for low back pain has been shown to provide greater functional improvement compared to minimal intervention (232,233).

Studies evaluating exercise therapy have demonstrated moderate effectiveness in the treatment of chronic low back pain; however, there is no clear evidence that any single form of exercise is superior to another. A review of 217 RCTs involving 20,969 participants with non-specific low back pain lasting longer than 12 weeks concluded that Pilates, McKenzie, and functional restoration approaches were more effective than other exercise modalities in reducing pain intensity and functional limitations (234). Furthermore, a systematic review and meta-analysis including 79 RCTs comparing exercise-based interventions with placebo demonstrated that exercise training was more effective than active control interventions or standard medical care in reducing chronic musculoskeletal pain (235).

Morkoç et al (206) evaluated the effects of lumbar stabilization exercises and general exercise programs on selected biochemical mediators and clinical outcomes in patients with LDH with and without neurologic deficits. Their results demonstrated that lumbar stabilization exercises did not alter interleukin-6 (IL-6), TNF-α, IL-1β, IL-4, BE, AEA, or 2-AG levels, but did demonstrate reductions in depression and anxiety levels in patients with LDH and neurologic deficits compared to general exercise programs.

The cost-effectiveness of spinal manipulation, exercise, and self-management strategies for spinal pain was evaluated by Leininger et al (207). The results demonstrated favorable cost-effectiveness findings for spinal manipulative therapy (SMT) compared to home exercise and advice (HEA) for acute neck pain, with incremental cost-effectiveness ratios (ICERs) below $50K per quality-adjusted life year (QALY), and when added to HEA for chronic back-related leg pain and chronic neck pain in older adults, showing improved outcomes and lower costs. However, SMT was not likely to be cost-effective compared to HEA for chronic back pain in adults or when added to HEA for older adults because of higher costs and worse outcomes. In addition, findings for SMT were favorable when compared to exercise therapy in adults with chronic back pain. Exercise therapy also demonstrated favorable findings for chronic neck pain in adults, with better outcomes and lower costs, and for chronic back pain in adolescents, with ICERs below $50K per QALY.

González-Gómez et al (236) conducted a systematic review with meta-analysis and meta-regression comparing exercise therapy with manual therapy for the management of pain intensity, disability, and physical function in patients with chronic low back pain. The review included 6 RCTs involving 743 patients. Meta-analysis demonstrated a statistically significant, although not clinically meaningful, difference favoring long-term exercise therapy for disability (standardized

mean difference [SMD] = -0.25, 95% CI [-0.43, -0.07], *P* = 0.007). The GRADE assessment demonstrated very low certainty across all outcomes, emphasizing the lack of high-quality evidence. The authors concluded that exercise therapy may provide modest long-term benefits over manual therapy for disability in chronic low back pain. Differences appeared to be influenced by sex, age, and treatment duration. However, current evidence does not clearly support the use of exercise therapy over manual therapy, or vice versa, as a standalone treatment approach.

Ford et al (237) evaluated individualized manual therapy (IMT) combined with guideline-based advice compared to advice alone in patients with clinical features suggestive of lumbar zygapophysial joint pain in an RCT. The intervention consisted of 10 weeks of physiotherapy involving IMT based on pathoanatomical, psychosocial, and neurophysiological barriers to recovery, together with guideline-based advice delivered over 10 sessions, compared to advice alone delivered over 2 sessions. Outcomes were assessed using the Oswestry Disability Index (ODI) for up to 52 weeks. The investigators concluded that among participants with clinical features suggestive of lumbar zygapophysial joint pain, IMT resulted in greater reductions in back pain at 5-, 10-, and 26-week follow-up, as well as improvements in activity limitation at 26 and 52 weeks. However, participants in both groups improved over time across all primary outcomes, with the greatest improvements occurring within the first 10 weeks following randomization. In addition, statistically significant improvements in back pain NRS at 5, 10, and 26 weeks favored the IMT group, although these improvements were not maintained at 52 weeks. Similarly, statistically significant improvements in activity limitation at 26 and 52 weeks favored the IMT group.

4.2.2 Physical and Occupational Therapy

Physical and occupational therapy have long been recognized as supportive modalities in the treatment of both acute and chronic pain. The primary goals of these therapies are to reduce pain, improve function, prevent unnecessary disability, facilitate activities of daily living, and enhance overall quality of life. A systematic review evaluating occupational therapy interventions for chronic pain recommended individualized treatment approaches and biomechanics education as essential components for therapeutic success (238). In an evaluation of physical therapy and rehabilitative interventions across 83 studies involving 8,816 patients with chronic low back pain, exercise therapy was shown to reduce pain intensity and disability while improving long-term function compared with conventional non-exercise care. Behavioral therapy was also effective, at least in the short term, in reducing pain intensity compared with no treatment (239).

However, physical therapy is considered a relatively high-cost treatment option. A randomized trial demonstrated no significant difference in the reduction of chronic low back pain intensity, frequency, or disability between patients assigned to relatively low-cost group aerobic exercise programs and those assigned to individual physiotherapy or muscle reconditioning sessions (240). Nevertheless, physical therapy may be particularly beneficial for patients who lack motivation, are noncompliant with medication therapy, have limited access to safe public exercise or recreational facilities, and/or whose pain has not improved with low-intensity physical exercise (224). A randomized trial (241) evaluating a stepped exercise program demonstrated meaningful reductions in osteoarthritis-related knee pain. In this study, patients initially participated in an internet-based exercise program, followed by progression to biweekly coaching calls and subsequent in-person physical therapy if necessary. Ultimately, only 35% of patients required in-person physical therapy.

The cost-effectiveness of spinal manipulation, exercise, and self-management strategies for spinal pain has been described previously (207). In addition, insurers frequently require documentation of recent physical therapy participation, documentation of adverse effects related to physical therapy, or evidence of a structured exercise program before approving interventional techniques.

Beyond low back pain, the effectiveness of exercise therapy has also been evaluated in cervical spine pain, presumably including facet joint-related pain. Overall, exercise-based treatment, including graded activity, stretching, strengthening, and range-of-motion exercises, has been shown to be effective for chronic cervical pain, resulting in 10% to 30% reductions in pain intensity and neck disability scores (242-247). Furthermore, there is no definitive evidence demonstrating that supervised exercise programs are superior to home exercise programs, although guided exercise appears to be more effective than no exercise or simple advice to remain active (243). Multimodal rehabilitation programs based on the biopsychosocial model, including manual therapy, education, and exercise therapy, have also demonstrated effectiveness in reducing pain and

improving function; however, no evidence suggests that these programs are superior to simple graded activity programs (242). In addition, cognitive behavioral therapy (CBT) has demonstrated effectiveness in reducing pain and psychological distress following whiplash injury, with evidence suggesting that intervention within 6 months of injury is more effective than CBT initiated after 6 months (248).

The role of physical therapy has been more extensively studied in acute neck pain than in chronic neck pain, specifically cervical facet joint pain. Vos et al (249) evaluated 187 patients with acute neck pain, with a mean baseline symptom duration of 16 days. At one-year follow-up, 74% of patients treated with physiotherapy reported improvement and recovery. However, the investigators also observed that 79% of control patients reported similar recovery at one year without physiotherapy intervention, suggesting that most patients with acute neck pain improve without therapy. In another controlled trial, Gustavsson et al (250), evaluating 156 patients, demonstrated that a multimodal approach incorporating self-management and coping skills training was more effective than individualized physical therapy over a 2-year follow-up period. Conversely, Walker et al (251) demonstrated that manual physical therapy combined with exercise was more effective than advice regarding motion exercises in patients with chronic mechanical neck pain.

It is important to recognize that spinal pain does not necessarily equate to facet joint pain when evaluating exercise therapy, physical therapy, and manual therapy interventions. Multiple other spinal structures, including intervertebral discs, may contribute to pain generation, although a substantial proportion of patients with cervical pain, and to a lesser extent thoracic and lumbar pain, may experience pain originating from the facet joints.

4.2.3 Acupuncture

Acupuncture has been increasingly utilized in the treatment of patients with chronic pain. Acupuncture is considered the most widely used complementary and alternative therapy and has been employed extensively in the management of multiple pain conditions (252,253). Substantial literature has evaluated the role of acupuncture in alleviating non-specific musculoskeletal pain (254), osteoarthritis (255), chronic headache (256), and shoulder pain (257). In addition, acupuncture has been associated with reduced opioid utilization (258). A clinical study demonstrated that among patients with migraine without aura, true acupuncture was associated with a long-term reduction in migraine recurrence compared with sham acupuncture (259).

The analgesic effectiveness of acupuncture in chronic pelvic pain was evaluated in a systematic review and meta-analysis (260), which demonstrated that acupuncture monotherapy resulted in significantly lower pain levels compared to controls. Another systematic review and meta-analysis evaluating acupuncture for chronic prostatitis and chronic pelvic pain syndrome (261), which included 11 high-quality RCTs, demonstrated measurable benefits of acupuncture in reducing pain associated with chronic prostatitis and chronic pelvic pain syndrome.

A review by Trivedi et al (262) concluded that acupuncture is effective for the short-term treatment of chronic pain, with benefits lasting approximately 3 to 5 months.

Multiple guidelines have been published with varying recommendations regarding the use of acupuncture in the treatment of low back pain (263-265), based in part on multiple systematic reviews evaluating acupuncture compared to sham treatments. However, the evidence across these reviews has been somewhat inconsistent. Among 16 systematic reviews, 7 demonstrated that acupuncture provided greater pain relief and functional improvement than no treatment during short-term follow-up, while 5 systematic reviews demonstrated that acupuncture, when combined with conventional therapy, provided short-term improvements in pain and function in patients with chronic low back pain (266-269). Furthermore, a meta-analysis of 25 studies involving 6,200 patients (270) comparing acupuncture with sham treatments demonstrated statistically significant, although modest, positive differences favoring acupuncture over controls receiving NSAIDs, muscle relaxants, and other analgesic therapies.

4.2.4 Massage

Massage therapy has traditionally been considered beneficial for pain relief through both physical and mental relaxation, as well as through increasing pain thresholds via the release of endogenous opioids, including endorphins and enkephalins (271). The proposed analgesic mechanism of massage involves local stimulation of large nerve fibers, which may exert inhibitory effects on nociceptive primary afferents as well as mast cells and/or T cells (272). Massage therapy may

also influence the autonomic nervous system by inducing shifts between sympathetic and parasympathetic responses (273). Although the exact mechanisms are not completely understood, numerous clinical trials, literature reviews, and systematic meta-analyses have evaluated the efficacy and effectiveness of massage therapy (274-276).

A meta-analysis by Farber et al (274) found that the quality of evidence supporting massage therapy was low to very low, primarily because of study bias and imprecision. In acute low back pain, massage therapy was superior to inactive controls for short-term pain relief but did not improve functional outcomes. In patients with subacute and chronic low back pain, massage therapy was more effective than inactive treatments in the short term, although long-term benefits were not demonstrated. The analysis also demonstrated that, compared with active control treatments, massage therapy provided superior short-term pain relief and maintained benefits at long-term follow-up. Functional improvement in patients with subacute and chronic low back pain was observed when compared with inactive controls; however, these improvements were limited to short-term follow-up.

A review by Furlan et al (275) demonstrated that 8 of 13 studies had a high risk of bias. In 2 studies, massage therapy was superior in reducing pain and improving function during both short- and long-term follow-up. Eight studies demonstrated that massage therapy produced outcomes similar to exercise therapy and superior outcomes compared to joint mobilization, relaxation therapy, physical therapy, acupuncture, and self-care education in reducing symptoms when compared with other active treatments. When positive effects were observed, benefits persisted for up to one year following completion of treatment. Two studies demonstrated that acupuncture massage and combined massage therapies produced superior outcomes compared to Swedish massage alone, while another study demonstrated that Thai massage produced outcomes similar to Swedish massage. Overall, there was moderate evidence supporting short- and long-term improvements in pain and function with massage therapy compared with sham or alternative treatments; however, the magnitude of improvement was modest. The review concluded that massage therapy may benefit patients with subacute and chronic low back pain, particularly when combined with exercise, pain management strategies, and education regarding activities of daily living.

4.2.5 Transcutaneous Electrical Nerve Stimulation (TENS)

Despite its widespread use in pain management, the evidence supporting the effectiveness of TENS remains inconclusive. Due to the lack of strong supporting evidence, TENS is generally not covered by insurance carriers and is frequently restricted to use within RCT settings. Previous health technology assessments and meta-analyses have demonstrated no significant benefit of TENS in patients with chronic pain (277,278). Some investigators, however, have criticized recent meta-analyses because of the limited number of available RCTs and the absence of comparisons between TENS and other nerve stimulation therapies.

Overall, multiple systematic reviews and meta-analyses (279-282) demonstrated no significant improvement in pain outcomes with the use of TENS. However, some evidence suggested that TENS may improve functional disability in the short term compared with control treatments. In contrast, one systematic review (282) demonstrated that TENS effectively reduced pain intensity immediately following treatment in patients with neck pain; however, in these studies, TENS was utilized as an adjunctive therapeutic modality. Similarly, another review (283) concluded with moderate certainty that pain intensity was lower during or immediately after TENS treatment compared with placebo.

4.2.6 Manual Therapy or Chiropractic Treatments

Mobilization and manipulation therapies are widely utilized in the treatment of patients with chronic pain; however, debate continues regarding their actual effectiveness, appropriate dosing, and safety profiles.

It is important to differentiate the various types and proposed mechanisms of manipulative therapies utilized in osteopathic and/or chiropractic practice. The effectiveness of SMT in the treatment of chronic low back pain remains controversial, and recommendations regarding its use are heterogeneous. According to a systematic review by de Luca et al (284), there is moderate evidence supporting the use of manual therapy to reduce pain and disability.

In some healthcare systems, SMT is considered a first-line treatment option, whereas in others it is recommended only in conjunction with other spinal treatments or is not recommended at all (285). At least one review of clinical guidelines suggested that SMT should be considered a second-tier treatment option following exercise and behavioral therapy (286).

As noted, multiple theories have been proposed regarding the mechanism of action of SMT, most of which involve biomechanical and/or neurophysiological processes (287). The biomechanical theory proposes that SMT reduces mechanical stress, whereas the neurophysiological theory suggests that SMT influences primary afferent neurons originating from the paraspinal musculature, thereby activating systems involved in pain modulation (288,289). However, it remains unclear to what extent: 1) these proposed mechanisms are distinct or function synergistically; 2) specific forms of manipulative therapies selectively engage these mechanisms; and 3) differing techniques demonstrate therapeutic utility for specific pain syndromes.

A Cochrane review by Rubinstein et al (290) found moderate-quality evidence demonstrating that SMT was not different from other treatments for short-term pain relief. Rubinstein et al (290) also demonstrated moderate-quality evidence indicating that SMT produced slight improvement in function. In addition, they reported high-quality evidence showing that SMT provided a small positive effect on short-term pain relief and small-to-moderate positive effects on functional improvement compared with non-recommended therapies. Similar findings were observed for intermediate- and long-term outcomes.

Most adverse events associated with SMT were transient and mild to moderate in severity. However, considerable concern has been raised regarding the safety of certain types of SMT in patients with anatomical variations involving the cervico-cerebral vasculature. Overall, SMT demonstrated clinical outcomes similar to other recommended therapies for chronic low back pain and appeared superior to non-recommended interventions in improving short-term functional outcomes.

Coulter et al (291) published a systematic review and meta-analysis evaluating manipulation and mobilization for chronic low back pain, including 51 trials meeting inclusion criteria and 9 additional trials involving a total of 1,176 patients. Their analysis concluded that there is moderate-quality evidence suggesting that manipulation and mobilization are likely to reduce pain and improve function in patients with chronic low back pain. In addition, manipulation appeared to provide greater benefit than mobilization, although both therapies appeared safe, and multimodal treatment programs may represent a promising therapeutic approach.

Coulter et al (186) also conducted a systematic review and meta-analysis evaluating manipulation and mobilization for chronic nonspecific neck pain. This review included 47 randomized trials with low risk of bias involving 4,460 patients with chronic nonspecific neck pain. Acknowledging the aforementioned contraindications associated with cervical manipulation and mobilization, the investigators concluded that studies published since January 2000 provide low-to-moderate quality evidence supporting the use of various forms of manipulation and/or mobilization to reduce pain and improve function in patients with chronic nonspecific neck pain compared with other interventions. Furthermore, multimodal approaches integrating multiple treatment modalities may offer the greatest clinical benefit.

A RAND review by Sherbourne et al (292) evaluated coping and management strategies among chronic low back pain patients receiving chiropractic care. Respondents reported an average of 9 coping behaviors during the preceding 6 months. Patients with chronic low back pain were proactive in utilizing coping strategies and frequently implemented self-care techniques, including those taught through chiropractic patient education. Another RAND publication demonstrated that 79% of patients reported positive experiences regarding the time spent with chiropractic providers, with most patients rating their providers at the highest levels. These findings also demonstrated that chiropractic patients more frequently reported positive impressions of their clinical encounters, particularly with respect to receiving prompt answers to questions and being evaluated within 15 minutes of scheduled appointment times.

Sezerel and Yüksel (293) conducted an RCT comparing the efficacy of osteopathic muscle energy techniques (METs) and cervical mobilization on pain, disability, and proprioception in patients with cervical spondylosis. Cervical spondylosis was described as a degenerative disorder of the cervical spine characterized by persistent neck pain. Cervical facet joint mobilization and osteopathic METs were evaluated as manual therapeutic interventions for neck pain. The study included 96 participants randomized into 3 groups: electrothermal therapy alone (control), electrothermal therapy plus MET, and electrothermal therapy plus cervical facet joint mobilization, with 32 patients in each group. All participants received 3 treatment sessions per week for 4 weeks, and 76 participants completed the study. The investigators concluded that both MET and cervical facet joint mobilization produced similar improvements in pain and disability in patients with cervical spondylosis and chronic neck pain. However,

MET combined with electrothermal therapy was more effective in improving cervical position sense.

Leininger et al (207) evaluated the cost-effectiveness of spinal manipulation, exercise, and self-management strategies for spinal pain. Their analysis demonstrated favorable cost-utility outcomes for SMT, with ICERs below $50K per QALY for chronic low back pain.

Maas et al (294) evaluated societal costs among older adults with low back pain seeking chiropractic care in a prospective cohort study conducted in chiropractic private practices in the Netherlands involving 38 practices. A total of 223 individuals older than 55 years with a new episode of low back pain participated. The primary outcome measure was total societal cost, with high societal costs defined as costs within the top 20th percentile. Final prediction models were developed using forward selection methodology. The investigators reported that the mean total annual societal cost per patient was €5297 (95% confidence interval [CI]: 4191-6403). Presenteeism represented the largest cost driver, accounting for 65% of total costs. Costs were higher among non-retired participants (€7759; 95% CI 6047-9470) compared with retired participants (€1892; 95% CI 1088-2695). In the overall population, predictors of high societal costs included younger age [odds ratio (OR): 0.87 for each additional year; 95% CI 0.80-0.95], male sex (OR 2.96; 95% CI 1.19-7.44), lower alcohol intake (OR 0.49; 95% CI 0.20-1.19), active employment rather than retirement (OR 9.37; 95% CI 1.83-48.04), and greater baseline disability (OR 1.08; 95% CI 1.00-1.16). Employment status was identified as the strongest predictor of high societal costs. The authors concluded that the mean annual societal cost for older adults seeking chiropractic care for a new episode of low back pain was €5297 (95% CI 4191-6403), with costs largely attributable to presenteeism and varying substantially according to employment status.

4.2.7 Extracorporeal Shock Wave Therapy (ESWT)

Extracorporeal shock wave therapy (ESWT), originally developed for lithotripsy, has increasingly been explored as a treatment modality for musculoskeletal conditions. ESWT includes 2 forms of energy delivery: focused ESWT and radial pressure waves (RPWs), which differ with respect to penetration depth and physical characteristics. Focused ESWT, because of its greater tissue penetration, has demonstrated efficacy in deeper tissues, including subchondral bone (295). However, the relationship between the specific characteristics of ESWT and clinical effectiveness remains unclear.

Studies evaluating the biological effects of shockwave therapy have primarily utilized ESWT and have demonstrated multiple effects of shockwaves on biological tissues. The effects of ESWT are achieved through direct mechanical loading of tissue structures, which may disrupt calcific processes, such as those observed in calcific shoulder tendonitis. Biological effects of ESWT have been demonstrated in tendon healing (295,296), cartilage repair (297), osteogenesis (298), and pain modulation (299). ESWT has also demonstrated improvements in motor function and reductions in pain in animal models of osteoarthritis (300). The complex interactions between mechanical loading and tissue response have been described as mechanotransduction (301).

More recent studies have investigated the effects of ESWT on spinal conditions. In a rat model of spinal disc degeneration, low-energy shockwaves promoted disc regeneration by restoring disc height and hydration and improving the microenvironment for tissue repair (302). Similarly, in a spinal cord injury model, repeated ESWT reduced tissue inflammation and enhanced neural tissue regeneration, resulting in improved locomotor function (303). These findings suggest that ESWT may reduce chronic spinal inflammation and facilitate tissue healing.

With respect to spinal applications, a prospective RCT (304) demonstrated positive short-term outcomes with ESWT in sacroiliac joint pain. Evidence also supports the efficacy of ESWT in myofascial low back pain (305) and coccydynia (306). In addition, recent meta-analyses have described ESWT as a safe and effective treatment modality for multiple forms of non-specific chronic low back pain (303,307,308). More recent studies have also demonstrated both short- and long-term pain relief with focused ESWT (309). One study (310) comparing quadratus lumborum trigger point injections with ESWT found that ESWT was more effective than corticosteroid trigger point injections in improving quality of life and disability, resulting in at least a 30% reduction in pain intensity and disability and at least a 20% improvement in quality of life in ESWT-treated patients compared with corticosteroid trigger point injection therapy.

Several trials have evaluated ESWT as either an adjunct or alternative to conventional therapies. Lee et al (311) randomized 28 patients with chronic low back pain into 2 groups. Both groups participated in a 6-week exercise therapy program, while one group additionally received weekly ESWT sessions. The ESWT

plus exercise group demonstrated greater pain relief and improved dynamic balance compared with the exercise-only group.

Importantly, one clinical trial demonstrated that ESWT not only reduced back pain but also improved peripheral nerve conduction velocity (312). In this study, 30 patients were randomized to receive either ESWT or a standard exercise rehabilitation program. At both one- and 3-month follow-up, the ESWT group demonstrated significantly lower pain scores and disability indices, including Roland-Morris and ODI scores, compared with the exercise group. In addition, nerve conduction studies in the ESWT group demonstrated improvements in sensory and motor nerve function, whereas no significant electromyography (EMG) changes were observed in the exercise group. These findings suggest that ESWT may provide not only symptomatic relief but also physiologic improvement. Liu et al (307) conducted a comprehensive meta-analysis of 12 RCTs involving 632 patients evaluating ESWT for chronic low back pain. The results demonstrated significantly greater pain relief and improvements in disability indices with ESWT compared with control interventions at both 4- and 12-week follow-up. Overall, the authors concluded that ESWT provides superior pain and functional outcomes compared with placebo or standard care in chronic back pain, reinforcing its potential value as a non-invasive treatment modality.

In low back pain, bone marrow edema (BME) characterized by Modic I changes, specifically hyperintense signal changes on T2-weighted magnetic resonance imaging (MRI), has been shown to represent BME and inflammation (313). Studies utilizing MRI T2-weighted fat-suppressed and STIR (Short Tau Inversion Recovery) sequences have demonstrated facet joint BME in 14% to 41% of patients with chronic low back pain (314,315).

A retrospective pilot study (316) evaluated the effectiveness of RPWs in providing long-term pain relief and improving quality of life in patients with lumbar facet joint pain compared with standard treatment modalities, including medial branch anesthetic blocks and radiofrequency ablation. The shockwave therapy group achieved superior long-term pain relief compared with the injection group and only slightly less pain relief compared with the radiofrequency ablation (RFA) group. Importantly, both the ESWT and RFA groups demonstrated significant long-term improvements in daily functional activities, whereas steroid injections produced only transient benefits. No adverse effects were observed with ESWT. However, no significant long-term benefit was observed in patients with high body mass index (BMI > 30), and only minimal effects on neuropathic pain were identified.

Nedelka et al (317) conducted a randomized, sham-controlled trial evaluating the efficacy of high-energy focused ESWT for lumbar facet joint pain. This sham-controlled trial included 128 patients with chronic lumbar facet syndrome confirmed by medial branch blocks. Patients were randomized to receive either focused ESWT (Group A, n = 64; 0.35 mJ/mm², 1200 shocks/session, 600 shocks per segment, 5 weekly sessions) or sham therapy (Group B, n = 64). Pain intensity using the Visual Analog Scale (VAS), disability using the ODI, and neuropathic pain characteristics using the PainDETECT Questionnaire (PD-Q) were assessed at 2, 6, and 12 months. Lumbar spine MRI was performed at baseline and at 6 months following treatment. Results demonstrated significant reductions in VAS scores in Group A at both 6 and 12 months, with a mean 64.4% reduction at 12 months ($P < 0.01$) and a large effect size (Cohen's d = 1.12). ODI scores decreased by 42.3% in Group A compared with 12.5% in the sham group. Neuropathic pain symptoms improved significantly only in Group A, with PD-Q scores decreasing from 18.3 ± 2.4 to 10.2 ± 1.9 ($P < 0.01$). MRI follow-up demonstrated resolution of BME in 58.8% of ESWT-treated patients, whereas no resolution was observed in the control group. No adverse effects were reported. The investigators concluded that high-energy focused ESWT is a safe and effective non-invasive treatment for chronic lumbar facet joint pain, providing sustained improvements in pain, function, and neuropathic symptoms. MRI findings further support its biologic effect on joint-related BME. ESWT may therefore represent a promising alternative to interventional pain procedures.

4.2.8 Biofeedback Therapy

Biofeedback is a psychological treatment modality that may be administered independently or as an adjunctive therapy in combination with interventional and non-interventional medical treatments, physical therapy, and/or CBT. During biofeedback sessions, patients receive information regarding physiological processes such as respiratory rate, heart rate, and muscle tension. Biofeedback teaches patients to self-regulate physiologic responses by providing information that is "fed back" to them, thereby creating an informational-regulatory loop in which patients actively respond to cues regarding their physiologic

state (318). The primary goal of biofeedback is to enable patients to consciously modulate physiologic processes to positively influence their physiologic responses, functional status, and psychological and behavioral coping mechanisms.

Multiple forms of biofeedback therapy are available, including electromyographic biofeedback, heart rate variability biofeedback, respiratory biofeedback, and neurofeedback, with electromyographic biofeedback and neurofeedback currently being the most widely utilized modalities. Somato-cognitive, somato-neurocognitive, and neurocognitive-somatic regulatory processes have been proposed as potential mechanisms underlying biofeedback and neurofeedback therapies. The benefits of biofeedback and neurofeedback have been demonstrated in the treatment of multiple chronic pain conditions (319). Previous meta-analyses have suggested that these modalities may be more effective than cognitive-behavioral therapy and physical therapy in certain settings (320,321). However, assessment of the overall effectiveness of these therapies has been challenging because of treatment heterogeneity, variability in the underlying mechanisms involved according to pain type, and the frequent use of these therapies as adjunctive interventions combined with other treatment modalities.

A meta-analysis by Sielski et al (321) evaluated the short- and long-term effects of biofeedback on pain, focusing on studies in which biofeedback was utilized either as a stand-alone intervention or as a component representing at least one-fourth of the total treatment plan. The objectives were to evaluate the efficacy of biofeedback compared with different control groups and to identify the critical components contributing to treatment effects. The analysis demonstrated that biofeedback produced a significant small-to-medium reduction in pain, with benefits maintained at 8-month follow-up. In addition, biofeedback was effective in reducing symptoms of depression, disability, and muscle tension, while improving patients' cognitive coping skills. Moderator analyses demonstrated that longer durations of biofeedback therapy were associated with greater reductions in disability, and that a higher proportion of biofeedback within the overall treatment strategy resulted in greater reductions in depression. Consequently, the authors concluded that biofeedback may be utilized as either a stand-alone treatment or an adjunctive intervention and may improve pain-related outcomes in both the short and long term.

4.2.9 Multidisciplinary Rehabilitation

As has been explicitly recognized, addressed, and advocated, a multidisciplinary approach to pain management is effective, efficient, ethically appropriate, and arguably warranted given the multidimensional nature, contributing factors, and complexities of chronic pain conditions. An RCT of 521 patients with chronic low back pain (322) demonstrated that multimodal non-pharmacological interventions, including cognitive therapy, mindfulness-based stress reduction, and behavioral therapy, resulted in reductions in pain and improvements in physical function, mood, and sleep disturbances. Such an integrative multidisciplinary approach can and should include mechanisms to coordinate and provide access not only to cognitive-behavioral therapies, but also to the full spectrum of therapeutic modalities described above. Multidisciplinary rehabilitation for pain management involves coordinated care delivered by a team consisting of clinicians, physical and/or occupational therapists, mental health and behavioral therapists, and additional specialty services when indicated (224,323,324). CDC guidelines support the concept that multimodal therapies and multidisciplinary biopsychosocial rehabilitation may reduce long-term pain and disability when compared with usual care and/or physical treatments alone. In conjunction with this multidisciplinary approach, non-pharmacological therapies may also provide synergistic benefits when combined with non-opioid and/or opioid medications (224,325). Consequently, CDC guidelines recommend that medications ideally be combined with non-pharmacologic therapies to optimize improvements in pain and functional outcomes.

However, as noted in the CDC guidelines (224), multimodal therapies are not consistently available or reimbursed by insurance providers and, when implemented sequentially or iteratively, may become time-consuming and costly for patients. Disparities in access to multimodal care also persist (325). In clinical practice, multidisciplinary therapies are often among the least available and most expensive treatment options. Such limited availability and high cost may result in time inefficiency and cost inefficiency, thereby creating both economic and ethical concerns, particularly when these approaches are utilized outside the established infrastructure and fixed-cost setting of multidisciplinary pain treatment centers. CDC guidelines (224) further note evidence indicating that less intensive multidisciplinary rehabilitation may be as effective as high-intensity multidisciplinary rehabilitation (184).

Additional considerations include the use of combination pharmacologic strategies, such as 2 non-opioid medications with differing mechanisms of action or a combination of non-opioid and opioid medications, as components of multidisciplinary pain management.

Although short- and intermediate-term outcomes of multidisciplinary care for chronic pain have demonstrated clinical effectiveness, third-party payer support for multidisciplinary pain centers and integrated multimodal care programs for chronic pain patients had largely disappeared by 2010. The limited availability of programs, treatment settings, and financial support for this approach has contributed to a lack of robust evaluations regarding the long-term effects of coordinated multimodal care. Reflecting this limitation, evidence supporting long-term benefits of multidisciplinary pain management ranges from minimal to absent (184,208,326). This issue was highlighted in a recent review (323), which reported insufficient evidence supporting multi- or interdisciplinary pain rehabilitation for lumbar radiculopathy (208). Similarly, a Cochrane review (326) demonstrated that pain, disability, and work-related outcomes among candidates for spinal fusion were comparable at 2 years between surgically treated patients and those managed with multi- or interdisciplinary pain rehabilitation.

Despite positive reports supporting CBT and/or physical rehabilitation for persistent spinal pain, O'Connell et al (327), including multiple authors frequently involved in Cochrane reviews, identified concerns regarding the trustworthiness of several CBT trials for spinal pain that substantially influenced the analyses and conclusions of systematic reviews and clinical practice guidelines. Nevertheless, their review ultimately concluded favorably regarding the interventions evaluated.

4.3 Opioids

Opioids continue to be widely utilized in clinical practice for the management of chronic low back pain. As outlined in ASIPP opioid guidelines (15), numerous reviews over the years have evaluated opioid use, overuse, abuse, and the broad spectrum of adverse consequences associated with opioid therapy, including opioid-related mortality. Manchikanti et al (15,112) described the evolution of a fourth wave of opioid-related deaths, representing a modification of the 3 distinct waves previously described by the CDC. This fourth wave began in 2016 and has continued to expand steadily because of multiple contributing factors, including misapplication of the 2016 CDC guidelines, increased availability of illicit substances, spillover effects from the COVID-19 pandemic, and healthcare policies that have reduced patient access to interventional procedures for chronic pain management (Fig. 2) (15,112,328,329).

The overall trends at the time of this publication are as follows (329):

- Decline in 2024: Provisional CDC data demonstrated an unprecedented 27% one-year reduction in overdose deaths in the United States in 2024 compared to 2023. This decline followed a 4% reduction in opioid overdose deaths from 2022 to 2023.
- Declines Across Drug Types: The reduction was observed across all major categories of drug use, including opioids, which have represented the primary cause of overdose deaths over the past decade.
- Fentanyl Remains a Concern: Synthetic opioids, particularly fentanyl, continue to be the substances most frequently implicated in overdose deaths, although deaths involving synthetic opioids declined by approximately 37% between 2023 and 2024.
- Long-Term Perspective: Despite these recent improvements, the number of opioid overdose deaths in 2023 remained nearly 10 times higher than in 1999. More than 645,000 individuals have died from opioid overdoses since the onset of the epidemic.

Multiple initiatives have been implemented to address the opioid crisis. There has been substantial debate regarding the relationship between opioid overdoses and prescription opioid analgesics, including the terminology used to characterize this association (15,112,328). The relationship between opioid overdoses, opioid treatment admissions, and prescription opioid analgesics in the United States from 2010 through 2019 has been previously evaluated (328). As illustrated in Figs. 3 and 4, the relationships among total opioid dosage, accidental opioid deaths, prescription opioid-related deaths, opioid treatment admissions, and annual prescription opioid sales measured as morphine milligram equivalents (MME) per capita were either nonexistent or demonstrated significant negative or inverse associations (330).

4.4 Interventional Techniques

Over the years, substantial changes have occurred

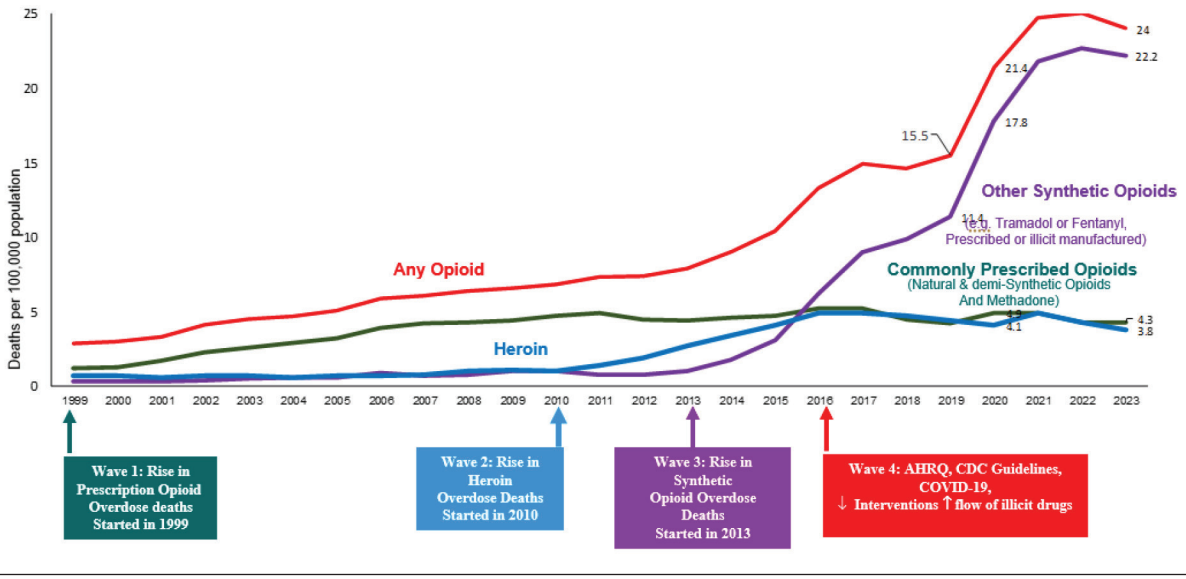


Fig. 2. *Four waves of rise in opioid overdose deaths.*
Redrawn and modified from CDC figure.

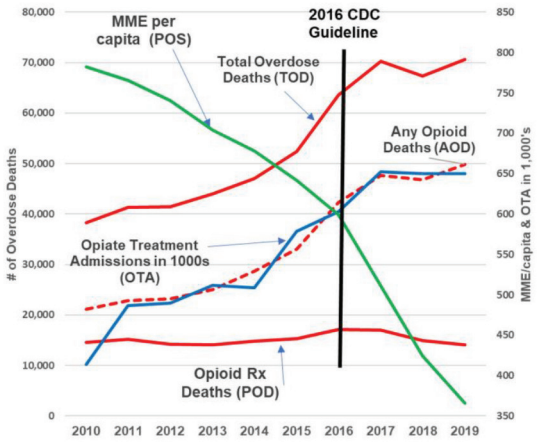


Fig. 3. *2010–2019 update.*
AOD = any opioid overdose death; POD = prescription opioid deaths; POS = prescription opioid sales; OTA = opioid treatment admissions; TOD= total overdose deaths; MME= morphine milligram equivalents
The green line represents opioid prescribing (POS, MME/capita); the red lines are opioid deaths (POD, AOD, and TOD); the blue line represents opioid addiction (OTA). Over the past decade, as the green line (prescription opioids) declined by +50%, prescription opioid deaths remained flat while opioid addiction, any opioid and total overdose deaths continued increasing "exponentially (122)".

Source: Aubry L, Carr BT. Overdose, opioid treatment admissions and prescription opioid pain reliever relationships: United States, 2010-2019. *Front Pain Res (Lausanne)* 2022; 3:884674 (121).

in the utilization patterns of interventional techniques, initially characterized by exponential growth, but subsequently failing to demonstrate comparable sustained increases. The COVID-19 pandemic exerted a lasting impact on interventional pain management practices (9,10,15,25,26,66,105,106,112,331-335). However, even prior to the pandemic, growth patterns for interventional techniques within the Medicare population had begun to change and, in some instances, decline following implementation of the ACA (6-10,112,334).

Multiple studies have documented these trends. As described previously, Zajacova et al (26) demonstrated a significant 13% increase in the prevalence of chronic pain and high-impact chronic pain from 2019 to 2023 associated with the COVID-19 era. They estimated that approximately 60 million Americans experienced chronic pain and 21 million experienced high-impact chronic pain. In addition, they reported significant increases in back and neck pain prevalence, from 11.2% to 12.4%. In contrast, utilization patterns for interventional pain management techniques have declined not only as a consequence of COVID-19, but also because of multiple additional factors (6-10,83-120).

An analysis of utilization patterns of interventional

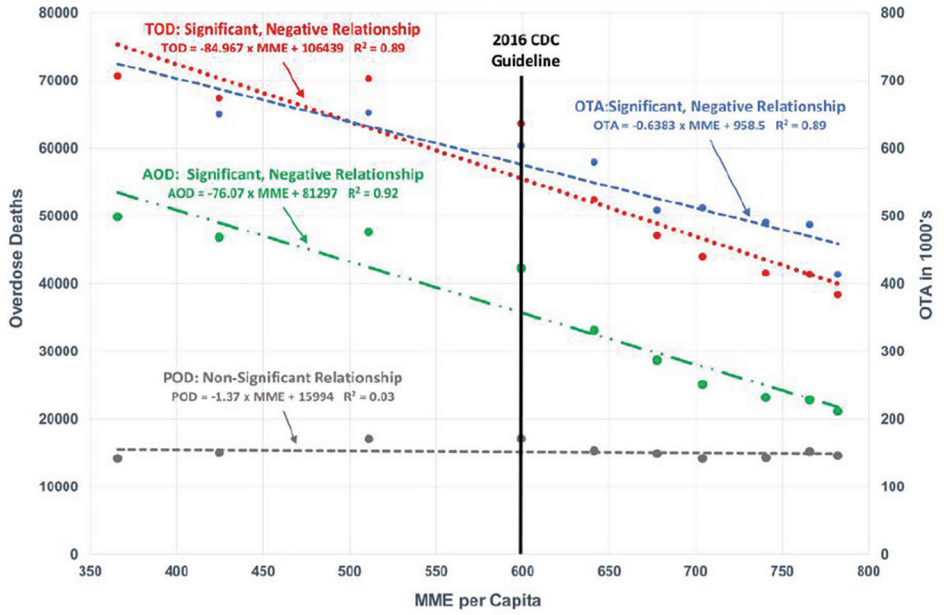


Fig. 4. *2010–2019 regression models: Illustrates the regression of opioid treatment admissions.*
OTA = opioid treatment admissions; POD = prescription opioid deaths; AOD= any opioid overdose death; TOD = total overdose deaths; POS = prescription opioid sales
Significant, negative relationships were found for OTA, AOD, and TOD. No significant relationship exists between POD and POS.

Source: Aubry L, Carr BT. Overdose, opioid treatment admissions and prescription opioid pain reliever relationships: United States, 2010-2019. Front Pain Res (Lausanne) 2022; 3:884674 (121).

pain management techniques among traditional fee-for-service Medicare beneficiaries by Manchikanti et al (9) demonstrated that service rates for interventional pain management procedures per 100,000 Medicare beneficiaries declined cumulatively by 16.8% from 2019 to 2024, corresponding to an average annual decrease of 3.6%. This finding contrasts with the period from 2010 through 2019, during which a cumulative increase of 14.5% and an average annual growth rate of 1.5% were observed. The most substantial decline occurred between 2019 and 2020, with a 15.4% reduction coinciding with the onset of the COVID-19 pandemic (Figs. 5, 6, and 7).

In an updated analysis evaluating the continued decline in utilization of facet joint interventions for spinal pain in the traditional Medicare population, Manchikanti et al (10) described substantial fluctuations in utilization patterns over time. Utilization of facet joint interventions increased rapidly from 2000 to 2010, with an annual growth rate of 15.5%, followed by slower growth from 2010 to 2019 at 4.2% annually, and subsequent decline from 2019 to 2024 at a rate of -6.1% annually. Episode utilization demonstrated similar trends, although the decline in episodes was less pronounced than the decline in procedures, with increases of 15.3% and 4.8% from 2000 to 2010 and from 2010 to 2019, respectively. From 2019 to 2024, episode utilization declined by 4% compared with a 6.1% decline in procedures (Fig. 8). By 2024, service rates had returned to levels approximating those observed in 2012, with 5,016 procedures per 100,000 beneficiaries compared with 5,046 per 100,000 beneficiaries in 2012.

From 2000 to 2010, lumbar and cervical/thoracic facet joint blocks and ablation procedures increased substantially, with annual growth rates ranging from 13.5% to 24.6%. This period was followed by slower growth from 2010 to 2019, ranging from 2.8% to 11.0%, and then by a sharp pandemic-related decline from 2019 to 2020, ranging from 10.6% to 17.4%, with subsequent partial recovery and modest growth or stabilization through 2024. Between 2019 and 2024, the episode ratio of facet joint nerve blocks to radiofrequency ablation declined from 5.0 to 1.7 for lumbar procedures and from 7.2 to 2.0 for cervical procedures, findings attributed to implementation of mandatory radiofrequency policies (Figs. 9, 10, and 11).

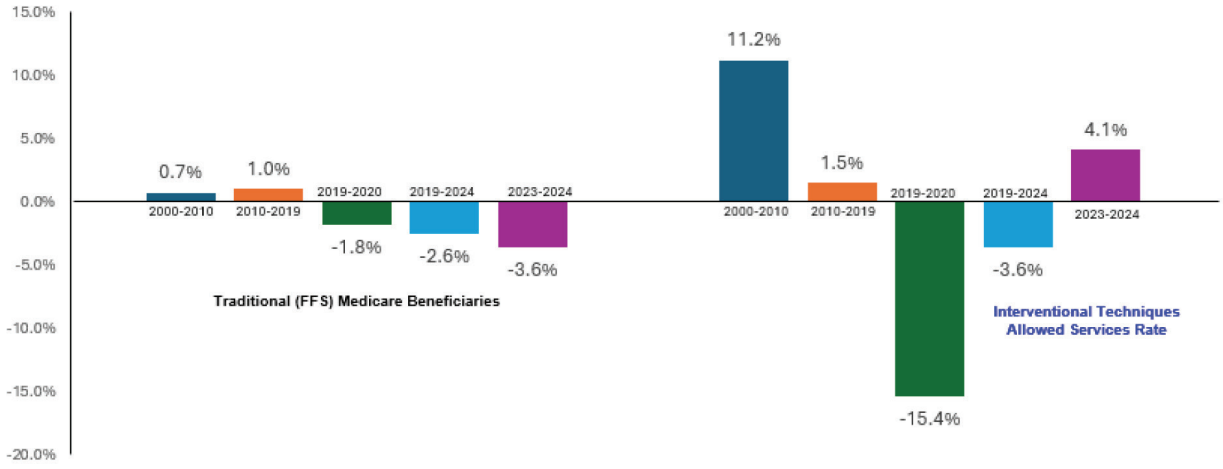


Fig. 5. *Comparative trends in interventional techniques (epidural and adhesiolysis procedures, facet joint interventions and sacroiliac joint blocks, disc procedures and other types of nerve blocks) utilization rates (per 100,000 traditional (FFS) Medicare Beneficiaries), using geometric average annual change in rates.*

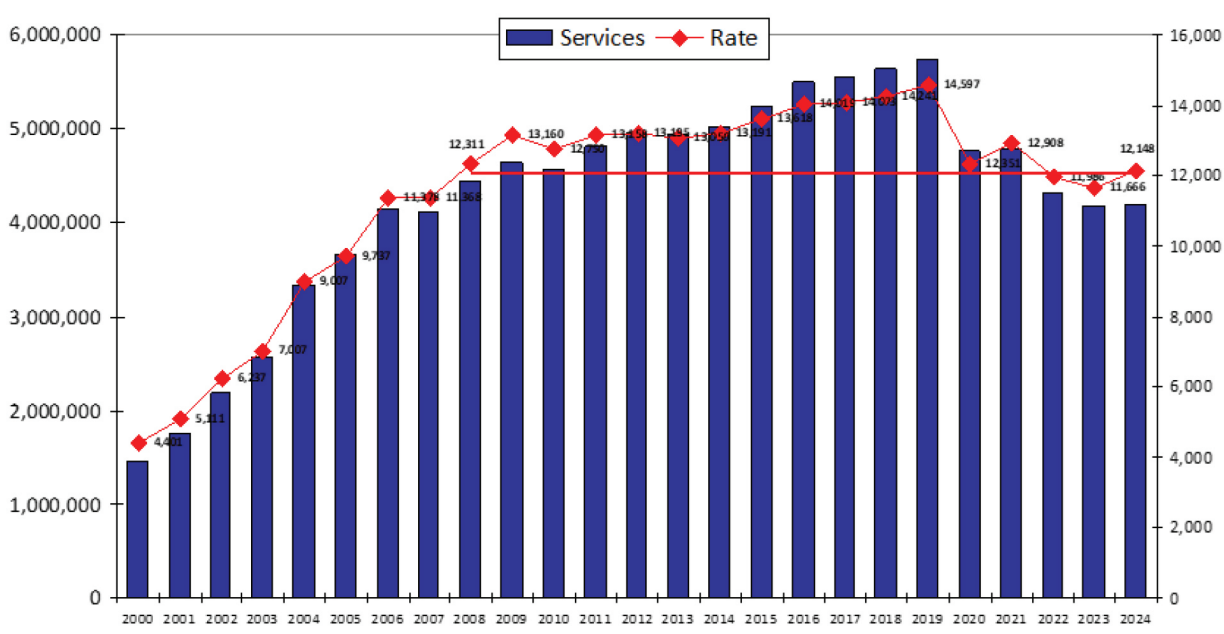


Fig. 6. *Growth of interventional pain management techniques, services, and rates from 2000 to 2024, in traditional (FFS) Medicare recipients.*

Interventional pain-related specialties accounted for the majority of facet joint procedures, increasing their proportion from 87.3% in 2010 to 95% by 2024, whereas surgical specialties declined from 4.8% to 2.0% (Table 5). During the same period, the site of service demonstrated a modest shift away from office-based settings, which declined from 50.7% to 48.8%, and hospital outpatient departments (HOPDs), which declined to 20.5%, toward ambulatory surgery centers (ASCs), which increased from 25.6% to 30.6%, as illustrated in Fig. 12. These findings reflect increasing subspecialization, recent reductions in treatment intensity, and the

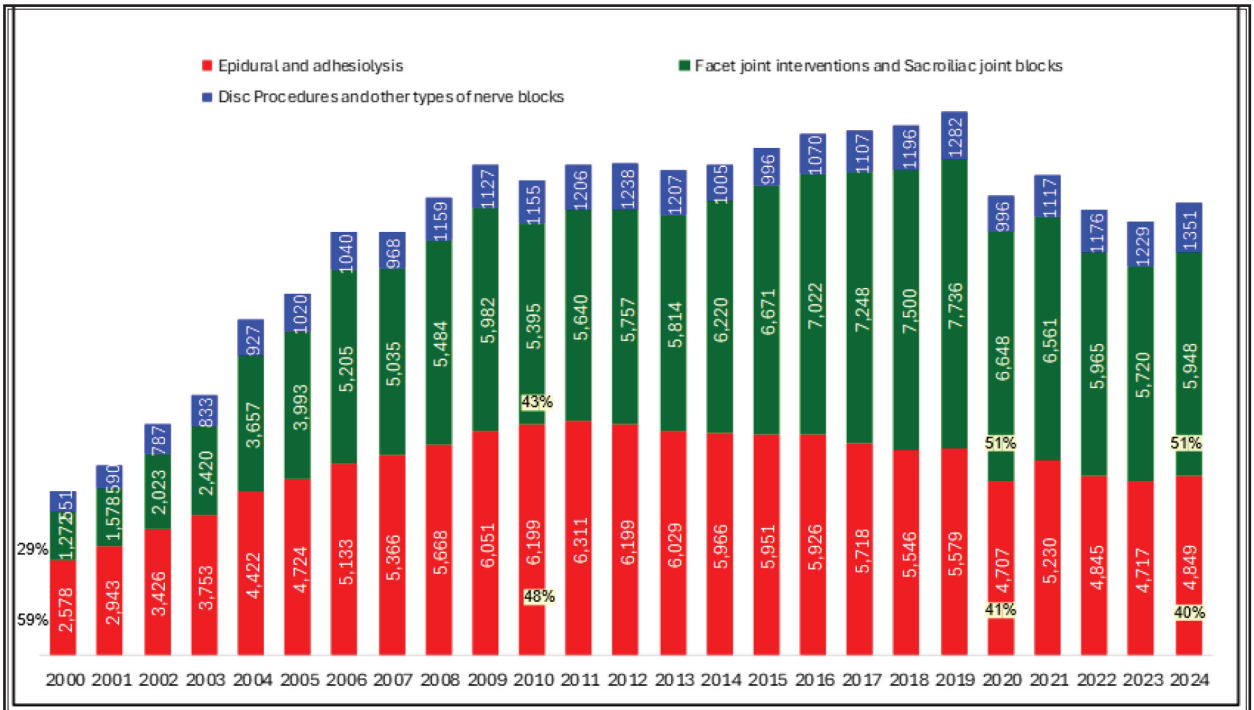


Fig. 7. *Trends in procedural rates by procedure type from 2000 to 2024, illustrating the distribution and changes in frequency of each procedure type over time in the traditional (FFS) Medicare population.*

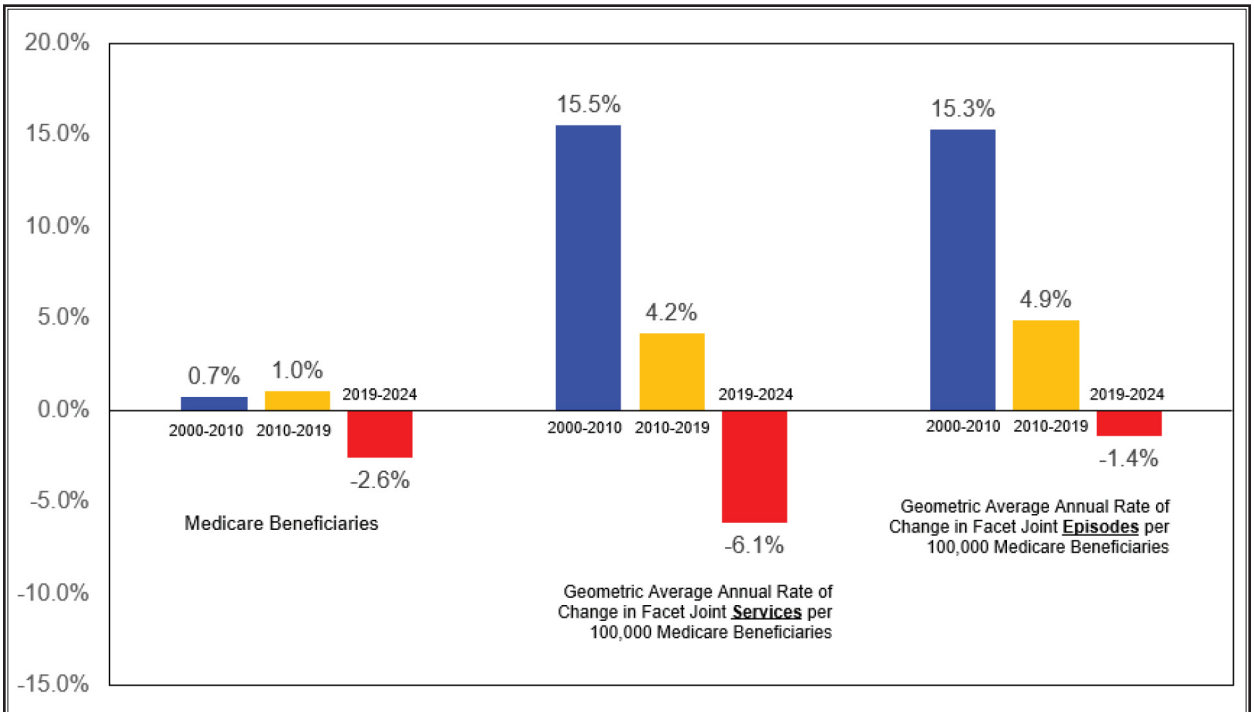
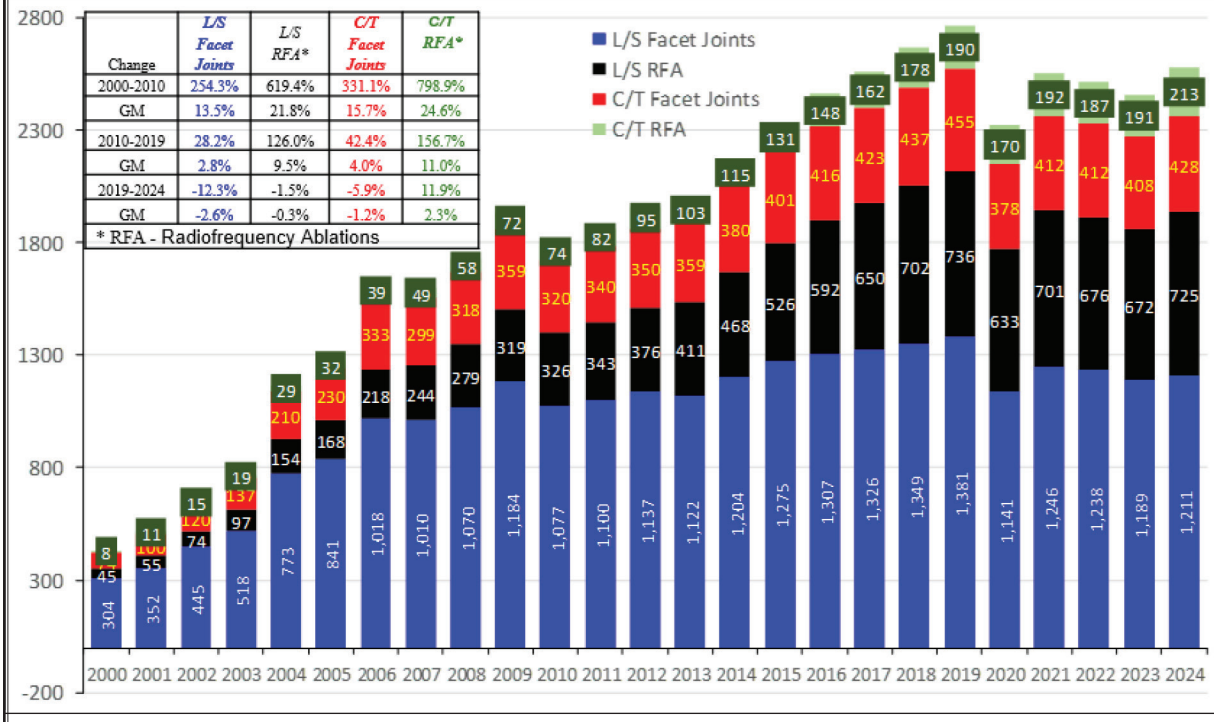


Fig. 8. *Comparative analysis of annual utilization patterns in the traditional Medicare population and utilization rate of facet joint services and episodes per 100,000 Medicare beneficiaries (2000–2024) (geometric average annual change).*



Change	L/S Facet Joints	L/S RFA*	C/T Facet Joints	C/T RFA*
2000-2010	254.3%	619.4%	331.1%	798.9%
GM	13.5%	21.8%	15.7%	24.6%
2010-2019	28.2%	126.0%	42.4%	156.7%
GM	2.8%	9.5%	4.0%	11.0%
2019-2024	-12.3%	-1.5%	-5.9%	11.9%
GM	-2.6%	-0.3%	-1.2%	2.3%

Fig. 9. *Frequency (per 100,000) of utilization of facet joint intervention episodes from 2000 to 2024, in Medicare recipients.*

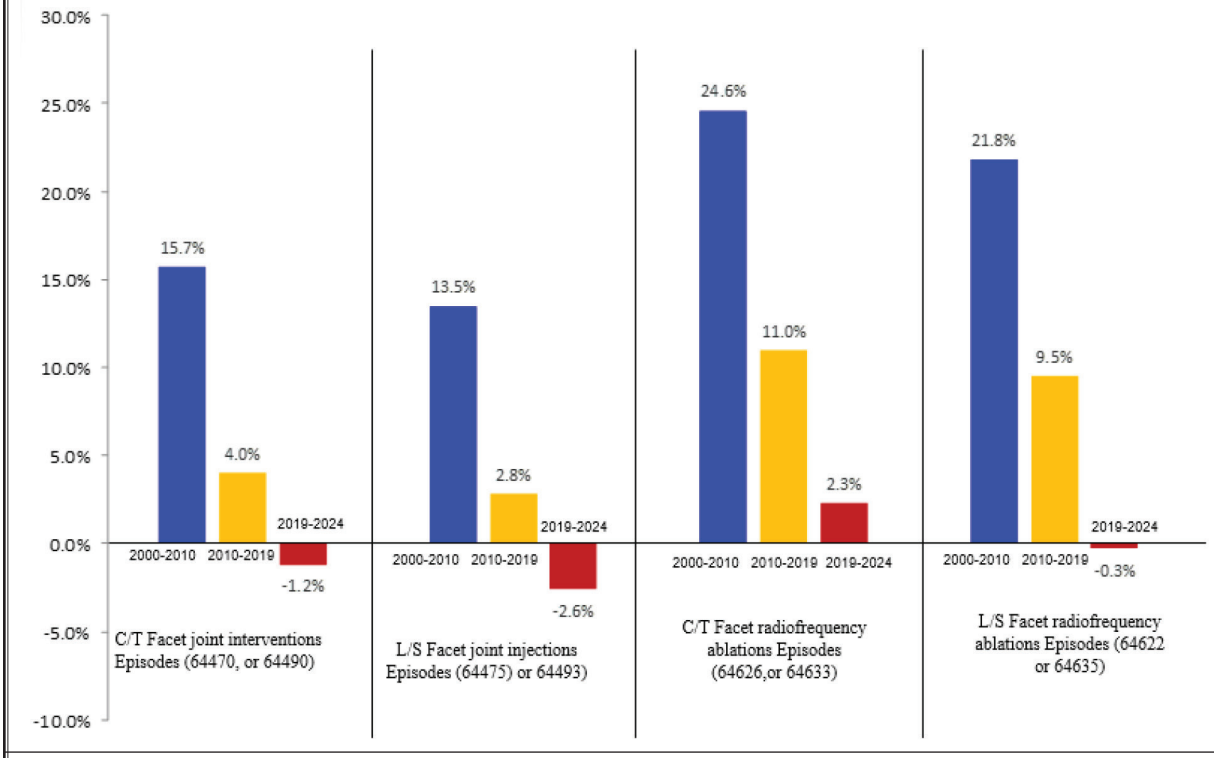


Fig. 10. *Annual change in frequency of utilization of facet joint intervention episodes from 2000 to 2024 in Medicare recipients.*

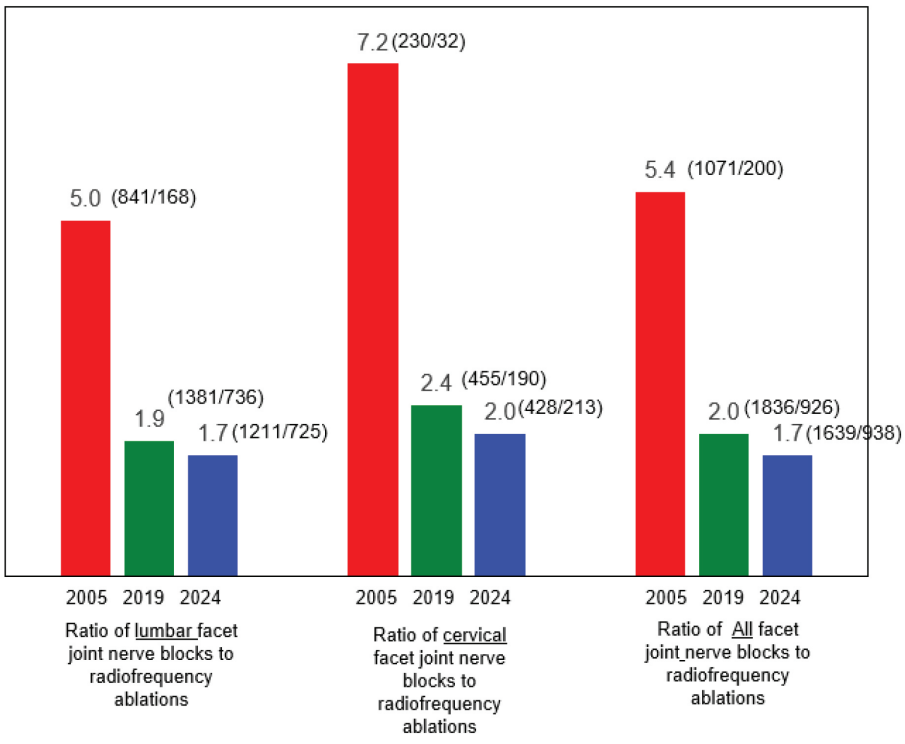


Fig. 11. *Comparison of episode rate ratios: facet joint nerve blocks vs. radiofrequency ablation (2005, 2019, and 2024).*

influence of healthcare policy changes, growth in Medicare Advantage enrollment, and broader healthcare system pressures affecting pain management practices.

4.5 Surgery

Since the first description of discectomy for the treatment of disc herniation, initially misidentified as a "chondroma," by Mixter, a neurosurgeon, and Barr, an orthopedic surgeon, in 1932 (336), surgical treatment modalities for spinal pain have evolved substantially with the development of multiple techniques. This evolution has been accompanied by a general trend toward increasing surgical interventions, raising ongoing questions regarding the true effectiveness of such treatments (337).

The Spine Patient Outcomes Research Trial (SPORT) prospectively collected surgical data (338), demonstrating increasing national trends in surgical interventions (174,194,195,339-351). However, for most studies, the available data extend only through 2015. Best et al (351) reported a 460% increase in surgical treatment for intervertebral disc disorders and a 910% increase in spinal stenosis surgeries from 1994 through 2006. Yoshihara and Yoneoka (195) reported a 2.4-fold increase in population-adjusted surgical interventions for degenerative disc disease from 2000 through 2009. Bae et al (174) demonstrated a 45% increase in lumbar spinal stenosis surgeries accompanied by a 1.9% decrease in lumbar decompression procedures from 2004 through 2009. Similarly, Martin et al (340) reported a 62.3% increase in elective spinal fusion procedures, with the largest increase, 138.7%, observed among patients aged 65 years or older between 2004 and 2015. They also demonstrated that aggregate hospital costs increased by 177% during this 12-year period, exceeding $10 billion in 2015.

Studies by Lopez et al (339) evaluating the period from 2012 through 2017 demonstrated a 24.2% increase in surgical interventions for chronic pain. In addition, reoperation rates for disc herniation and spinal stenosis ranged from 10% to 23% (174), with data indicating that approximately 40% of postoperative patients developed post-surgery syndrome or failed back surgery syndrome (FBSS), requiring additional treatment (174,344-350). These patients frequently develop substantial disability and often require multiple

Table 5. *Utilization of facet joint intervention episodes by specialty in the traditional Medicare population from 2010 to 2024.*

Year	IPM Specialties		surgical group		Radiology		Other Specialties		CRNA, NP, PA		Total	
	Services	Rate (%)	Services	Rate (%)	Services	Rate (%)	Services	Rate (%)	Services	Rate (%)	Services	Rate (%)
2010	563,114	1,568 (87.3%)	31,104	87 (4.8%)	14,072	39 (2.2%)	30,044	84 (4.7%)	6863	19 (1.1%)	645,197	1,797
2011	601,824	1,644 (88.2%)	28,544	78 (4.2%)	14,761	40 (2.2%)	29,746	81 (4.4%)	7597	21 (1.1%)	682,472	1,865
2012	650,963	1,736 (88.6%)	27,222	73 (3.7%)	15,300	41 (2.1%)	31,450	84 (4.3%)	9576	26 (1.3%)	734,511	1,959
2013	680,423	1,800 (90.3%)	25,398	67 (3.4%)	12,850	34 (1.7%)	29,556	78 (3.9%)	5695	15 (0.8%)	753,922	1,995
2014	751,742	1,973 (91.1%)	25,440	67 (3.1%)	12,385	33 (1.5%)	32,185	84 (3.9%)	3535	9 (0.4%)	825,287	2,166
2015	823,086	2,138 (91.7%)	26,046	68 (2.9%)	13,000	34 (1.4%)	32,826	85 (3.7%)	2784	7 (0.3%)	897,742	2,332
2016	897,451	2,284 (92.7%)	26,429	67 (2.7%)	13,911	35 (1.4%)	27,196	69 (2.8%)	2881	7 (0.3%)	967,868	2,463
2017	946,641	2,397 (93.6%)	25,713	65 (2.5%)	14,713	37 (1.5%)	21,198	54 (2.1%)	3022	8 (0.3%)	1,011,287	2,560
2018	994,354	2,511 (94.2%)	26,316	66 (2.5%)	15,663	40 (1.5%)	16,091	41 (1.5%)	3147	8 (0.3%)	1,055,571	2,666
2019	1,023,256	2,604 (94.3%)	25,607	65 (2.4%)	16,550	42 (1.5%)	16,442	42 (1.5%)	3624	9 (0.3%)	1,085,479	2,762
2020	843,679	2,186 (94.1%)	23,095	60 (2.6%)	12,952	34 (1.4%)	12,651	33 (1.4%)	3931	10 (0.4%)	896,308	2,322
2021	890,487	2,407 (94.3%)	23,257	63 (2.5%)	12,772	35 (1.4%)	12,870	35 (1.4%)	4543	12 (0.5%)	943,923	2,551
2022	856,476	2,379 (94.7%)	19,663	55 (2.2%)	11,784	33 (1.3%)	11,918	33 (1.3%)	4845	13 (0.5%)	904,686	2,513
2023	834,755	2,332 (94.8%)	18,457	52 (2.1%)	10,146	28 (1.2%)	11,683	33 (1.3%)	5429	15 (0.6%)	880,470	2,459
2024	844,617	2,448 (95.0%)	17,653	51 (2.0%)	8,315	24 (0.9%)	12,623	37 (1.4%)	5705	17 (0.6%)	888,913	2,577

Rate Per 100,000 Medicare beneficiaries: Percentages are expressed as a proportion of the total rate within each row.

treatment modalities, including physical therapy, pharmacologic therapy, interventional techniques, complex spinal fusion procedures, and neuromodulation therapies (169,171,174,352-366).

From a paradigmatic perspective, clinicians managing patients with chronic low back pain should ideally exhaust all low- to moderate-risk treatment modalities before considering surgical intervention. A retrospective analysis of more than 75 million individuals by Kim et al (367) demonstrated that nonadherence to clinical guidelines for patients with newly diagnosed low

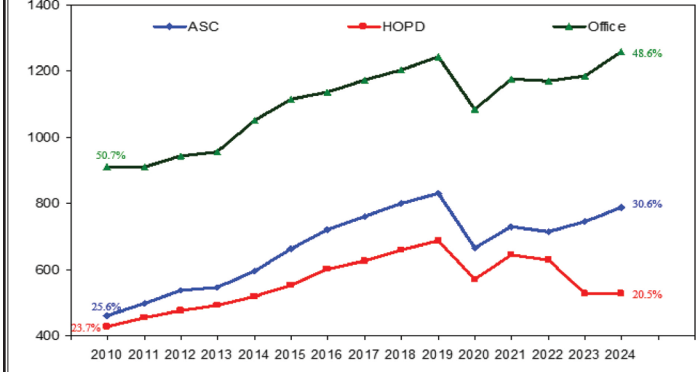


Fig. 12. *Distribution of Facet Joint episodes by Site of Service Among Medicare Beneficiaries, 2010–2024.*

back pain or lower extremity pain contributed substantially to the economic burden of spinal disorders in the United States. Notably, 38.7% of patients who underwent surgery had not received conservative management, including either physical therapy or epidural steroid injections, accounting for approximately $265 million in healthcare expenditures during the first 12 months after patients diagnosed with low back or lower extremity pain (367). This gap in adherence to appropriate conservative care highlights the need for a more informed and judicious approach to high-risk surgical interventions in order to optimize clinical and economic outcomes.

Overall, surgical outcomes for chronic spinal pain have often been disappointing; consequently, post-surgical syndrome, also referred to as post-procedural spine pain, occurs in a substantial proportion of patients (355,359-361,368-379). Fritsch et al (355) reported that epidural fibrosis, recurrent disc herniation, spinal instability, and facet joint pathology were responsible for recurrent symptomatology. Although previous reports have suggested that a definitive etiology for back pain can be established in only approximately 15% of patients based solely on clinical examination (5,13,36,37,39,361,374-382), identifying the precise pain generator in post-lumbar surgery syndrome is even more challenging, with potential sources including the facet joints, intervertebral discs, sacroiliac joints, other spinal structures, or combinations thereof.

Manchikanti et al (368) demonstrated a prevalence of facet joint pain of 16% among post-surgical patients with chronic low back pain, with a 95% confidence interval (CI) of 9% to 23%, and a false-positive rate of 49% for a single lidocaine block. In patients with post-surgical chronic neck pain related to facet joint pathology, Manchikanti et al (369) reported a prevalence of 36% with a false-positive rate of 50%, utilizing controlled comparative local anesthetic blocks with 80% pain relief as the diagnostic criterion standard. Furthermore, DePalma et al (361), in a smaller cohort of patients who had undergone lumbar fusion, identified facet joint pain in 5 of 28 cases. They also identified 7 patients with internal disc disruption, 12 patients with sacroiliac joint pain, and 4 patients with soft tissue irritation associated with spinal fusion hardware. In a subsequent study, DePalma et al (377) demonstrated that the prevalence of facet joint pain did not differ significantly between patients with and without prior surgical discectomy. Manchikanti et al (379), in another investigation evaluating the contribution of facet joints to chronic low back pain in post-laminectomy syndrome, demonstrated a prevalence of 44% in patients without prior surgery compared with 32% in patients who had undergone surgical intervention. Klessinger (378) further described the effectiveness of medial branch blocks and RFA in managing facet joint pain among patients with post-lumbar surgery syndrome. Consequently, many of these patients ultimately undergo facet joint interventions following spinal surgical procedures.

5.0 Pathophysiology and Structure Basis of Spinal Facet Joint Pain

Key Question 3: What is the pathophysiologic and structural basis of spinal facet joint pain?

It is well recognized that chronic spinal pain is a multifactorial disorder with numerous potential etiologies. With the advancement of modern diagnostic technologies, including MRI, computed tomography (CT), neurophysiologic testing, comprehensive physiologic examination, and psychological assessment, the cause of spinal pain can now be objectively identified in approximately 85% of patients in the absence of disc herniation and neurological deficits (5,13,36,37,39,374,376,380,381,383-413). Consequently, once an appropriate diagnosis has been established, the terminology of "nonspecific low back pain" may no longer be applicable. The term "nonspecific low back pain" lacks support from primary diagnostic studies and has increasingly been questioned, particularly by interventionalists (408,414).

Han et al (415), in a systematic review assessing the diagnostic accuracy of low back pain originating from the disc, sacroiliac joint, or facet joints, challenged the prevailing view in the low back pain field that a pathoanatomical diagnosis is generally not possible. They argued that the label "nonspecific low back pain" should not be universally applied to all patients. Their review provided preliminary evidence that a specific diagnosis may be achievable in a subgroup of patients with low back pain, thereby potentially moving beyond the nonspecific low back pain construct. This conclusion was based on the identification of informative diagnostic index tests for the disc, sacroiliac joint, and facet joints as pain generators. Consequently, establishing a specific diagnosis may facilitate the transition from generic symptomatic treatment approaches toward therapies targeted to the underlying pathoanatomical source of pain.

The majority of painful spinal conditions originate from structures within the spine and may manifest as pain in the neck, upper back, mid back, low back, or upper and lower extremities. Bogduk proposed that, for any structure to be considered a source of back pain (405):

1. The structure must possess a nerve supply.
2. The structure must be capable of producing pain similar to that observed clinically, ideally demonstrated in normal volunteers.
3. The structure must be susceptible to diseases or injuries known to be painful.
4. The structure must be demonstrable as a source of pain in patients using diagnostic techniques of established reliability and validity.

Kuslich et al (39) identified the skin, compressed nerve roots, outer annulus fibrosus, vertebral end plate, facet capsule, ligaments, fascia, muscles, and dura as tissues capable of transmitting pain in the low back. Based on evidence derived from multiple diagnostic interventions, particularly controlled diagnostic blocks, the intervertebral discs, facet joints, sacroiliac joints, and nerve roots have been established as common sources of pain in volunteers and patients with spinal pain (5,36,37,391,393-397,411-413,416-430). In contrast, muscles and ligaments have not been definitively identified as pain generators through validated diagnostic techniques. Multiple prospective studies have identified various spinal structures as causes of chronic neck or low back pain in patients who failed conservative therapy. Diagnoses were established using medical history, physical examination, x-ray, CT, MRI, and EMG/nerve conduction studies.

In a prospective evaluation of the lumbar spine, Pang et al (431) utilized a pain mapping strategy in patients with intractable low back pain unrelated to disc herniation or radiculitis who had failed conservative treatment. They identified facet joint pain in 24% of patients, combined lumbar nerve root and facet joint pathology in 24%, combined facet joint and sacroiliac joint pathology in 4%, lumbar nerve root irritation in 20%, internal disc disruption in 7%, sacroiliac joint pain in 6%, and sympathetic dystrophy in 2%. In another study, Manchikanti et al (432) evaluated the relative contributions of different spinal structures in patients with chronic low back pain following failure of conservative treatment and without radiologic evidence of disc protrusion or radiculopathy. Utilizing controlled comparative double diagnostic blocks, they demonstrated facet joint pain in 40% of patients, discogenic pain in 26%, sacroiliac joint pain in 2%, and possible segmental dural or nerve root pain in 13%. In these studies, no specific etiology was identified in 13% (431) and 19% (432) of patients. Schwarzer et al (433-439), in separate investigations, reported facet joint pain in 15% to 40% of patients, internal disc disruption in 39%, and sacroiliac joint pain in 30%. DePalma et al (440), in a retrospective evaluation of 156 patients with chronic low back pain, assessed pain sources utilizing

controlled comparative local anesthetic blocks and demonstrated a prevalence of facet joint pain of 31%, disc disruption of 42%, and sacroiliac joint pain of 18%. Bokov et al (441) identified facet joint pain in 50.6% of cases using 50% pain relief as the diagnostic criterion standard, discogenic pain in 16.9%, and sacroiliac joint pain in 7.2%. They were unable to identify a pain source in 25.3% of patients.

In the cervical spine, Bogduk and Aprill (442) evaluated the prevalence of discogenic and zygapophysial facet joint pain. They demonstrated that discs alone were symptomatic in only 20% of patients. However, 41% of patients exhibited both symptomatic discs and symptomatic zygapophysial joints. Yin and Bogduk (443), in a study of 143 patients with chronic neck pain of varying etiologies, identified discogenic pain in 16% of patients and zygapophysial joint pain in 55%, with no diagnosis established in 32% of patients completing investigations. Only 46% of the sample completed the full diagnostic evaluation.

The pathophysiologic phases of facet joint pain, spinal degeneration, and the relationship to osteoarthritis have been described extensively in multiple publications (5,36,37,408-410,444-458). The facet, or zygapophysial, joints are paired diarthrodial joints located in the posterior vertebral column and represent the only true synovial joints between adjacent spinal levels in humans (402,409,410). Facet joint arthritis is closely associated with degenerative disc disease, which affects the anterior spinal column. At every spinal level except C1/C2, the so-called "3-joint complex," or motion segment, is composed of one intervertebral disc and 2 facet joints between adjacent vertebrae (444,451,454,455). Consequently, the spine can be conceptualized as a series of interconnected motion segments whose composite motion reflects the contribution of individual segments. Since the 3 joints within each motion segment are highly interdependent, changes in one structure can significantly affect the other 2, and vice versa (444,451,454,455). Thus, lesions affecting the intervertebral disc may eventually involve the facet joints, while trauma or instability affecting the posterior column may secondarily alter disc function (410,448,449,456-458). Multiple studies have demonstrated that spinal degeneration typically begins within the disc and is subsequently followed by degenerative changes within the facet joints in the majority of individuals (448,456-458).

Facet joint osteoarthritis is a clinical and pathological condition characterized by functional failure of the synovial facet joints. Although often considered primarily a disorder of articular cartilage loss and bony hypertrophy, the degenerative process involves the entire joint complex, including the subchondral bone, cartilage, ligaments, synovium, and periarticular paraspinal musculature and soft tissues.

A scoping review by Bogduk and MacVicar (459) evaluating zygapophysial joint osteoarthritis as a cause of back and neck pain reviewed multiple studies and found no positive association between facet joint osteoarthritis and pain. All reviewed studies demonstrated that pain was independent of the presence or severity of osteoarthritis. Osteoarthritis was found to be equally prevalent among individuals without pain and those with pain. Consequently, the null hypothesis could not be rejected. They concluded that the published evidence does not support the belief that osteoarthritis itself causes zygapophysial joint pain and, in fact, that the available evidence contradicts such a belief.

Facet joints are richly innervated, including the subchondral bone, synovium, synovial folds, and joint capsule (460-480). However, the articular cartilage itself is aneural. The nerve endings, which are components of the medial branches arising from the dorsal rami, are involved in pain sensation and proprioception (461). The medial branch is especially important because it provides sensory innervation from the midline of the spine to the facet joint line (461). Consequently, many facet joint diagnostic and therapeutic interventions rely upon blocking medial branch neural transmission to identify and alleviate pain (460). Numerous studies have demonstrated innervation of the facet joints by the medial branches of the dorsal rami (461-480). In addition, neuroanatomic investigations have identified free and encapsulated nerve endings within the facet joints, as well as nerves containing substance P and calcitonin gene-related peptide (481-495). Neurophysiologic studies have further demonstrated that facet joint capsules contain low-threshold mechanoreceptors, mechanically sensitive nociceptors, and silent nociceptors (470-499). Inflammation has been shown to decrease the activation thresholds of nerve endings within facet capsules and increase baseline discharge rates (450,470,492-502). Biomechanical studies have demonstrated that lumbar and cervical facet joint capsules undergo substantial strain during spinal loading (470,503-506). Furthermore, both basic science and clinical investigations have shown that mechanical injury, inflammation, and degeneration of facet joints

can produce persistent pain (391,412,413,452,456,507-531). In the cervical spine, differences in pressure and thermal pain hypersensitivity have been demonstrated between patients with acute and chronic neck pain and healthy controls (519). Cold hypersensitivity has also been observed. Javanshir et al (519) concluded that these findings support the existence of distinct sensitization mechanisms in patients with acute and chronic mechanical and insidious neck pain.

Thus, based on neurophysiologic and pathophysiologic evidence, spinal facet joints have been established as sources of neck pain and referred pain to the head and upper extremities, upper back and mid back, chest wall, low back, and lower extremities.

6.0 Non-Interventional Diagnosis of Facet Joint Pain

Key Question 4: What is the evidence of diagnostic accuracy and value of non-interventional methods in the diagnosis of facet joint pain?

Non-interventional diagnosis of facet joint pain is based on medical history, physical examination, and imaging studies. Imaging modalities include x-ray, ultrasound (US), MRI, CT, single-photon emission computed tomography (SPECT), and scintigraphy.

6.1 History and Physical Examination

Accurate diagnosis of the underlying etiology is a prerequisite for successful treatment of low back pain. Evaluation of patients with spinal pain begins with patient self-report questionnaires and history-taking, followed by physical examination to assist clinicians in formulating a probable diagnostic hypothesis that may differentiate musculoskeletal pain from non-spinal or serious spinal pathology (532). In other areas of medicine, this paradigm is accepted or presumed to be valid (533). However, in spinal pain, the reliability of history and physical examination in identifying the source of pain remains uncertain. An accurate diagnosis is essential to provide the most effective treatment for the individual patient.

Multiple studies and systematic reviews have evaluated the validity and utility of non-invasive assessments, including history, physical examination, and imaging studies (13,532,534-542). The validity and reliability of history-taking and physical examination in clinical practice continue to be debated (415,535,543-545). Nevertheless, clinicians routinely rely on information obtained from history-taking and physical examination to determine the need for additional diagnostic testing, including imaging studies. Numerous investigators have attempted to establish diagnostic clinical criteria for facet joint pain as a source of axial spinal pain. Consequently, multiple publications have identified patient history and physical examination findings suggestive of facet joint-related pain. These findings include unilateral or bilateral axial spinal pain associated with pain in the shoulder, buttock, hip, posterior thigh, or paravertebral thoracic region (546), pseudoradicular pain (547), morning stiffness (548), pain exacerbated by extension and rotation (537,538,548-550), negative neurological examination findings (546,551,552), and normal gait (553). However, the sensitivity and specificity of these criteria are low. Regardless, history and physical examination remain fundamental in screening patients with low back pain (554). Although they cannot definitively establish facet joint pain as the specific source of pain, they may raise clinical suspicion for the diagnosis (537,538,554).

In a systematic review of the literature and pilot study assessing a clinical diagnostic scale for lumbar facet joint pain (538), the investigators incorporated 6 phases and evaluated a total of 36 signs and symptoms for the diagnosis of lumbar facet joint pain, which were subsequently reviewed by a panel of experts. Ultimately, 12 items, including 8 symptoms and 4 signs, were included in the final survey instrument. They also performed diagnostic facet blocks in 31 patients, predominantly women, with an average age of 60 ± 11.5 years, demonstrating a reduction in pain scores from 8/10 preoperatively to 1.7/10 postoperatively. The symptoms most frequently included in the diagnostic scale were: 1) unilateral or bilateral axial lumbar pain; 2) improvement with rest; and 3) absence of a nerve root pain pattern. Although pseudoradicular pain may occur, lumbar pain predominated over leg pain. The clinical signs included Kemp sign, also referred to as Kemp's test (540,555), Quadrant Test (540,556), Extension-Rotation test (538,557), and Facet Stress Sign or Acevedo Sign (538), named after the author who described it (538,541). All descriptors were well recognized except the Facet Stress Sign, which involved positioning the patient supine, elevating the lower extremity as in a straight leg raise, lowering it against resistance applied by the examiner at the foot level, abruptly releasing the resistance before the leg touched the examination table, and then quickly supporting the leg again to prevent impact against the table. The test was considered positive if pain was reproduced on the same side as the suspected facet joints. The authors reported a diagnostic sensitivity of 70.3%, specificity of 50%, positive predictive value of 90.4%, negative predictive value of 20%, and overall diagnostic accuracy of 67.7%. The proposed diagnostic scale demonstrated positive signs and symptoms both in the general population (n = 28) and in patients with positive diagnostic blocks.

Custers et al (558) described diagnostic criteria in a narrative review and reported that Kemp's test is a specific maneuver intended to reproduce pain originating from lumbar facet joints through combined extension and rotation. The test is considered positive when pain is reproduced ipsilateral to the direction of rotation (559,560). However, Kemp's test demonstrated variable

sensitivity ranging from 0.23 to 1.0, indicating poor performance in identifying true positives. Specificity ranged from 0.116 to 0.673, which was considered moderate and suggested limited clinical utility because the test neither reliably confirms nor excludes the condition (540).

Revel et al (549,561), in 1972, proposed a general criterion consisting of 7 clinical signs, with the presence of 5 of 7 signs during patient evaluation predicting an adequate response to lumbar facet joint blocks with a sensitivity of 92% and specificity of 80%. Laslett et al (562) subsequently evaluated Revel's criteria as a screening tool. Their results failed to replicate Revel's findings. Sensitivity was low at less than 17%, whereas specificity was high at approximately 90%. Absence of pain with coughing or sneezing reached significance in only one predictive model. They concluded that Revel's criteria were unsuitable as a clinical screening tool for selecting chronic low back pain patients for facet joint blocks (562). Laslett et al (563) later attempted to refine clinical prediction rules. Utilizing a double-block paradigm with varying durations of pain relief and a cutoff value of less than 90%, they found that no clinical findings predicted a positive response to facet joint injections. However, with a cutoff value of 95%, predictors of facet joint pain included a negative Extension Rotation test, absence of pain centralization, age greater than 50 years, pain relief with walking, pain relief with sitting, paraspinal onset of pain, and Modified Somatic Perceptions Questionnaire scores suggestive of somatization. In another investigation, Young et al (564) were unable to identify clinical characteristics associated with a positive response to intraarticular facet joint injections except for absence of pain provocation when rising from a seated position and absence of pain centralization, although they identified predictive factors for sacroiliac joint and lumbar discogenic pain. Manchikanti et al (565) assessed the inability of the clinical presentation to accurately characterize facet joint pain in 200 patients and concluded that history, clinical findings, and radiologic features were not useful in establishing the diagnosis of facet joint pain with certainty. Specifically evaluating Revel's criteria (549), they were unable to identify any combination of tests with statistical significance.

Manchikanti et al (566) also evaluated correlations between nonphysiological behavior and chronic low back pain. Historically, reliance on Waddell's signs and symptoms led to assumptions that patients with positive findings exaggerated pain or malingered (566-570). Manchikanti et al (566) demonstrated that among 120 patients with chronic low back pain, 22% exhibited nonphysiological symptoms, 28% demonstrated nonphysiological signs, and 16% demonstrated both. They identified significant correlations between nonphysiological signs and diagnoses of depression, anxiety, and somatization. Nonphysiological symptoms were correlated only with elevated anxiety and somatization scores. Cohen et al (567), in a prospective observational study of 53 patients, demonstrated that fewer Waddell's signs were associated with better outcomes following radiofrequency denervation.

Numerous investigators have evaluated individual signs and symptoms for diagnosing facet joint pain, including Kemp's Sign (540,555-557), spinal percussion test (540), spring test, segmental rotation test, and Acevedo Test (538,540,571). However, none proposed a definitive diagnostic scale. In a systematic review, Maas et al (542) concluded that no diagnostic scale with adequate performance was available and that patient history and physical examination could only serve as cautious guides to diagnosis. Hancock et al (535) evaluated Revel's criteria and discussed conflicting findings reported by other investigators. In a subsequent systematic review by Han et al (415), with Hancock as second author, no major differences from the earlier publication were identified (535).

Schwarzer et al (433), in a prospective study involving 176 patients with chronic low back pain evaluated with comparative local anesthetic injections or medial branch blocks, were unable to identify any of 16 physical signs or symptoms associated with positive responses. In another study, Schwarzer et al (439) reported that none of the historical features or clinical tests distinguished patients diagnosed with facet joint pain from those with negative diagnostic blocks. DePalma et al (572), in a retrospective assessment of axial pain, identified that paramedian pain significantly increased the likelihood of sacroiliac joint or facet joint pain confirmed by diagnostic blocks. In another study, DePalma et al (573) demonstrated that older age and higher BMI were more likely to be associated with facet joint pain than with internal disc disruption or sacroiliac joint pain.

Similar to low back pain, although less frequently studied, clinical diagnostic tests have also been described for cervical facet joint pain (419,422,533,574-580). No comparable descriptions are available for the thoracic spine. Usunier et al (574) conducted a systematic review and meta-analysis comparing clinical diag-

nostic tests with medial branch blocks in adults with persistent cervical zygapophysial joint pain. Four clinical tests were identified in the 7 studies included in the review and meta-analysis (419,422,533,575). Two tests had sufficient data and at least 2 independent cohorts permitting statistical pooling (533,575-577). These tests included passive intersegmental motion testing (533,575-577), mechanical sensitivity testing (576,577), cervical zygapophysial joint pain patterns (419,422,577), and the extension-rotation test (577). Aprill et al (422) and Dwyer et al (419) evaluated the diagnostic utility of cervical facet joint referral patterns or pain maps. They demonstrated strong agreement between pain maps and localization of cervical facet joints, with 9 of 10 patients exhibiting cervical zygapophysial joint pain confirmed by medial branch blocks at the predicted spinal segments (422). Speldewinde et al (577) reported in a retrospective audit that 36% of patients with cervical facet joint pain were correctly identified at the appropriate segment using the pain maps described by Dwyer et al (419). However, neither study provided sufficient information regarding false-positive, false-negative, or true-negative findings to allow statistical pooling, and the reviewers were unable to obtain this information from the original authors (574). Schneider et al (578) described an extension-rotation test in 125 patients not reported in other primary studies included in the review. They reported a sensitivity of 0.83 and specificity of 0.59. Additionally, local tenderness was investigated in cervical zygapophysial joint pain. In that evaluation, 33 patients with chronic unilateral neck pain underwent pressure pain threshold (PPT) assessment at all cervical zygapophysial joints. Diagnostic facet joint nerve blocks confirmed the diagnosis of zygapophysial joint pain. The results demonstrated zygapophysial joint pain in 14 patients; however, differences in mean PPTs between the affected and contralateral sides were not statistically significant. The investigators concluded that assessment of mechanical pain sensitivity is not diagnostic for cervical facet joint pain.

In 2021, Anarte-Lazo et al (544) published a systematic review and meta-analysis evaluating physical examination findings that differentiate migraine from cervicogenic headache. The review included 61 studies in the qualitative analysis and 41 studies in the meta-analysis. The results demonstrated reduced cervical range of motion and reduced rotation during the flexion-rotation test in patients with cervicogenic headache compared with migraine patients; however, no differences were identified for other movements. They also reported reduced neck flexion strength in cervicogenic headache patients, whereas neck extension strength did not differ across headache subtypes. These findings contradicted conventional assumptions that facet joint pain is exacerbated primarily by extension and rotation.

Multiple guidelines from ASIPP (1,15,45,65,66,123,383,385,387-390), the International Spine Intervention Society (ISIS) (411), and consensus guidelines from multiple societies (12-14) have been unable to provide definitive conclusions regarding clinical diagnosis of facet joint pain.

Thus, conventional clinical findings are unreliable for diagnosing zygapophysial (facet) joint pain. The distinguishing characteristics of somatic or referred pain secondary to facet joints and radicular pain secondary to disc pathology are described in Table 6. Figure 13 illustrates pain patterns associated with facet joint pain that may resemble discogenic pain and/or disc herniation. Consequently, no definitive physical examination finding or historical feature can reliably diagnose facet joint pain or predict response to facet joint blocks in patients with chronic low back pain. However, pain that is not predominantly midline and tenderness overlying the facet joints appear to be weakly associated with positive responses to facet joint interventions. Overall, based on numerous studies, somatic or axial pain associated with paravertebral tenderness, worsened by extension, and accompanied by negative neurological signs and symptoms appears to support proceeding with diagnostic facet joint nerve blocks.

Table 7 shows the findings of literature reviews of studies on the clinical examination of the cervical and lumbar spine (422,433,533,549-551,561,562,564,572,575,581-583).

6.2 Imaging for Diagnosis of Facet Joint Pain

The facet (zygapophyseal) joints are the only synovial-lined joints of the spine. They constitute a major component of the posterior spinal column. These joints are diarthrodial, containing opposing articular cartilage surfaces which, together with lubrication produced by the connective tissue synovium, create a low-friction environment within the joint (584). The synovium lines the ligamentous, crimped fibrous capsule that connects the superior facet of the lower vertebral body to the inferior facet of the vertebral body above. The capsular ligaments extend between the laminae and connect to the ligamenta flava, surrounding the articular surfaces. An exception exists in the thoracic spine, where the fi-

Table 6. *Features of somatic and radicular pain.*

	Axial (Somatic) or Referred Pain	Radicular Pain
Segment Causes	Posterior segment or element	Anterior segment
	Facet joint pain	Disc herniation, degenerative disc disease
	Sacroiliac joint pain	Annular tear, discogenic pain
	Myofascial syndrome	Spinal stenosis
	Internal disc disruption/discogenic pain/central foraminal stenosis	Post laminectomy syndrome
Symptoms		
Quality	Dull, aching, deep	Sharp, shooting, superficial, lancinating
	Like an expanding pressure	Like an electric shock
	Poorly localized	Well localized
	Covers a wide area	Well defined
	Axial pain or headache worse than extremity pain	Extremity pain worse than axial pain
	No paranesthesia	Paranesthesia
	No radicular pain or shooting pain	Radicular distribution
Modification	Worse with extension	Worse with flexion
	Better with flexion Better with rest	Better with extension May or may not improve with rest
	No radicular pattern	Radicular pattern
Radiation	Low back to hip, thigh, groin	Follows nerve distribution
	Radiation below elbow or knee unusual	Radiation below elbow or knee common
	Quasi segmental	Radicular pattern
Signs		
Tenderness to Deep Palpation	Moderate to severe paravertebral or midline and paravertebral	Moderate to severe midline and mild paravertebral or midline only
Sensory Alteration	Uncommon – only subjective	Probable - common
Motor Changes	Only subjective weakness	Objective weakness
	Atrophy rare	Atrophy possibly present
Reflex Changes	None	Commonly described, but seen only occasionally
Straight Leg Raises	Only low back pain	Reproduction of leg pain
	No lumbar root tension signs	Positive root tension signs
Spurling Test	Neck pain only	Reproduction of radicular pain
	No cervical root signs	Positive Spurling test

brous capsule covers only the posterolateral portion of the joint. The capsule is approximately 1 mm thick and is thickest posteriorly, where it lies in close association with the multifidus muscle. Joint volume is approximately 1 to 2 mL (585).

The capsular ligaments resist tensile forces across the joint, whereas uncrimping of these ligaments decreases mechanical resistance. The facet joints are situated between the pedicle and lamina of the vertebra and form part of the motion segment composed of 2 adjacent vertebral bodies, the intervertebral disc, and 2 facet joints (586) (Fig. 14). The thickened portion of the lamina connects the superior and inferior articular processes, known as the pars interarticularis. Acting as articular pillars, the facet joints provide structural stability and support, transfer compressive loads, and both guide and constrain spinal movement according to the orientation of the facet articulation plane (585). For example, because thoracic facet joints have a coronal orientation, they facilitate rotation while limiting extension. In contrast, lumbar facet joints, which possess a sagittal-oblique orientation, permit flexion and extension while limiting rotation (Fig. 15).

The facet joints receive dual innervation from the medial branches of the dorsal rami. They are richly innervated with mechanoreceptive, proprioceptive, and

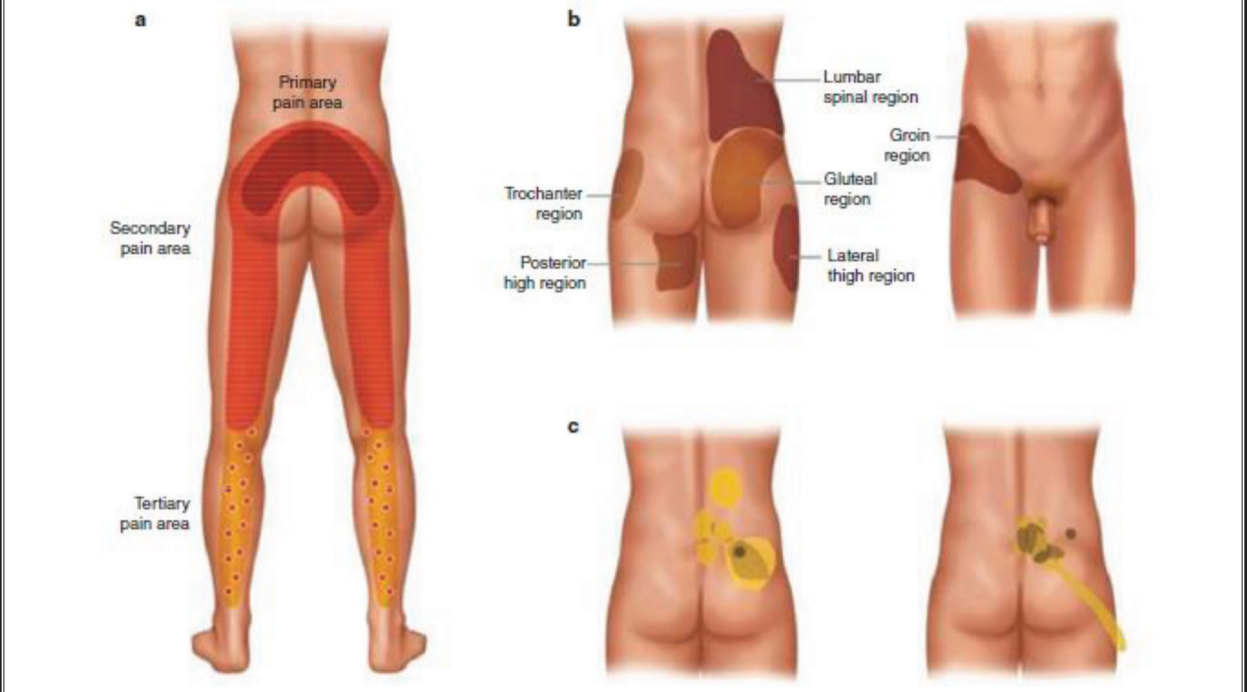


Fig. 13A. *Patterns of lumbar facet joint pain based on descriptions of multiple authors (392-397).*
(a) Illustration of the distribution of lumbar facet joint pain. (b) Referred pain distribution. (c) Composite drawing of the referral zones of all eight subjects derived from the minimal threshold stimulation of their right L3 (left) and right L4 (right) medial branches
Source: Manchikanti L, Schultz DM, Falco FJE, Singh V. Lumbar facet joint interventions. In: Manchikanti L, Singh V, Falco FJE, Kaye AD, Soin A, Hirsch JA (eds). Essentials of Interventional Techniques in Managing Chronic Pain, 2nd ed. Springer Nature Switzerland, 2024, pp 437-458 (391).

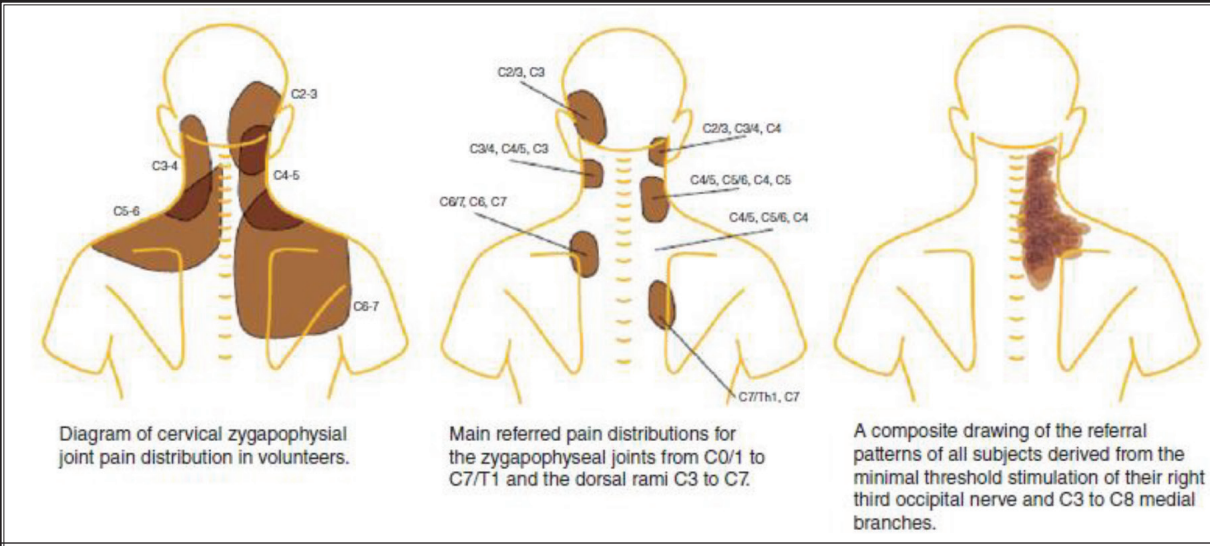


Fig. 13B. *Referral patterns for cervical facet joint pains, as described by various investigators (418-420).*
Reprinted with permission from: Manchikanti L, Schultz DM, Falco FJE, Singh V. Cervical facet joint interventions. In: Manchikanti L, Singh V, Falco FJE, Kaye AD, Soin A, Hirsch JA (eds). Essentials of Interventional Techniques in Managing Chronic Pain, 2nd ed. Springer Nature Switzerland, 2024, pp 477-504 (430).

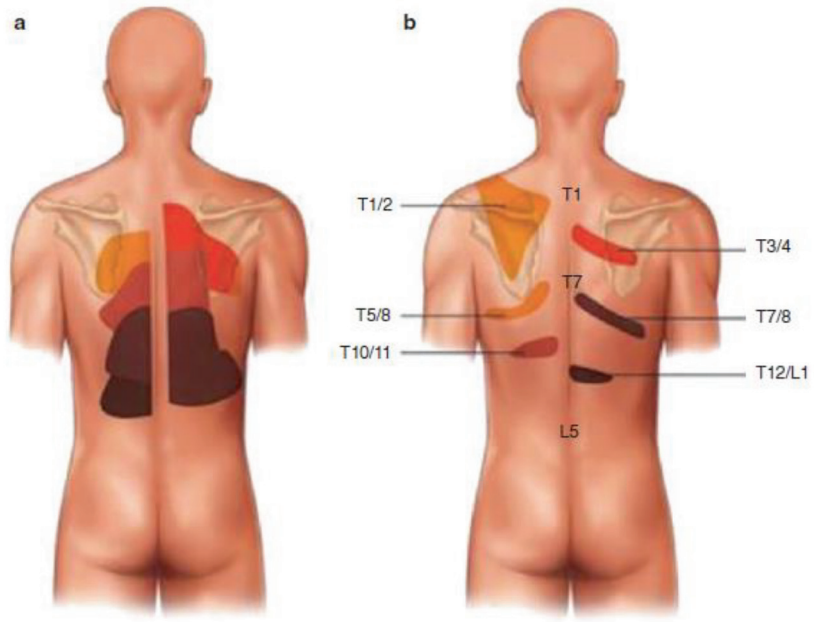


Fig. 13C. *Thoracic facet joint referral pain patterns.*
(a) Adapted from Fukui et al (425).
(b) Adapted from Dreyfus et al (426)
Reprinted with permission from: Manchikanti L, Schultz DM, Falco FJE. Thoracic facet joint interventions. In: Manchikanti L, Singh V, Falco FJE, Kaye AD, Soin A, Hirsch JA (eds). Essentials of Interventional Techniques in Managing Chronic Pain, 2nd ed. Springer Nature Switzerland, 2024, pp 459-476 (429).

nociceptive nerve fibers supplying the capsule, subchondral bone, synovium, and synovial folds (391). Consequently, it is understandable that facet joints represent one of the many potential spinal pain generators.

Imaging plays an important role in identifying the etiology of facet joint pain, the most common cause of which is facet joint degeneration, frequently accompanied by intervertebral disc degeneration. These degenerative processes may affect the bony pillars, capsular ligaments, synovium, and cartilage. As cartilage degradation progresses, characteristic features of facet joint osteoarthritis develop. However, facet tropism, inflammation, infection, trauma or injury, crystalline disorders, and neoplastic processes may also involve the facet joints.

Arthritis or facet degeneration is commonly identified on multiple imaging modalities and should be considered only a potential cause of low back pain (587-596). It has been demonstrated that plain oblique radiography has a sensitivity of 55% and specificity of 69% in distinguishing the presence or absence of degenerative disease confirmed by facet joint nerve blocks in 50 consecutive patients with low back pain (588). However, oblique radiography demonstrated greater specificity (94%) in distinguishing absent or mild disease from moderate or severe disease, although sensitivity was substantially lower at 23%. Interobserver agreement among radiologists interpreting plain radiographs was 57%, with a discrepancy rate of 43% (588). CT scans in patients with facet arthritis demonstrated a kappa value of 0.4, indicating perfect agreement in 63% of cases and disagreement in 27% (589). Both CT and MRI are considered valid modalities for detecting facet degeneration (589). Facet joint arthritis has been classified into 4 grades according to imaging findings (588,589), as shown in Table 8. However, patients with Grade 2 and 3 facet degeneration may not experience low back pain, whereas patients with Grade 0 and 1 degeneration may present with facet joint pain. Consequently, no consistent correlation exists between imaging findings on CT, MRI, or plain radiographs and the presence or absence of facet joint pain (590). Schwarzer et al (435) evaluated the ability of CT to identify painful zygapophysial joints in patients with chronic low back pain. In 63 patients undergoing CT imaging and diagnostic zygapophysial joint blocks at 3 spinal levels, no correlation was identified between CT findings and pain originating from the zygapophysial joints. They concluded that CT has no role in diagnosing lumbar zygapophysial joint pain.

Despite the multiple discordant opinions described above, Bogduk and MacVicar (459), in a 2024 scoping review that included 11 population studies, 4 diagnostic studies, and 3 case-control studies, reported that no positive association was identified between facet joint osteoarthritis and pain. All included studies demonstrated that pain was independent of the presence or severity of osteoarthritis. Furthermore, osteoarthritis

Table 7. *Literature review of studies on clinical examination of the diagnosis of facet joint pain.*

STUDY	DESIGN	POPULATION/ CONTROL	RESULTS
CERVICAL SPINE			
DIAGNOSTIC BLOCKS			
Jull et al, 1988 (575)	Prospective observational study	20	Positive correlation between manual medical examination and symptomatic level
Aprill et al, 1990 (422)	Prospective observational study	10	Pain maps helpful for identification of symptomatic level
Lord et al, 1994 (581)	Prospective observational study	100	Positive correlation between muscle tension and symptomatic level
King et al, 2007 (533)	Observational study, consecutive patients	173	Poor specificity for the clinical examination
LUMBAR SPINE			
Fairbank et al, 1981 (582)	Prospective observational study	25	Better response to an intra-articular block with a negative straight leg test
Lewinnek & Warfield, 1986 (551)	Retrospective observational study	21	No correlation between response to an intra-articular block and the clinical examination
Helbig & Lee, 1988 (550)	Retrospective observational study	22	Better response to an intra-articular block with muscle tenderness
Revel et al, 1992 (561)	Prospective observational study	40	Responders to a facet joint block often had an age greater than 65 years, pain that was not exacerbated by coughing, not worsened by hyperextension, not worsened by forward flexion, not worsened when rising from flexion, not worsened by extension rotation, and well relieved by recumbency
Schwarzer et al, 1994 (433)	Prospective observational study	176	No correlation of the results of test blocks with a clinical examination
Revel et al, 1998 (549)	Placebo-controlled, randomized study	43	Sensitivity 92%, specificity 80% for the presence of facet joint pain if at least 5 of criteria were present (pain that was not exacerbated by coughing, not worsened by hyperextension, not worsened by forward flexion, not worsened when rising from flexion, not worsened by extension rotation, and well relieved by recumbency)
Manchikanti et al, 1999 (583)	Prospective observational study	120	The criteria of Revel were not confirmed
Young et al, 2003 (564)	Prospective observational study	23	Positive correlation between facet joint pain and examination when there was no pain when standing up from a sitting position and a negative correlation for centralizing pain
Laslett et al, 2004 (562)	Prospective observational study	116	The criteria of Revel were not confirmed
DePalma et al, 2011 (572)	Retrospective Chart review	52	Positive correlation between facet joint pain and examination with paraspinal pain, negative correlation with lack of muscle hardening

was found to be equally prevalent in subjects without pain and in those with pain. Consequently, the null hypothesis was not refuted. They concluded that the published evidence does not support the belief that osteoarthritis causes facet joint pain. In fact, the available evidence contradicts that belief.

6.2.1 Computed Tomography (CT)

Computed tomography can be utilized for image guidance and provides excellent osseous evaluation. In osteoarthritis, CT demonstrates joint space narrowing, marginal osteophytes, hypertrophic changes, subchondral sclerosis, subchondral cystic changes, malalignment/spondylolisthesis, joint vacuum phenomena, osseous loose bodies, and joint effusions. In the spine, CT clearly demonstrates neural foraminal narrowing, but poorly identifies the nerve root and, although nerve root compression may be implied, it cannot be identified as accurately as with MRI.

Inflammation and infection may produce cortical

loss with bone erosion, soft tissue changes including edema, chronic calcification, mineralized joint loose bodies, and ligamentous thickening, indistinctness, and chronic calcification.

In trauma, CT facilitates fracture identification, including subtle and non-displaced fractures, morphologic changes such as accompanying vertebral compression fractures, malalignment/spondylolisthesis, and spondylolysis, as well as fragmentation.

In neoplastic disease, CT demonstrates osteoblastic and/or osteolytic changes and tumoral calcinosis.

6.2.2 Magnetic Resonance Imaging (MRI)

Magnetic resonance imaging can be used for image guidance; however, it requires MRI-compatible devices and equipment. Advantages of MRI include the absence of radiation exposure, reduced metal artifact through the use of specialized sequences and optimized imaging parameters that minimize magnetic field distortion, signal loss, and geometric distortion, as well as excellent soft-tissue characterization.

In osteoarthritis, MRI identifies articular cartilage thinning and/or defects and demonstrates subchondral reactive marrow changes (bone marrow edema), synovitis, fibrin loose bodies, subchondral cysts, synovial cysts, malalignment/spondylolisthesis, hypertrophic changes (osseous and ligamentous), neural foraminal narrowing with nerve root compromise, and paraspinal muscle involvement.

With inflammation and infection, MRI identifies soft-tissue edema, phlegmon, abscess formation, synovitis, myositis, gas formation, enthesitis, and osteomyelitis. These features are enhanced and differentiated with the use of MRI contrast agents.

With trauma/injury, MRI demonstrates morpho-

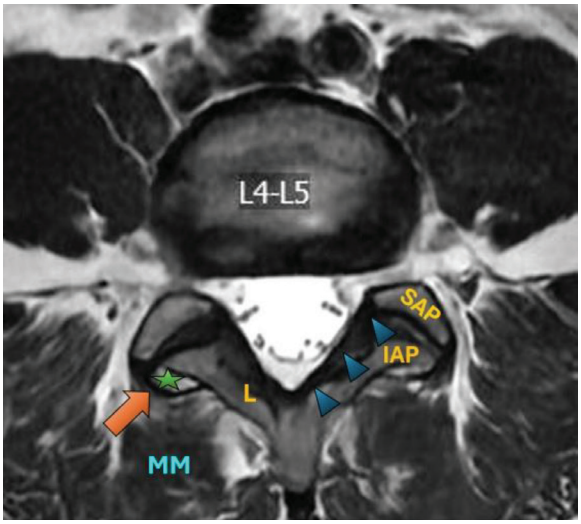


Fig. 14. *Normal L4-L5 facets.*
Normal joint space width. No effusion. No osseous hypertrophy. Normal thickness of the Ligamenta Flava (blue arrowheads). A normal posterior inferior recess can be seen adjacent to the IAP (green star). The joint capsule is slightly thickened (orange arrow) where it abuts the Multifidus Muscle (MM). Normal marrow signal. No spinal canal stenosis.
Superior Articular Process (SAP), Inferior Articular Process (IAP), Lamina (L)

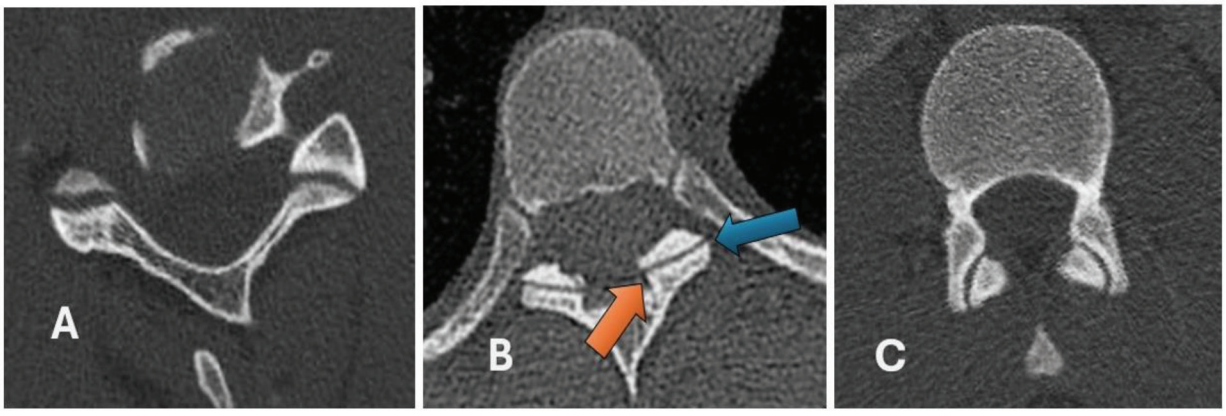


Fig. 15. *Facet joint (FJ) anatomy and orientation (A ,B, C).*
Axial CT images of the cervical (A), thoracic (B), and lumbar (C) facets. Cervical FJs have a transverse orientation. Thoracic FJs also have a transverse orientation but with an anterior inclination, where the lateral margin of the JF (blue arrow) is anterior to the medial margin (orange arrow). Lower lumbar FJs angle laterally.

Table 8. *Grading of facet joint arthritis based on the imaging tests*.

Grade 0	Normal
Grade 1	Mild degenerative disease: joint space narrowing less than 2 mm and/or small osteophytes and/or mild hypertrophy of the articular process.
Grade 2	Moderate degenerative disease: joint space narrowing (<1 mm) and/or moderate osteophytes and/or moderate hypertrophy of the articular process and/or mild subarticular bone erosions.
Grade 3	Severe degenerative disease: narrowing of the facet joint space and/or large osteophytes and/or severe hypertrophy of the articular process and/or severe subarticular bone erosions and/or subchondral cysts and/or vacuum phenomenon

Source: de Andrés Ares J, Gilsanz F. Diagnostic nerve blocks in the management of low back pain secondary to facet joint syndrome. *Rev Esp Anestesiol Reanim* 2019; 66:213-221 (537).

logic changes, including accompanying vertebral compression fractures, and assists in determining timing, including acute versus chronic changes, BME, and early stress response, including early pars interarticularis fractures. MRI clearly depicts soft-tissue edema and hemorrhage. With contrast-enhanced vascular phase imaging, vascular trauma, including extravasation and thrombosis, can also be visualized. Because of the low signal produced by bony callus, healed nondisplaced fractures, including some pars interarticularis defects, may be difficult to identify on MRI.

In neoplastic disease, MRI provides soft-tissue characterization of the mass, including enhancement characteristics, necrosis or calcification, the presence of satellite or metastatic deposits, vascular invasion, and nonmicroscopic tumoral infiltration and mass effect on adjacent tissues.

Unless contraindicated, contrast should be administered in cases of infection and neoplastic disease. Contrast may also be beneficial in inflammatory conditions.

Facet arthropathy may be secondary to an inflammatory process, for which various grading systems have been proposed to assess the presence and severity of inflammatory features, including the degree of facet joint effusion, capsulitis, BME, soft-tissue edema, and areas of enhancement (597). Patients with more severe facet morphologic changes have been reported to be more likely to respond to intraarticular facet joint injections or medial branch blocks than patients with less severe morphologic changes (587,598,599). In an assessment of facet joint inflammation in lumbar spine MRI studies of patients with low back pain, Acosta Julbe et al. (597) evaluated 49 subjects with prior facet-related interventions, including medial branch blocks or intraarticular facet joint injections, and reviewed lumbar spine MRI studies available in the medical records. The authors identified inflammatory markers mentioned in the radiology reports and calculated the sensitivity and positive predictive value of the radiology reports compared with a gold standard published facet joint inflammation grading system. The results demonstrated that, compared with the gold standard grading system, the sensitivity of radiology reports for facet joint effusion, BME, and soft-tissue edema ranged from 6% to 22%, whereas the positive predictive value ranged from 25% to 100%. Among the facet joints, L4/5 had the highest number of cases with inflammatory features identified in the reports. The authors concluded that inflammatory findings, such as facet joint effusion, BME, and soft-tissue edema, are not commonly identified in radiology reports. Consequently, further investigations are needed to determine the clinical significance of MRI-detected lumbar facet joint inflammatory features as a potential mechanism of nociception and a predictor of outcomes following injections or other therapies. Interventional pain physicians should evaluate MRI studies for inflammatory features and request that these findings be specifically included in MRI reports.

6.2.3 Ultrasound

Ultrasound may be utilized for image guidance with the advantage of avoiding radiation exposure. US provides detailed soft-tissue evaluation, including assessment of normal soft-tissue anatomy and differentiation of normal versus abnormal soft-tissue characteristics (e.g., muscle atrophy/hypertrophy, joint effusion/synovitis, cartilage thickness/defects, hypervascularity [with the use of color flow], soft-tissue edema, and soft-tissue mass characteristics including calcification), in addition to evaluation of tendon/ligamentous degeneration or tears. Ultrasound readily identifies normal and abnormal vascular structures. Evaluation of vascular structures with US should include color flow and/or power doppler imaging together with duplex doppler assessment.

Ultrasound provides limited osseous detail because US beam penetration is restricted by cortical thickness. Ultrasound can identify and provide limited evaluation of the joint space, which is improved in the presence of increased joint fluid. US may also demonstrate superficial osseous erosions, osteophytes, superficial cortical disruption/fracture, cartilaginous and mineralized loose bodies, as well as foreign bodies, including radiolucent foreign bodies.

6.2.4 X-ray and Fluoroscopy

Fluoroscopy is utilized for image guidance, providing good (fluoroscopy) to excellent (X-ray/radiographs) visualization of osseous anatomy and identifying all of the osseous changes described under CT, although it is limited in detecting subtle detail due to bone and soft-tissue overlap. Estimation of the degree of facet degeneration may be difficult. Unlike CT imaging, there is no beam hardening or streak artifact from metal; however, x-rays cannot penetrate solid metal hardware or foreign bodies. The use of IV contrast during active fluoroscopic imaging or with digital subtraction angiography provides excellent visualization of vascular structures.

6.2.5 Nuclear Medicine

6.2.5.1 Single Photon Emission Computed Tomography/CT (SPECT/CT)

More sensitive than single-plane bone scan or x-rays for inflammation/infection localization, SPECT/CT provides metabolic, functional, and anatomic information, and assesses hypermetabolism with osteoblastic/osteogenic activity (inflammation, infection, blastic neoplasm, fractures including insufficiency and stress). Its rate of infection/inflammation localization within the cervical spine is 92% and within the lumbar spine is 86%. Although SPECT/CT does expose patients to radiation, it provides high spatial resolution, assesses incident timing (acute vs chronic) with detection accuracy within 72 hours, remains positive up to one year, and can detect malalignment/spondylolisthesis due to its 3-dimensional imaging ability. Further, increased tracer uptake on SPECT/CT improves the likelihood of a therapeutic response, while post-treatment imaging provides information on the patient's therapeutic response, which is especially useful in cases of multiple pain generators. SPECT/CT may be used post-operatively for infection/inflammation. Although it is affected by metal artifact due to the CT component, the combination of SPECT and CT is less sensitive to metal artifact than MRI. Finally, there is a lack of high correlation with facet disease, but it is scintigraphically positive in 69%, which may still help direct therapy (600).

6.2.5.2 Positron Emission Tomography (PET)/CT and PET/MR (Reduced Availability)

PET/CT and PET/MRI scans still expose patients to radiation. Both utilize a radioactive tracer injected into the body (nuclear medicine portion), although PET/MRI significantly reduces the total radiation exposure by eliminating the CT component, offering approximately 50% less radiation exposure than traditional PET/CT. Tumor, infection, and active inflammation all have high metabolic activity and an avidity for 18F-FDG (most often used clinically), making it most commonly utilized for tumor identification.

6.2.5.3 Single Photon Emission Computed Tomography (SPECT)

Investigators were prompted to consider more complex imaging tests, such as scintigraphy; however, the tests yielded contradictory results for the diagnosis of low back pain (590,591,596). The most widely investigated imaging modality for detecting potentially painful facet joints is single-photon emission computed tomography (SPECT). This nuclear medicine imaging technique involves intravenous administration of a gamma-emitting radioisotope, which produces greater radiation exposure than conventional radiography. SPECT has been considered one of the most reliable tests for facet joint pathology, as the quantity of emissions detected from the radionuclide provides a measure of biological activity, identifying active inflammation involving the facet and other joints. While scintigraphy is a similar technique requiring the administration of a gamma-emitting radioisotope and the use of external detectors, it produces only 2D images, unlike SPECT, which produces 3D images. Multiple studies in the past have used SPECT, scintigraphy, or CT to conduct controlled diagnostic blocks, reporting mixed results regarding their correlation and predictive value (435,587,590-596,601,602).

The role of SPECT has been evaluated extensively. A 2008 publication of a best-evidence review of diagnostic procedures for neck and back pain by Rubenstein and Van Tullder concluded that SPECT use in low back pain patients was not supported by empirical evidence (545). In a 2023 publication by Han et al (415) on the diagnostic accuracy of low back pain of disc, sacroiliac joint, or facet joint origin, the authors showed that facet joint uptake on SPECT was informative. They showed that 4 studies (590,593,595,603) investigated evidence of facet joint uptake on SPECT, and they were able to pool 3 of them (590,593,603). Pooling demonstrated informativeness; however, the evidence appears weak.

In a 2023 publication, Varga et al (604) performed a systematic review of SPECT imaging for the diagnosis and treatment of chronic neck or back pain caused by spinal degeneration. In this systematic review,

they identified 8 studies (590,591,595,596,605-608) that compared the effect of facet block intervention in SPECT-positive and SPECT-negative patients with cervicogenic headache, neck pain, and low back pain. They concluded that a positive SPECT finding in facet arthropathy was associated with a significantly greater facet blockade effect. However, they also cautioned that controlled studies have not confirmed this finding. Further, they hypothesized that SPECT/CT might be a useful method for evaluating patients with neck or back pain, especially in cases with unclear findings or multiple degenerative changes. Among the 8 studies, only one was properly performed by Freiermuth et al (590) and will be discussed below. The majority of the other studies used steroids in their intraarticular injections, which is not an approved modality.

In a study correlating SPECT/CT activity in cervical facet joints with a positive response to cervical medial branch blocks, Scholten et al (609) reported that 43 procedures were analyzed, and both concordant and discordant groups demonstrated improvement in NRS pain scores. Consequently, there was no significant association between concordance and a positive medial branch block at a 50% pain relief threshold.

Vega-Alvear et al (52) concluded that SPECT alone may help predict outcomes for facet interventions, especially intraarticular injections, since evidence for SPECT/CT remains inconclusive. This should be interpreted with caution, given the current study limitations.

SPECT was assessed with confirmatory medial branch blocks in at least 4 studies (590,594,595,601). In 2015, Freiermuth et al (590), in a randomized, double blind, placebo-controlled trial with inclusion of 29 patients with low back pain, performed SPECT scans on all patients, following which a pain clinician examined patients. Based on the results of the clinical examination, the patients received a series of 3 fluoroscopically guided medial branch blocks with 0.5 mL of lidocaine 2%, 0.5% bupivacaine, or a placebo injection of sodium chloride solution. The three substances were injected randomly, and the clinician was blinded to the injectate. They used 70% pain relief or a numeric pain rating less than 3 as a pain relief standard. The entire series of 3 blocks were considered negative if ≥ 50% pain reduction was reported following a placebo injection. Following completion of the first series of blocks, 24% (7 of 29) of patients had a positive response and 76% (22 of 29) had a negative response. Among individuals who had positive blocks, 4 of 7 had positive SPECT scans, with a sensitivity of 57%, and 17 of 22 had negative SPECT scans with a specificity of 77%. A second series of blocks was also performed in 6 patients, 2 of whom had a positive response. The authors concluded that SPECT should not be recommended as a first-line diagnostic tool prior to facet joint interventions.

The second RCT was by Jain et al (594), involving 80 patients. Forty patients were randomized to receive a SPECT scan prior to their diagnostic block. The group not receiving SPECT was solely based on clinical assessment. Facet joint blocks were performed utilizing 0.6 mL of a local anesthetic, with a positive block defined as ≥ 50% pain reduction 4 hours after the block was completed. In the SPECT scan group, 7 of 40 patients were diagnosed with facet arthropathy, while 14 of 40 patients in the control group had a similar diagnosis. In the SPECT scan group, 71% (5 of 7) had a positive facet joint nerve block compared to 43% (6 of 14) in the control group. Between the groups, response rate to facet joint blocks was statistically significant. Thus, this study is in favor of SPECT prior to performing diagnostic facet joint blocks.

In another observational study (595), the authors performed facet joint nerve blocks in 30 patients with chronic low back pain with and without facet joint positive SPECT findings. The primary outcome measure of pain relief was ≥ 50% pain reduction on VAS at weeks 2 and 4 following the facet joint nerve blocks. All facet joint nerve blocks were performed using US guidance, and the injectate consisted of 2 mL of lidocaine 1% and triamcinolone 30 mg. At week 2 follow-up, 85.7% (24 of 28) of patients in the SPECT-positive group reported ≥ 50% pain reduction compared with 20% in the SPECT-negative group. At 4-week follow-up, 78.6% in the SPECT-positive group reported ≥ 50% pain reduction compared with none in the SPECT-negative group. Overall, these results also appear to be positive. However, these were not performed for diagnostic purposes.

Facet joint intraarticular injections were also performed in 2 prospective, open-label studies. In the first study by Pneumaticos et al (596), 47 patients were randomized in a 2:1 ratio to receive a SPECT scan prior to fluoroscopically guided intraarticular facet joint injection or no scan prior to the intraarticular injection. Patients randomized to SPECT scanning were further categorized into positive and negative scans. The primary outcome measure was a change in pain scores at 1, 3, and 6 months following the injections. Fluoroscopically guided facet joint injections were performed with an injection of 2.5 mL of bupivacaine

0.5% and 0.5 mL of betamethasone, for a total dose of 3 mg. Change in pain scores was significantly greater in the SPECT-positive group compared with the SPECT-negative group and the group that had not undergone SPECT. The results were also statistically significant at 3 months. They speculated that SPECT was helpful in diagnosing facet joint pain and was cost effective. However, follow-up cost-effectiveness studies have not been conducted. Medicare reimbursement has been reduced from $2,191 to $1,865, inclusive of imaging costs as per the cost per patient.

In another study (595), 58 patients with a clinical diagnosis of facet joint pain received SPECT scans, with 22 showing facet joint positive scans and 36 with negative scans. Outcome measures were at 1-, 3-, and 6-months, including VAS pain scores, present pain intensity score, and the modified McGill Pain Questionnaire (MPQ). Fluoroscopically guided intraarticular injections consisted of 1 mL of lidocaine 1% and methylprednisolone 40 mg. At 1-month and 3-month follow-ups, the patients who were positive on SPECT showed significantly greater reductions of pain. This was also considered a positive study even though no diagnostic blocks were performed in these patients. Further, a group of authors (592) also compared intraarticular facet joint injections and facet joint nerve blocks with a 12-week follow-up in patients with chronic low back pain who had positive lumbar facet joint SPECT scans. The results of this study showed that at the 12-week follow-up, 61% of the patients experienced ≥ 50% pain reduction in the intraarticular group compared with 26% (6 of 23) in the facet joint nerve blocks group. They calculated the sensitivity and specificity of facet joint SPECT scan in the intraarticular group as 79% and 70%, respectively. In a prospective assessment, SPECT was assessed for sensitivity and specificity compared with plain scintigraphy for identifying patients likely to respond to intraarticular facet joint injections (593). In a study assessing facet joint pain in 43 patients, the sensitivity and specificity of scintigraphy for identifying intraarticular injection-confirmed facet joint pain was 71% and 76%, respectively, while the sensitivity and specificity for SPECT was 100% and 71%.

Perez-Roman et al (601) also assessed the use of SPECT for hypermetabolic facet identification in the diagnosis of cervical and axial low back pain. In this retrospective review of adult patients, 190 patients underwent high-resolution SPECT/CT imaging. A total of 85 patients (48%) demonstrated zygapophysial joint hypermetabolism on SPECT imaging. A total of 202 hypermetabolic facets were identified, indicating the average number of facets with facet joint pain was 2.38 ± 1.91. Of the patients with a positive scan, lumbar facets were most affected (69%), followed by cervical (24%) and thoracic regions (6%).

Romera et al (610) explored the usefulness of bone SPECT/CT for providing additional information to MRI in patients with axial pain, and for guiding the site of spinal injections. Overall, they studied 194 patients with axial pain. Patient outcomes after SPECT/CT-guided spinal injections were evaluated during clinical follow-up. The results showed that the response to spinal injections guided by SPECT/CT was assessed in 56 patients with facet joint arthropathy. Among these, 26 of 56 had a history of previous spinal injection guided by physical examination. In this group, the response was effective or partially effective in 65.4% of the patients and ineffective in 34.6%. After a second injection guided by SPECT/CT, the response rate increased to 88.4%, with only 11.6% remaining ineffective, resulting in an absolute benefit of 23.4%. In patients with no prior spinal injections, the injections were partially effective in 93.3%, while 6.7% did not show any improvement in pain. Overall, the conclusion was that bone SPECT/CT complements MRI by providing valuable information identifying pain generators. ASIPP guidelines showed variable evidence for imaging with Level III evidence for SPECT for identifying patients with painful lumbar facet joints and Level V evidence for scintigraphy, MRI, and CT for identifying painful facet joints. Cohen et al (13) showed moderate evidence for the use of SPECT/CT to identify painful lumbar facet joints prior to medial branch blocks. There is weak evidence for CT or MRI to identify a painful facet joint in the lumbar spine.

For the cervical spine, Hurley et al (12) concluded that current evidence would not be sufficient to weigh the harms and benefits of imaging regarding the success of a cervical facet block. However, imaging should be considered for planning. Imaging is required in relation to the detection of other essential diseases.

Klessinger et al (14) showed that there is insufficient evidence to diagnose symptomatic facet joints using x-ray, CT, MRI, SPECT, or PET alone. Further, diagnostic procedures have no predictive value regarding the results of diagnostic blocks, intraarticular, or medial branch blocks. In addition, diagnostic methods of imaging provide relevant information on different diagnostic diseases. Consequently, existing imaging should be considered along with history and clinical examination findings when deciding which levels to treat.

Benzon et al (11), in developing multisociety multispecialty consensus recommendations on corticosteroid injections for facet joint and sacroiliac joint pain, described the role of SPECT. They concluded that evidence of an inflammatory contribution to facet pain (acute injury, SPECT-positive) identifies patients who will likely benefit from intraarticular facet joint corticosteroid injection.

There are many options for imaging, but not all will produce the desired results. These guidelines have been written to optimize imaging decision-making in efforts to improve diagnostic accuracy and patient treatment outcomes.

Table 9 shows findings of the literature review of studies on imaging and diagnosis of facet joint pain (435,587,590-596,601,611-630).

6.3 Strength of Evidence and Recommendations

1. The **level of evidence is II** for selecting patients for facet joint nerve blocks at least 3 months after onset and failure of conservative management who have axial pain, tenderness over the facet joints, reduced range of motion and pain exacerbation with extension and lateral rotation, pain reduction with rest, and absence of a radicular pattern, with **strong strength of recommendation** for physical examination and assessment.
2. The **level of evidence is III** for accurate diagnosis of facet joint pain with physical examination based on symptoms and signs, with **strong strength of recommendation**.
3. The **level of evidence is I**, with **strong strength of recommendation**, for mandatory fluoroscopic or CT guidance for all facet joint interventions.
4. The **level of evidence is III** supporting the use of SPECT for identifying painful facet joints before diagnostic facet joint nerve blocks, with **weak strength of recommendation**.
5. The **level of evidence is V**, with **weak strength of recommendation**, for scintigraphy, MRI, and CT for identifying painful facet joints.

Table 9. *Literature review of studies on imaging in diagnosis of facet joint pain.*

STUDY	DESIGN	POPULATION/ CONTROL	RESULTS
X-RAY			
Heller et al, 1983 (611)	Retrospective case control study	653 case patients were referred for cervical spine x-ray. 365 control patients who were referred for barium studies received cervical spine x-rays	No correlation between degenerative changes and X-ray No significant difference in the presence of cervical spondylosis between groups. There were no significant associations between neck, arm, or occipital pain, and neck stiffness with x-ray findings Cervical spondylosis was positively correlated with age
Rudy et al, 2015 (612)	Retrospective cross-sectional study	322 patients with neck stiffness, shoulder pain, arm pain and/or headache attending chiropractic teaching clinics with cervical radiographs	Symptoms of neck pain, headaches, referral of pain to the shoulder, and upper extremity radiculopathy did not correlate with cervical facet joint degeneration Convenience sample with no asymptomatic comparison group. Small association between neck stiffness and facet hypertrophy
Van der Donk et al, 1991 (613)	Cross-sectional survey study	5440 volunteers 20-65 years of age enrolled in a national survey study stratified by presence of neck pain	Osteoarthritis of the facet joints noted on cervical radiographs was not associated with neck pain Mean age of participants was 46 years. Age was positively associated with neck pain
Gore et al, 1987 (614)	Retrospective	205 patients with neck pain >10 years duration	Presence or severity of pain was not associated with the presence of degenerative changes including facet arthropathy, sagittal diameter of the spinal canal, or degree of cervical lordosis on initial or final cervical x-ray 68 of 205 (33%) were involved in litigation. Mean age at onset of neck pain was 43 years; mean age at final evaluation was 58 years.
COMPUTED TOMOGRAPHY			
Schwarzer et al, 1995 (435)	Prospective cross-sectional study Single-blind, placebo-controlled trial designed to evaluate the effects of CT-confirmed facet osteoarthritis on IA facet joint injections	63 patients Median age 59 years (IQR 51-68) Female:male ratio 3:1 Median LBP duration 7 years (IQR 2-20)	No possibility to detect a painful facet joint or to predict the outcome of an infiltration 32% (95% CI 20 to 44) with ≥50%pain reduction at 3 hours following IA placebo injection 40% (95% CI 27 to 53) with ≥50%pain reduction at 3 hours following IA LA injection No significant group differences in CT joint scores based on patient response to IA placebo or IA LA injections CT not recommended in the diagnostic evaluation of facet pain
Tiwari et al, 2020 (615)	Cross-sectional	10 patients were referred for cervical spine CT for reasons unrelated to spinal pain	Facet joint arthritis on CT was negatively associated with patient-reported neck pain Subgroup analysis of only 10 pts
Kim et al, 2019 (616)	Retrospective	50 patients who received CT scans for non-spinal pathologies. Patients with neck pain were excluded	33.4% prevalence of asymptomatic cervical facet arthritis C6-7 joint was most likely to demonstrate arthritic changes with findings more common among older (≥40 years) pts

Table 9 cont. *Literature review of studies on imaging in diagnosis of facet joint pain.*

STUDY	DESIGN	POPULATION/ CONTROL	RESULTS
Rydman et al, 2019 (617)	Prospective longitudinal	121 patients present to the emergency department for neck pain after motor vehicle collision with a cervical CT scan performed at admission	Moderate facet joint degeneration, but not disc degeneration, was associated with persistent pain after 6 months Regions of mild and severe facet degeneration were not associated with recovery
Le Clec'h et al, 2016 (618)	Prospective observational	121 patients who underwent cervical IA facet injections based on MRI or CT imaging findings (91 patients) vs palpation for pain (30 patients)	A greater proportion of patients referred for injections based on pain palpation reported relief for up to 1 month Cervical facet joint injections were completed under CT guidance
Morishita et al, 2008 (619)	Retrospective	215 patients with degenerative disease of the cervical spine	Neck pain was more common among patients with hypertrophic changes in facet joints Did not control for confounding variables
Hechelhammer et al, 2007 (620)	Retrospective	37 patients who underwent 50 cervical IA facet joint injections	No statistically significant difference in pain relief from cervical facet joint blocks based on osteoarthritis grade IA injections performed under CT guidance. 56% of injections were peri-articular, 40% were peri- and IA, and 4% were IA
MAGNETIC RESONANCE IMAGING			
Stojanovic et al, 2010 (587)	Retrospective review of correlations between MRI and outcomes of MBB and RF denervation	127 consecutive patients Male=52% Mean age=52.9 years	Positive correlation between MRI and the result of medial branch blocks, but not with the result of RF denervation Facet joint degeneration or hypertrophy on MRI significantly correlated with ≥50%pain reduction following MBB but not RF. Younger patients significantly more likely to fail MBB but not RF Prospective studies recommended to confirm study findings.
Daimon et al, 2019 (621)	Prospective longitudinal	81 pts presenting immediately and 20 years after whiplash injury for MRI	Progression of degeneration on MRI was observed in 95% of subjects. Changes in neck pain severity was not associated with progression of degenerative changes on MRI C4-5 and C5-6 levels most frequently exhibited degeneration
Nevalainen et al, 2016 (622)	Retrospective	173 pts with MRI studies demonstrating cervical facet edema	Significant correlation between neck pain and/or unilateral radiculopathy and ipsilateral BME. No correlation between pain intensity and severity of edema 9% prevalence of cervical facet edema, most commonly at C3-4, C4-5, and C2-3. The study did not confirm the presence of facet-mediated pain through diagnostic blocks
Cohen et al, 2007 (623)	Retrospective, multicenter study examining factors associated with cervical medial branch RFA outcomes	92 pts who underwent cervical facet RFA after positive MBB 92 patients, 44 with significant facet pathology on MRI	The only clinical variable associated with positive response to cervical medial branch RFA was paraspinal tenderness Facet pathology was noted on cervical spine MRI in 48% of pts but was not predictive of treatment outcome 57% success rate in overall cohort, 52% in individuals with significant MRI pathology (p=0.75) Slightly higher success rate in the younger patients (i.e., with less facet joint pathology) treated at Walter Reed may have contributed to findings.

Table 9 cont. *Literature review of studies on imaging in diagnosis of facet joint pain.*

STUDY	DESIGN	POPULATION/ CONTROL	RESULTS
Cohen et al, 2007 (624)	Retrospective, multicenter study examining factors associated with lumbar medial branch RFA outcomes	192 patients, 117 with significant facet pathology on MRI	54% success rate in overall cohort, 52% in individuals with significant MRI pathology (p=0.75) Slightly higher success rate in the younger patients (i.e., with less facet joint pathology) treated at Walter Reed may have contributed to findings.
SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY/COMPUTED TOMOGRAPHY			
Dolan et al, 1996 (591)	Prospective comparison of IA facet joint injections between patients with SPECT (+) and SPECT (−) scans	SPECT (+) group=22 SPECT (−) group=36	Better outcomes of injections in SPECT/CT positive patients compared to SPECT/CT negative patients Significant improvement in VAS and McGill pain scores in SPECT (+) group at months 1 and 3 94% SPECT (+) group reported improvement at month 1 compared with 47% in SPECT (−) group No significant improvements evident at month 6 47% of SPECT (+) patients had osteoarthritic facet joints compared with 18% of SPECT (−) group.
Slipman et al, 1996 (625)	Prospective observational study	31/19	Sensitivity 13%, specificity 100% comparing the results of radionuclide bone scanning with intra-articular injections in the sacroiliac joint
Maigne et al, 1998 (626)	Prospective observational study	32/34	Sensitivity 46%, specificity 90% comparing the results of radionuclide bone scanning with intra-articular injections in the sacroiliac joint
Pneumaticos et al, 2006 (596)	Prospective comparison of IA facet joint injections between patients with SPECT (+) and SPECT (−) scans	SPECT (+) group=15 SPECT (−) group=16 No SPECT comparison group=16	Better outcomes of injections in SPECT/CT positive patients compared to SPECT/CT negative patients Significant improvement in pain at months 1 and 3 in SPECT (+) group vs SPECT (−) and no SPECT comparison groups Number of facet joints treated in SPECT (+) group reduced from 60 to 27 with cost savings of U.S. $326/patient No significant group differences at month 6.
Matar et al, 2013 (627)	Retrospective observational study	72 pts with clinically suspected facet joint-mediated neck and back pain and non-conclusive MRI/CT findings	Activity in SPECT/CT in 52% of the patients in the cervical spine, but a correlation with the clinical findings in only 12.5% (38% correlation in the lumbar spine) Among the 24 cervical SPECT-CT scans, 13 (52%) had evidence of active cervical facet joint arthropathy and 10 (36%) demonstrated other pathology No correlation with outcomes from IA facet joint blocks
Lehmann et al, 2014 (628)	Retrospective observational study	74 pts with SPECT/CT scan of the cervical spine who underwent IA facet joint injection or dual comparative MBB	No correlation of facet joint injections or medial branch blocks with SPECT/CT findings 18 pts received cervical IA facet joint injections and 1 received cervical MBB. 52 pts (70%) had at least one discrepancy between facet joint activity on SPECT/CT and clinical treatment 103 of 195 (53%) active facet joint(s) observed on SPECT/CT did not correlate with clinical findings

Table 9 cont. *Literature review of studies on imaging in diagnosis of facet joint pain.*

STUDY	DESIGN	POPULATION/ CONTROL	RESULTS
Jain et al, 2015 (594)	Randomized, double-blind, placebo-controlled trial to determine the sensitivity/ specificity of SPECT/CT to identify patients with facet joint pain prior to IA facet injections	SPECT/CT group=7 Control group (no SPECT)=14	Significantly more responders after a medial branch block or an intraarticular SI joint injection in the SPECT/CT positive group 71% with >50%pain reduction in SPECT/CT group vs 43% in the control group ($p<0.05$) immediately following MBB Included patients with chronic LBP. Most common diagnoses were sacroiliitis, followed by L4-5 and L5-S1 facet arthropathy.
Freiermuth et al, 2015 (590)	Randomized, double-blind, placebo-controlled trial to determine the sensitivity/ specificity of SPECT/CT to identify patients with facet joint pain prior to IA facet injections	29 patients (male=16, female=13) age range=38–83 years	Moderate sensitivity and specificity regarding the agreement between SPECT/CT and the result of placebo-controlled medial branch blocks SPECT/CT; sensitivity 0.57 (95% CI 0.18 to 0.90), specificity 0.77 (95% CI 0.55 to 0.92) Diagnostic accuracy=0.72 (ideal value 1.0) SPECT/CT not recommended as first-line diagnostic tool prior to IA facet joint injections
Nolan et al, 2022 (629)	Retrospective cohort study	89/23	Better outcomes of injections in SPECT/CT positive patients compared to SPECT/CT negative patients
Perez-Roman et al, 2020 (601)	Retrospective	190 pts with axial neck (n=25) or back pain underwent high-resolution SPECT/CT scan	A total of 202 hypermetabolic facet joints in 85 pts (48%) were identified. Lumbar facet joints were most commonly affected (69%), followed by cervical (24%) and thoracic regions (6%). C1-2 and C2-3 (22% each) were the most commonly affected in the neck. In the 37 pts who reported axial neck pain, 16 (43.2%) were found to have cervical facet hypermetabolism Diagnostic facet blocks were not performed. Injection techniques were not described
Holder et al, 1995 (593)	Prospective study designed to evaluate the sensitivity and specificity of PS or SPECT scans in identifying patients responsive to IA facet injections	43 patients (male=17, female 26) Mean age 55 years (range 16–18 years)	PS group: sensitivity=0.71, specificity=0.76, (+) predictive value=0.38, (–) predictive value=0.93 SPECT group: sensitivity=1.0, specificity=0.71, (+) predictive value=0.41, (–) predictive value=1.0 The authors concluded that the high sensitivity and (–) predictive value made SPECT scan a valuable screening tool before invasive facet injections. Other symptomatic abnormal areas of tracer uptake were identified in 37% of patients.
Ackerman and Ahmad, 2008 (592)	Randomized, double-blind trial of MBB vs IA facet joint injections in patients with SPECT (+) scans	IA facet injection group=23 (male=14, female=9) MBB group=23 (male=12, female=11) Median age=39.3 years Mean symptom duration=7.6 weeks	61% had ≥50%pain relief at week 12 in IA facet injection group vs 26% in MBB group 26% Sensitivity/specificity of SPECT in the IA facet joint injection group 0.79 and 0.70, respectively Pain rating and ODI scores significantly less in the IA facet group vs MBB group at week 12 All patients in the IA facet injection and MBB groups received lidocaine and triamcinolone.
Koh et al, 2011 (595)	Prospective comparison of MBB between patients with SPECT (+) and SPECT (–) scans	SPECT (+) group=28 (male=12, female=16) SPECT (–) group=5 (male=2, female=3) Mean age SPECT (+) group=60.4 Mean age SPECT (–) group=51.8 years	85.7% with >50%pain reduction at week 2 in SPECT (+) group vs 20% in the SPECT (–) group 78.6% with >50%pain reduction at week 4 in SPECT (+) group vs 0% in the SPECT (–) group No significant between-group differences in ODI All MBB performed with ultrasound guidance using lidocaine and triamcinolone.

Table 9 cont. *Literature review of studies on imaging in diagnosis of facet joint pain.*

STUDY	DESIGN	POPULATION/ CONTROL	RESULTS
POSITRON EMISSION TOMOGRAPHY//MAGNETIC RESONANCE IMAGING			
Sawicki et al, 2017 (630)	Retrospective study to determine if PET/ MRI could predict MBB responders	10 patients with mechanical neck pain. 140 joints assessed. 6 joints in 6 patients had increased uptake of radioactive tracer and facet arthrosis, and 27 joints had arthrosis without increased uptake	Significantly better results of CT-guided injection into the cervical joint capsule when the joint was selected using positive 18F-FDG PET/MRI F-FDG PET/MRI was used to determine the location of MBB in 6 pts. Landmarks were used in 4 PET-negative pts. The PET-positive pts had significantly less pain up to 3 months after MBB CT-guided MBB done with 3 mL of LA and steroid. Pain did not decrease in PET-negative pts The six patients with positive PET and MRI scans had better outcomes immediately after blocks, and through 3-month follow-up Used 3 mL of LA and steroid per level

CI = confidence interval; CT = computed tomography; F-FDG = F-fluorodeoxyglucose; IA = intraarticular; IQR = interquartile range; LA = local anesthetic; LBP = low back pain; MBB = medial branch blocks; MRI = magnetic resonance imaging; ODI = Oswestry Disability Index; PET = positron emission tomography; PS = planar scintigraphy; RF = radiofrequency; RFA = radiofrequency ablation; SPECT = single photon emission computed tomography; VAS = visual analog scale

Adapted and modified from: Hurley RW, Adams MCB, Barad M, et al. Consensus practice guidelines on interventions for cervical spine (facet) joint pain from an international, multispecialty working group. Reg Anesth Pain Med 2022; 47:3-59 (12); Cohen SP, Bhaskar A, Bhatia A, et al. Consensus practice guidelines on interventions for lumbar facet joint pain from a multispecialty, international working group. Reg Anesth Pain Med 2020; 45:424-467 (13); and Klessinger S, Casser HR, Gillner S, et al. Radiofrequency denervation of the spine and the sacroiliac joint: A systematic review based on the Grades of Recommendations, Assessment, Development, and Evaluation Approach, resulting in a German National guideline. Global Spine J 2024; 14:2124-2154 (14).

7.0 Diagnostic Facet Joint Interventions

Key Question 5: What is the evidence of diagnostic accuracy and value of interventional procedures in the diagnosis of facet joint pain?

Based on the postulates of Bogduk (405), spinal facet joints have been shown to possess an abundant nerve supply (461-476), to be capable of generating persistent pain (5,391-397,411-413,417-426,429,430,477-508), and to be affected by osteoarthritis, rheumatoid arthritis, spondylitis, degeneration, inflammation, and injury, all of which may lead to restricted motion and pain on movement (5,391,402,429,430,500,516,518,521-523,587-596,601). In addition, reliable and valid diagnostic techniques have identified these joints as a source of pain (5,391,412,413,429-443,565). Consequently, controlled local anesthetic blocks of the spinal facet joints or medial branch blocks are utilized to diagnose facet joint pain.

The rationale is that a painful joint will cease to be painful for the duration of action of the local anesthetic. In contrast, anesthetic blockade of a nonpainful joint will not produce a significant effect. Repeating the block with an anesthetic agent of different duration and reproducing the analgesic response increases the probability that the blocked joint is the true pain generator. Therefore, to ensure accuracy and validity, these blocks must be controlled and verified using 2 different local anesthetic agents to eliminate placebo responses (5,391,412,413,429-443,545,565,573,631-643). A single facet joint injection is not recommended because it does not control for false-positive responses, although some investigators have advocated therapeutic interventions without any diagnostic blocks (644-649). The diagnostic accuracy of facet joint nerve blocks has been demonstrated through long-term follow-up studies (5,56,57,635,637). Nevertheless, multiple publications have challenged the accuracy of diagnostic facet joint nerve blocks (13,561,564,645-649).

Multiple systematic reviews have supported the value and validity of diagnostic facet joint nerve blocks. In addition to systematic reviews conducted by interventional pain physicians (5), Rubenstein and van Tulder (545) published a systematic review in 2008 concluding that strong evidence existed for the diagnostic accuracy of facet joint blocks in the evaluation of spinal pain. The 2020 facet joint guidelines (1) performed a systematic review, assessed diagnostic accuracy, and assigned a Level I clinical effectiveness rating for the lumbar spine, Level II for the cervical spine, and Level III for the thoracic spine. Consensus guidelines (12,13) were also evaluated; however, no evidence synthesis was provided. In 2022, Bogduk presented a review addressing the validity of diagnostic tests (650). He emphasized that the forms of validity most relevant to interventional pain medicine are concept validity, content validity, face validity, and construct validity. Furthermore, he explained how these forms of validity can be stratified across the evolution of diagnostic tests, progressing from conception through investigation and ultimately consolidation.

Concept validity examines whether the test is plausible in principle and supported by a rational biological basis. Diagnostic tests may be proposed for a structure suspected of being a pain source, yet rejected because the structure is not recognized as capable of producing pain. In such situations, content validity can be established by demonstrating experimentally that the structure can produce pain when subjected to noxious stimulation.

Content validity requires that the diagnostic test be comprehensively and accurately defined without ambiguity. The objective is to ensure that the test is performed consistently.

Face validity examines whether the diagnostic test has been demonstrated to operate through the anatomical and physiological mechanisms it purports to use. In this context, objective evidence is required rather than assumptions or assertions. For diagnostic blocks, it is well established that local anesthetics block nerves; therefore, there is no concern regarding the face validity of that aspect of diagnostic blocks. Instead, face validity pertains to whether anesthetizing a structure or its nerve supply successfully relieves pain arising from that structure. Establishing face validity depends on studies in normal volunteers. Face validity of medial branch blocks for facet joint pain has been demonstrated in both lumbar and cervical facet joint pain (419).

Construct validity is considered the most important type of validity for any diagnostic test (650). Construct validity directly evaluates whether the test can establish a diagnosis. It supersedes all other forms of validity and does not depend upon prior establishment of concept validity or face validity (640,651).

Construct validity refers to the ability of a diagnostic test to identify the condition of interest when present and exclude it when absent. Consequently, a diagnostic test has limited utility if it cannot distinguish between the presence and absence of the condition be-

ing evaluated. However, diagnostic tests may produce false-positive results. Understanding the occurrence and frequency of false-positive results is essential and is measured through assessment of the test's validity.

Bogduk also described the validity and clinical utility of comparative local anesthetic blocks for diagnosing spinal pain. He reviewed evidence derived from the studies of Barnsley et al (652), which demonstrated that comparative blocks were, on average, valid. Subsequently, Lord et al (653) further evaluated the validity of cervical facet joint nerve blocks.

Overall, Bogduk (650) explained that diagnostic confidence decreases as the prevalence of falsely diagnosed conditions increases. For example, when the prevalence of a condition is 60%, a likelihood ratio of 4.5 provides a diagnostic confidence of 87%, whereas even a likelihood ratio of 2.0 yields a confidence of 75%. However, when prevalence decreases to 30%, the diagnostic confidence associated with a likelihood ratio of 4.5 declines to 66%, while likelihood ratios of 2.9 and 2.0 reduce diagnostic confidence further to 55% and 46%, respectively.

Klessinger and Bogduk (654) discussed false-positive rates associated with diagnostic medial branch blocks and introduced the concept of inconsistency rates. They stated that false-positive rates cannot be accurately determined unless each patient undergoes both blocks. They further suggested that historical methodologies used to determine false-positive rates may not have been accurate. Since that time, multiple additional studies have been published, further strengthening the diagnostic value and validity of these procedures.

Establishing a true placebo control for nerve blocks has proven extremely difficult, and to date, true placebo-controlled trials have not been performed in the thoracic spine. Hancock et al (535) conducted a systematic review of tests used to identify the disc, sacroiliac joint, or facet joint as sources of low back pain. Based on the 8 available studies at that time, they concluded that none of the tests for facet joint pain were informative. Subsequently, systematic reviews conducted for guideline development by ASIPP, including those by Sehgal et al (655), Falco et al (656,657), and Atluri et al (658), were published. In 2007, Rubinstein and van Tulder (545) conducted a best-evidence review of diagnostic procedures for neck and low back pain and identified 17 studies evaluating the validity, prevalence, and false-positive rates of facet joint blocks. They concluded that strong evidence supported their diagnostic accuracy. In 2023, Hancock et al's review (535) was updated by Han et al (415), who reported that informative index tests could identify the facet joint, disc, and sacroiliac joint as sources of low back pain. They challenged the prevailing notion that pathoanatomical diagnosis is generally unattainable and questioned the routine use of the term non-specific low back pain.

The systematic review conducted for the ASIPP guidelines by Manchikanti et al (1) demonstrated **Level I evidence with moderate to strong strength of recommendation** for the lumbar spine, showing 75% to ≥80% pain relief with controlled diagnostic blocks, a prevalence of 16% to 45%, and presumed false-positive rates of 25% to 50%. For the cervical spine, the evidence was **Level II with moderate strength of recommendation**, ≥ 80% pain relief, prevalence ranging from 36% to 67%, and false-positive rates ranging from 26% to 63%, with substantial variability. For the thoracic spine, the evidence was also **Level II with moderate strength of recommendation**, ≥ 80% pain relief, a prevalence of 34% to 48%, and estimated false-positive rates of 42% to 58%.

Bogduk (650,651), in scholarly publications in 2022 and 2023, addressed the validity of diagnostic testing (650) and the validity and clinical utility of comparative local anesthetic blocks for diagnosing spinal pain (651). Together with Klessinger (654,659), he also introduced the concept of inconsistency rates related to false-positive responses in diagnostic medial branch blocks. In addition, Manchikanti et al (1,660) and other investigators have discussed numerous factors influencing diagnostic accuracy and clinical outcomes, including age, clinical assessment, psychological status, BMI, prior surgery, smoking, sex, opioid exposure, sedation, and the effects of chronic pain on diagnostic interpretation. Manchikanti et al (43,44) further described the evolving role of diagnostic blocks in chronic low back and neck pain and noted a paradigm shift. Although long-acting local anesthetics generally provide longer analgesia than short-acting agents, studies in chronic pain models have shown that short-acting agents with effects lasting less than 2 hours and long-acting agents with effects lasting less than 8 hours may be unreliable for diagnostic discrimination.

7.1 Evidence Synthesis of Diagnostic Accuracy

Manchikanti et al. (5) conducted an extensive systematic review and provided an updated 2026 best-evidence synthesis appraisal of the diagnostic accuracy

and utility of facet/zygapophyseal joint injections in chronic spinal pain. The systematic review utilized appropriate methodology, following the systematic review process outlined by the Standards for Reporting of Diagnostic Accuracy Studies (STARD) initiative.

The methodology used in this guideline preparation followed a systematic review process derived from the STARD initiative (661), as well as evidence-based systematic reviews and diagnostic accuracy studies (5,36,37,142,143,535,656-658,662-665). All systematic reviews and diagnostic accuracy studies evaluating spinal facet joint pain involving the cervical, thoracic, and lumbar facet joints were considered.

The process also included an appropriate literature search, data collection and analysis, data extraction and management with methodologic quality assessment, and, finally, analysis of the evidence utilizing best-evidence synthesis developed with modifications of multiple available criteria, including those of the United States Preventive Services Task Force (USPSTF) criteria as illustrated in Table 3 (123). The GRADE criteria were also applied in the analysis of evidence (125).

7.2 Study Selection

Figure 16, developed in accordance with the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (666), depicts the flow diagram of study selection using the PRISMA process. A large number of studies were initially considered for inclusion (43,44,95,98,368,431-434,438,440,443,565,577,583,631,633,636,637,642,652,667-696). Of these, 29 studies satisfied the inclusion criteria for evaluating the diagnostic accuracy and outcomes of facet joint injections (43,44,368,431-434,438,440,443,565,577,583,637,652,667-676,678-681).

Among the included studies, 18 addressed lumbar facet joint pain (44,368,431-434,438,440,565,583,637,667-673), 12 evaluated cervical facet joint pain (43,443,577,652,671-673,675,676,678-680), and 3 examined thoracic facet joint pain (672,673,681). Two studies (672,673) evaluated prevalence and presumed false-positive rates across all three spinal regions.

7.3 Methodological Quality Assessment

Appendix Table 1 presents the Quality Appraisal of Diagnostic Reliability (QAREL) criteria used to perform the methodological quality assessment of the included studies. Studies scoring 4 of 12 or higher were included. Scores of 8 of 12 or higher were classified as high quality, whereas scores of 4 to 7 were classified as moderate quality.

The results of the methodological quality assessment are summarized in Appendix Table 2 for the lumbar spine (44,368,431-434,438,440,565,583,637,667-673), Appendix Table 3 for the cervical spine (43,443,577,652,671-673,675,676,678-680), and Appendix Table 4 for the thoracic spine (672,673,681). In total, 29 studies meeting the inclusion criteria were evaluated (43,44,368,431-434,438,440,443,565,577,583,637,652,667-676,678-681).

Twenty-seven studies were rated as high quality (43,44,368,431-434,438,440,443,565,577,583,637,652,667-673,676,678-681), whereas one study was rated as moderate quality (675).

7.4 Characteristics of Diagnostic Accuracy Studies

Table 10 presents the characteristics of diagnostic accuracy studies of lumbar facet joint nerve blocks (44,368,431-434,438,440,565,583,637,667-673). One placebo-controlled study (438) used ≥ 50% pain relief as the criterion standard. Only one study used single blocks with ≥ 90% pain relief as the criterion standard (431). Two studies used controlled diagnostic blocks with ≥ 50% pain relief as the criterion standard (433,438). Six studies used controlled diagnostic blocks with ≥ 75% pain relief as the criterion standard (440,565,583,667-669). In addition, 8 studies used 80% or greater pain relief as the criterion standard (44,368,432,637,670-673).

Table 11 summarizes the characteristics of the diagnostic accuracy studies of cervical facet joint nerve blocks included in the review (43,443,577,652,671-673,675,676,678-680).

In the cervical spine, one placebo-controlled trial employed triple blocks with 100% pain relief as the criterion standard (680). Only one study (675) used ≥ 50% pain relief as the cutoff for a positive block. One study evaluated controlled diagnostic blocks with ≥ 75% pain relief as the criterion standard (676). Four studies used controlled diagnostic blocks with ≥ 80% pain relief as the criterion standard (43,671-673). Six studies used 100% pain relief as the criterion standard (443,577,652,678-680).

Table 12 describes the characteristics of diagnostic accuracy studies of thoracic facet joint nerve blocks considered for inclusion (672,673,681).

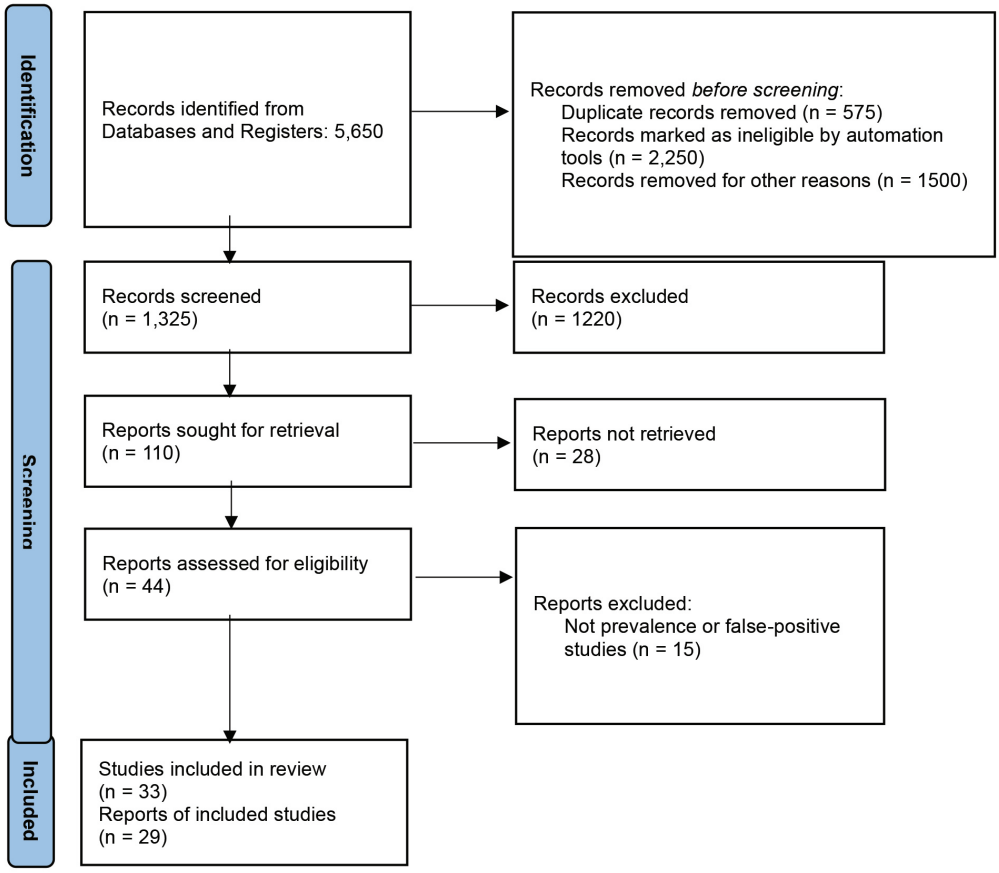


Fig. 16. *Flow diagram illustrating the literature based on 2020 PRISMA guidance used for evaluating diagnostic validity of facet joint nerve blocks in chronic spinal pain.*

In the thoracic spine, no studies evaluated placebo-controlled blocks or single blocks. Three studies used controlled diagnostic blocks with ≥ 80% pain relief as the criterion standard (672,673,681).

Table 13 summarizes the GRADE assessment, applying 5 levels of evidence and evaluating 5 key domains, including methodological limitations, consistency, indirectness, imprecision, and publication bias. Each study was graded as high, moderate, low, or very low.

Based on the quality assessment and GRADE evaluation of the 18 lumbar spine studies, 9 were rated as high quality, 7 as moderate quality, and one as low quality. Given the predominance of high-quality evidence and the use of ≥ 80% pain relief as the criterion standard, the estimated prevalence ranged from 16% to 45%, with presumed or estimated false-positive rates ranging from 25% to 50%.

Based on the quality assessment and GRADE evaluation of the 12 cervical spine studies, 7 were rated as high quality, 4 as moderate quality, and one as low quality. With the majority of studies demonstrating high-quality evidence and using ≥ 80% pain relief as the criterion standard, the estimated prevalence ranged from 36% to 67%, with presumed or estimated false-positive rates ranging from 26% to 63%.

Based on the quality assessment and GRADE evaluation of the 3 thoracic spine studies, 2 were rated as high quality and one as moderate quality. With most studies demonstrating high-quality evidence and ≥ 80% pain relief as the criterion standard, the estimated prevalence ranged from 34% to 48%, with presumed or estimated false-positive rates ranging from 42% to 58%.

Table 10. *Characteristics of studies assessing the accuracy of diagnostic facet joint nerve blocks in lumbar spine with ≥ 50% pain relief.*

Study **Study Characteristics** **Methodological Quality Scoring**	**Participants**	**Intervention(s)** **Injectate Volume**	**Outcome Measures**	**Results**	**Conclusion(s)**
Schwarzer et al, 1995 (438) Randomized, impure placebo, controlled diagnostic blocks Quality Score: QAREL: 9/12	63 patients with low back pain lasting for longer than 3 months underwentCT and blocks of the zygapophysial joints	A placebo injection followed by intraarticular zygapophysial joint injections with 1.5 mL of 0.5% bupivacaine. 1.5 mL	At least 50% reduction in pain maintained for minimum of 3 hours.	Prevalence = 40%	This study shows that CT has no place in the diagnosis of lumbar zygapophysial joint pain, with an impure placebo design.
Schwarzer et al, 1994 (433,434) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	176 consecutive patients with chronic low back pain after some type of injury.	Zygapophysial joint nerve blocks or intraarticular injections were performed with either 2% lignocaine or 0.5% bupivacaine. 0.5 mL	At least 50% pain relief concordant with the duration of local anesthetic injected.	Prevalence = 15% False-positive rate = 38%	First study of evaluation of controlled prevalence and false-positive rates.
Pang et al, 1998 (431) Prospective, single block Quality Score: QAREL: 8/12	In a prospective evaluation, 100 consecutive adult patients with chronic low back pain with undetermined etiology were evaluated with spinal mapping.	Single block was performed by injecting 2% lidocaine into facet joints < 2 mL	Verbal analog scale Pain mapping 90% pain relief	Prevalence Only facet joint pain = 24% Lumbar nerve root and facet disease = 24% Total = 48%	This is the first study evaluating application of diagnostic blocks in the diagnosis of intractable low back pain of undetermined etiology with facet joint disease in potentially 48% of patients with a single block.
Manchikanti et al, 2010 (637) Retrospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	181 patients with at least 50% or 80% pain relief with concordant pain relief were evaluated with dual blocks.	Controlled diagnostic blocks of lumbar facet joint nerves with 1% preservative-free lidocaine or 0.25% preservative-free bupivacaine. 0.5 mL	At least 50% or 80% pain relief and ability to perform previously painful movements.	≥ 50% pain relief Prevalence = 61% Presumed False-positive rate = 17% ——————— ≥ 80% pain relief Prevalence = 31% Presumed False-positive rate = 42%	An unusually high proportion of positive rate for facet joint prevalence with single blocks and ≥ 50% pain relief as the criterion standard.

Table 10 cont. *Characteristics of studies assessing the accuracy of diagnostic facet joint nerve blocks in lumbar spine with ≥ 50% pain relief.*

Study **Study Characteristics** **Methodological Quality Scoring**	**Participants**	**Intervention(s)** **Injectate Volume**	**Outcome Measures**	**Results**	**Conclusion(s)**
Manchikanti et al, 2000 (565) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	200 consecutive patients with chronic low back pain were evaluated.	Controlled diagnostic blocks with 1% lidocaine or 0.25% bupivacaine. 0.5 mL	75% pain relief with ability to perform previously painful movements.	Prevalence = 42% Presumed false-positive rate = 37%	The study showed that the clinical picture failed to diagnose facet joint pain.
DePalma et al, 2011 (440) Retrospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	In a retrospective evaluation, a total of 156 patients with chronic low back pain were assessed for the source of chronic low back pain including discogenic pain, facet joint pain, and sacroiliac joint pain.	Controlled diagnostic blocks with 1% lidocaine or 0.5% bupivacaine. 0.5 mL	Concordant relief with 2 hours for lidocaine and 8 hours for bupivacaine with ≥ 75% pain relief as the criterion standard.	Prevalence = 31%	This is the third study evaluating various structures implicated in the cause of low back pain with controlled diagnostic blocks.
Manchikanti et al, 2001 (667) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	Controlled comparative prevalence study in 100 patients with 50 patients below age of 65 and 50 patients aged 65 or over.	Controlled diagnostic blocks with 1% lidocaine or 0.25% bupivacaine. 0.4 mL to 0.6 mL	75% pain relief with ability to perform previously painful movements was utilized as the criterion standard.	Prevalence: < 65 years = 30% > 65 years = 52% Presumed false-positive rate: < 65 years = 26% > 65 years = 33%	This study showed higher prevalence of facet joint pain in the elderly compared to the younger age group in contrast to the study by Manchikanti et al which showed no differences (674).
Manchikanti et al, 2001 (668) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	Authors evaluated 100 patients with low back pain. Patients were divided into 2 groups, Group I was normal weight, and Group II was obese.	Diagnostic blocks with lidocaine 1% or bupivacaine 0.25%. 0.4 mL to 0.6 mL	A definite response was defined as relief of at least 75% in the symptomatic area.	Prevalence: Non-obese individuals = 36% Obese individuals = 40% Presumed false-positive rate: Non-obese individuals = 44% Obese individuals = 33%	This study showed no significant difference between obese and non-obese individuals either with prevalence or false-positive rate of diagnostic blocks in chronic facet joint pain.

Table 10 cont. *Characteristics of studies assessing the accuracy of diagnostic facet joint nerve blocks in lumbar spine with ≥ 50% pain relief.*

Study **Study Characteristics** **Methodological Quality Scoring**	**Participants**	**Intervention(s)** **Injectate Volume**	**Outcome Measures**	**Results**	**Conclusion(s)**
Manchikanti et al, 2001 (432) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	120 patients were evaluated with a chief complaint of chronic low back pain to evaluate relative contributions of various structures in chronic low back pain. All 120 patients underwent facet joint nerve blocks.	Controlled diagnostic blocks with 1% lidocaine followed by 0.25% bupivacaine. 0.3 mL to 0.6 mL	80% pain relief with ability to perform previously painful movements	Prevalence = 40% Presumed false-positive rate = 47%	This study evaluated all the patients with low back pain, even with suspected discogenic pain.
Manchikanti et al, 1999 (583) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	120 patients with chronic low back pain after failure of conservative management were evaluated.	Controlled diagnostic blocks with 1% lidocaine followed by 0.25% bupivacaine. 0.4 mL to 0.6 mL	Concordant pain relief with 75% or greater criterion standard with ability to perform previously painful movements.	Prevalence = 45% Presumed false-positive rate = 41%	This was the first study performed in the United States in the heterogenous population as previous studies were performed in only post-injury patients.
Manchikanti et al, 2000 (669) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	180 consecutive patients with chronic low back pain were evaluated after having failed conservative management	Controlled diagnostic blocks with lidocaine and 1% lidocaine and 0.25% bupivacaine with or without Sarapin and/or steroids 0.4 mL to 0.6 mL	75% pain relief with ability to perform previously painful movements	Prevalence = 36% Presumed false-positive rate = 25%	This study showed no significant difference if the steroids were used or not
Manchikanti et al, 2003 (670) Prospective, controlled diagnostic blocks QAREL: 9/12	At total of 300 patients with chronic low back pain were evaluated to assess the difference based on involvement of single or multiple spinal regions.	Controlled diagnostic blocks with 1% lidocaine followed by 0.25% bupivacaine. 0.5 mL	80% pain relief with ability to perform previously painful movements.	Single region: Prevalence = 21% Presumed false-positive rate = 17% Multiple regions: Prevalence = 41% Presumed false-positive rate = 27%	This study shows a higher prevalence when multiple regions are involved.
Manchikanti et al, 2002 (671) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	120 consecutive patients with chronic low back pain and neck pain were evaluated to assess involvement of facet joints as causative factors.	Controlled diagnostic blocks with 1% lidocaine followed by 0.25% bupivacaine. 0.5 mL	80% pain relief with ability to perform previously painful movements.	Prevalence = 40% Presumed false-positive = 30%	The results are similar to involvement of multiple regions with a prevalence of 40% as illustrated in another study.

Table 10 cont. *Characteristics of studies assessing the accuracy of diagnostic facet joint nerve blocks in lumbar spine with ≥ 50% pain relief.*

Study **Study Characteristics** **Methodological Quality Scoring**	**Participants**	**Intervention(s)** **Injectate Volume**	**Outcome Measures**	**Results**	**Conclusion(s)**
Manchikanti et al, 2004 (672) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	500 consecutive patients with chronic, non-specific spinal pain were evaluated of which 397 patients suffered with chronic low back pain.	Controlled diagnostic blocks with 1% lidocaine followed by 0.25% bupivacaine. 0.5 mL	80% pain relief with ability to perform previously painful movements.	Prevalence = 31% Presumed false-positive rate = 27%	Largest study performed involving all regions of the spine.
Manchukonda et al, 2007 (673) Retrospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	500 consecutive patients with chronic spinal pain were evaluated, of which 303 patients were evaluated for chronic low back pain.	Controlled diagnostic blocks with 1% lidocaine followed by 0.25% bupivacaine. 0.5 mL	80% pain relief with ability to perform previously painful movements.	Prevalence = 27% Presumed false-positive rate = 45%	Second largest study performed involving all regions of the spine by the same group of authors (637).
Manchikanti et al, 2007 (368) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	A total of 117 consecutive patients with chronic non-specific low back pain were evaluated, after lumbar surgical interventions, with post-surgery syndrome and continued axial low back pain with controlled, comparative local anesthetic blocks.	Controlled, comparative, local anesthetic blocks with 1% lidocaine and 0.25% bupivacaine. 0.5 mL	80% relief as the criterion standard	Prevalence = 16% Presumed false-positive rate = 49%	Lower prevalence of facet joint pain in post-surgery patients.
Manchikanti et al, 2020 (44) Retrospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	A total of 299 consecutive patients undergoing lumbar facet joint nerve blocks for chronic low back pain were included. Patients with axial low back pain with or without somatic radiation without radicular pattern for 6 months and have failed conservative management were included.	Controlled, comparative, local anesthetic blocks with 1% lidocaine and 0.25% bupivacaine. 0.5 mL	80% relief as the criterion standard	Prevalence = 34.1% Presumed false positive rate = 49.8% Duration of Relief: • ≥ 80% relief of 6 days with lidocaine, with total relief of over 50% of 32 days with lidocaine. • ≥ 80% relief of 30 days with bupivacaine, and total relief of ≥ 50% of 55 days	One of the more recent studies and the first one to study with a chronic pain model.

Table 11. *Studies assessing the accuracy of diagnostic facet joint nerve blocks in cervical spine with ≥ 50% pain relief.*

Study **Study Characteristics** **Methodological Quality Scoring**	**Participants**	**Intervention(s)** **Injectate Volume**	**Outcome Measures**	**Results**	**Conclusion(s)**
Lord et al, 1996 (680) Randomized, double-blind, placebo controlled, comparative local anesthetic diagnostic blocks Quality Score: QAREL: 9/12	68 consecutive patients referred for chronic neck pain after whiplash were studied in a cervical spine research unit in Australia. The criteria for inclusion were 3 months duration of neck pain after a motor vehicle accident and evaluation by a consultant specialist before referral, and over 18 years of age.	Diagnostic blocks with placebo and 2% lidocaine or 0.5% bupivacaine. 0.5 mL	100% pain relief was the criterion standard.	Prevalence = 60%	The study was performed in a highly specialized academic research unit in Australia in patients after whiplash injury.
Aprill & Bogduk, 1992 (675) Prospective, single block Quality Score: QAREL: 5/12	The records were reviewed of 318 patients with chronic neck pain of at least 6 months without myelopathy from January 1989 to April 1990 in a radiology practice in New Orleans.	Intraarticular lidocaine injection after contrast injection with provocation with assessment of provocation and pain relief. 0.2 mL to 0.3 mL Iohexol 0.5 mL betamethasone	Provocation and pain relief ≥ 50%)	Approximate prevalence = 63%. A 25% positive rate with the possibility that an additional 38% suffered with zygapophysial joint pain.	The study was performed in a radiology setting and only with patients who were involved in a motor vehicle injury. Only a single block was performed.
Barnsley et al, 1993 (652) Randomized, double-blind, controlled diagnostic blocks Quality Score: QAREL: 9/12	47 consecutive patients with chronic neck pain following motor vehicle accidents.	Cervical medial branch blocks utilizing comparative local anesthetics with 2% lidocaine or 0.5% bupivacaine. 0.5 mL	Definite or complete relief of pain (100%) following the medial branch blocks.	Prevalence=60%	Comparative local anesthetic medial branch blocks were used in the diagnosis of cervical zygapophysial joint pain.
Yin and Bogduk, 2008 (443) Retrospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	143 patients with chronic neck pain of various origins of at least 3 months duration were included. A total of 84 patients underwent cervical medial branch blocks.	Cervical controlled, comparative local anesthetic medial branch blocks with either 4% lignocaine or 0.75% bupivacaine. 0.5 mL	Complete pain relief (100%)	Prevalence = 55% Positive responses were determined with duration of relief based on the local anesthetic with concordant response (i.e., patients were required to have long-lasting relief when 0.75% bupivacaine was administered and short-lasting relief when 4% lignocaine was administered).	In this evaluation a large proportion of patients (36%) did not pursue investigations, which diluted the crude prevalence of various conditions. A diagnosis remained elusive in 32% of those patients who completed investigations.

Table 11 cont. *Studies assessing the accuracy of diagnostic facet joint nerve blocks in cervical spine with ≥ 50% pain relief.*

Study **Study Characteristics** **Methodological Quality Scoring**	**Participants**	**Intervention(s)** **Injectate Volume**	**Outcome Measures**	**Results**	**Conclusion(s)**
Manchukonda et al, 2007 (673) Retrospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	A total of 251 consecutive patients receiving controlled, comparative local anesthetic blocks with chronic neck pain were included. Patients had pain for at least 6 months, which was nonspecific without a radicular component.	Controlled diagnostic medial branch blocks using 1% lidocaine or 0.25% bupivacaine. 0.5 mL	A positive response was considered at least 80% pain relief with the ability to perform previously painful movements. There were no withdrawals.	Prevalence = 39% Presumed false-positive rate = 45%	This is the second largest study following the previous one (672) with inclusion of the heterogenous population and 251 patients with neck pain yielding a moderate prevalence of 39% with a false-positive rate of 45%.
Manchikanti et al, 2004 (672) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	The study evaluated 255 consecutive patients presenting with chronic neck pain. Patients suffered with chronic neck pain without disc-related pain with radicular symptoms.	Controlled diagnostic medial branch blocks using 1% lidocaine or 0.25% bupivacaine. 0.5 mL	A positive response was considered at least 80% pain relief with the ability to perform previously painful movements. There were no withdrawals.	Prevalence = 55% Presumed false-positive rate = 63%	This is the largest study until 2004 with patients with neck pain, yielding a 55% prevalence rate in the cervical spine, with a false-positive rate of 63%.
Manchikanti et al, 2002 (671) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	120 consecutive patients presenting with complaints of chronic low back pain and neck pain, in a non-university setting, in one private comprehensive interventional pain management practice were evaluated.	Controlled diagnostic medial branch blocks using 1% lidocaine or 0.25% bupivacaine. 0.5 mL	A positive response was considered at least 80% pain relief with the ability to perform previously painful movements. There were no withdrawals.	Prevalence = 67% Presumed false-positive rate = 63%	Prevalence may have been higher due to the nature of the selection criteria. Authors utilized controlled, comparative local anesthetic blocks yielding high false-positive rates.
Manchikanti et al, 2002 (676) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	106 consecutive patients with chronic neck pain of various origins were included. Patients must have had pain for at least 6 months and also have failed conservative management without any evidence of radiculitis or disc herniation.	Controlled diagnostic medial branch blocks using 1% lidocaine or 0.25% bupivacaine. 0.5 mL	A positive response was considered at least 75% reduction of pain with the ability to perform previously painful movements. There were no withdrawals.	Prevalence = 60% Presumed false-positive rate = 40%	This is the only study outside the group of Australians evaluating the prevalence of cervical facet joint pain in chronic neck pain of heterogenous origin yielding a prevalence of 60% with controlled diagnostic blocks and a false-positive rate of 40%.
Speldewinde et al, 2001 (577) Retrospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	97 patients with chronic neck pain undergoing diagnostic cervical medial branch blocks from 1994 to 1997 were evaluated by 3 independent rehabilitation physicians.	Controlled, comparative local anesthetic blocks, 2% lignocaine or 0.5% bupivacaine. 0.5 mL	Complete pain relief (100%) was the criterion standard.	Prevalence = 36%	The authors utilized 100% pain relief as the criterion standard with controlled diagnostic blocks utilizing strict selection criteria in a heterogenous population in a private practice setting in a retrospective evaluation.

Table 11 cont. *Studies assessing the accuracy of diagnostic facet joint nerve blocks in cervical spine with ≥ 50% pain relief.*

Study **Study Characteristics** **Methodological Quality Scoring**	**Participants**	**Intervention(s)** **Injectate Volume**	**Outcome Measures**	**Results**	**Conclusion(s)**
Barnsley et al, 1995 (678) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	50 consecutive patients referred to the cervical spine research unit, a tertiary referral unit, in Australia were evaluated. The criteria for inclusion were neck pain of more than 3 months duration following and attributed to a motor vehicle accident, previous assessment.	Medial branch blocks with 2% lidocaine or 0.5% bupivacaine. 0.5 mL	Patients were classified as having a painful cervical zygapophysial joint only if they achieved definite or complete relief of pain (100%) with both anesthetics and a longer duration of pain relief after the use of bupivacaine.	Prevalence = 54%	The study was performed in a highly specialized academic research unit in Australia in patients after whiplash injury.
Barnsley et al, 1993 (679) Randomized, double-blind, controlled diagnostic blocks Quality Score: QAREL: 9/12	The study evaluated 55 consecutive patients with neck pain of greater than 3 months attributed to a motor vehicle accident, with random allocation.	Medial branch blocks with either 2% lignocaine or 0.5% bupivacaine. 0.5 mL	100% pain relief	Presumed false-positive rate = 27%	A well-performed study in a highly research-oriented center in patients after whiplash.
Manchikanti et al, 2020 (43) Retrospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	A total of 294 consecutive patients undergoing cervical facet joint nerve blocks for chronic neck pain were included. Patients with neck pain with or without somatic radiation without radicular pain pattern for 6 months and have failed conservative management were included.	Controlled, comparative, local anesthetic blocks with 1% lidocaine and 0.25% bupivacaine. 0.5 mL	80% relief as the criterion standard	Dual block prevalence = 49.3% Single block prevalence = 66.3% Presumed false positive rate = 25.6% Duration of Relief: • ≥ 80% relief of 6 days with lidocaine, with total relief of over 50% of 31 days with lidocaine. • ≥ 80% relief of 12 days with bupivacaine, and total relief of ≥ 50% of 55 days	One of the more recent studies and the first one to study with a chronic pain model.

7.5 Analysis of Evidence

The evidence analysis included evaluation of the prevalence and false-positive rates of facet joint pain using dual diagnostic blocks. The evidence was assessed separately by spinal region, including lumbar, cervical, and thoracic. Table 14 presents the prevalence and presumed false-positive rates of facet joint pain in the lumbar spine, Table 15 presents the prevalence and presumed false-positive rates based on diagnostic blocks in the cervical spine, and Table 16 presents the prevalence and false-positive rates based on diagnostic blocks in the thoracic spine.

7.5.1 Lumbar Facet Joint Pain

Table 14 presents the prevalence and false-positive rates of facet joint pain in the lumbar spine. Based on the methodological quality assessment using QAREL criteria, all 18 studies (5,44,368,431-434,438,440,565,583,637,667-673) were rated as high quality. However, according to GRADE criteria, 9 of the 18 studies were rated as high quality (5,44,433,434,438,440,565,637,670,672,673), 7 were rated as moderate quality (5,368,432,583,667-669,671), and one was rated as low quality (428). Nine studies met both high-quality QAREL and high-quality GRADE criteria (5,44,433,434,438,440,565,637,670,672,673), including a total of 2,069 patients. Seven studies met high-quality QAREL criteria and moderate-quality GRADE criteria (5,368,432,583,667-

Table 12. *Studies assessing the accuracy of diagnostic facet joint nerve blocks in thoracic spine with ≥ 50% pain relief.*

Study **Study Characteristics** **Methodological Quality Scoring**	**Participants**	**Intervention(s)** **Injectate Volume**	**Outcome Measures**	**Results**	**Conclusion(s)**
Manchikanti et al, 2004 (672) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	500 consecutive patients with chronic, non-specific spine pain 72 patients with thoracic pain were evaluated.	Controlled comparative local anesthetic blocks with 1% lidocaine or 0.25% bupivacaine. 0.5 mL	80% pain relief with the ability to perform previously painful movements. The relief with bupivacaine to last longer than lidocaine.	The prevalence of facet joint pain in patients with chronic thoracic spine pain was 42% (95% CI, 30% – 53%). The presumed false-positive rate with single blocks with lidocaine was 55% (95% CI, 39% – 78%) in the thoracic spine.	Facet joints are clinically important spinal pain generators in a significant (42%) proportion of patients with chronic spinal pain, with a false-positive rate of 55%.
Manchikanti et al, 2002 (681) Prospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	46 consecutive patients with chronic midback and upper back pain	Diagnostic facet joint nerve blocks with lidocaine 1% or bupivacaine 0.25%. 0.5 mL	80% pain relief with the ability to perform previously painful movements. The relief with bupivacaine to last longer than lidocaine.	Prevalence = 48% Presumed false-positive rate = 58%	Comparative local anesthetic blocks showed the prevalence of facet joint pain to be 48%, with single blocks carrying a false-positive rate of 58%.
Manchukonda et al 2007 (673) Retrospective, controlled diagnostic blocks Quality Score: QAREL: 9/12	500 consecutive patients with chronic facet or zygapophysial joint pain. 65 patients with thoracic pain were evaluated.	Diagnostic blocks with 1% lidocaine or 0.25% bupivacaine. 0.5 mL	80% pain relief with the ability to perform previously painful movements. The relief with bupivacaine to last longer than lidocaine.	Prevalence of facet joint pain was 34% (95% CI, 22% - 47%) in patients with thoracic pain. The presumed False-positive rate with a single block in the thoracic region was 42%.	Significant prevalence of facet joint pain in chronic spinal pain, with 34% prevalence and 42% false-positive rate.

Table 13. *Evidence profile using randomized controlled trials of interventions for the same outcome and similar certainty of evidence.*

CERTAINTY ASSESSMENT							Number of Patients	Impact	Certainty
Study	**Study Design**	**Risk of Bias**	**Consistency**	**Indirectness**	**Imprecision**	**Publication Bias**			
Lumbar									
Schwarzer et al (438)	RA, PC, CDB	None	High	High	None	None	57 of 63	Prevalence: 40% (27% - 53%) Presumed False-Positive: NA	High
Schwarzer et al (433,434)	P, CDB	None	High	High	None	None	176	Prevalence: 15% (10% - 20%) Presumed False-Positive: 38% (95% CI, 30%-46%)	High
Pang et al (431)	P, SB	Moderate	Low	High	Moderate	Moderate	100	Prevalence: 48% Presumed False-Positive: NA	Low
Manchikanti et al (637)	RTR, CDB	Very low	Moderate	High	Very low	Very low	181	Prevalence: 61% (53% - 81%) 31% (26% - 35%) Presumed False-Positive: 17% (95% CI, 10%-24%) 42% (95% CI, 35%-50%)	High
Manchikanti et al (565)	P, CDB	Very low	Moderate	High	Very low	Very low	200	Prevalence: 42% (35% - 42%) Presumed False-Positive: 37% (95% CI, 32%-42%)	High
DePalma et al (440)	RTR, CDB	Very low	Moderate	High	Very low	Very low	156	Prevalence: 31% (24% - 38%) Presumed False-Positive: NA	High
Manchikanti et al (667)	P, CDB	Very low	Moderate	High	Very low	Very low	100 I: (<65 years) = 50 II:(>65 years) = 50	Prevalence: I: 30% (17% - 43%) II: 52% (38% - 66%) Presumed False-Positive: I: 26% (95% CI, 11%-40%) II: 33% (95% CI, 14%-35%)	Moderate

Table 13 cont. *Evidence profile using randomized controlled trials of interventions for the same outcome and similar certainty of evidence.*

CERTAINTY ASSESSMENT							Number of Patients	Impact	Certainty
Study	**Study Design**	**Risk of Bias**	**Consistency**	**Indirectness**	**Imprecision**	**Publication Bias**			
Manchikanti et al (668)	P, CDB	Very low	Moderate	High	Very low	Very low	100 I: (BMI<30) = 50 II: (BMI >30) = 50	Prevalence: I: 36% (22%, 50%) II: 40% (26%, 54%) Presumed False-Positive: I: 44% (95% CI, 26%-61%) II: 33% (95% CI, 16%-51%)	Moderate
Manchikanti et al (583)	P, CDB	Very low	Moderate	High	Very low	Very low	120	Prevalence: 45% (36% - 54%) Presumed False-Positive: 41% (95% CI, 29%-53%)	Moderate
Manchikanti et al (669)	P, CDB	Very low	Moderate	High	Very low	Very low	180	Prevalence: 36% (29% - 43%) Presumed False-Positive: 25% (95% CI, 21%-39%)	Moderate
Manchikanti et al (432)	P, CDB	Very low	Moderate	High	Very low	Very low	120	Prevalence: 40% (31%–49%) Presumed False-Positive: 47% (95% CI, 35%-59%)	Moderate
Manchikanti et al (670)	P, CDB	Very low	Moderate	High	Very low	Very low	300 I: Single region II: Multiple regions	Prevalence: I: 21% (14%-27%) II: 41% (33%-49%) Presumed False-Positive: I: 17% (95% CI, 10%-24%) II: 27% (95% CI, 18%-36%)	High
Manchikanti et al (671)	P, CDB	Very low	Moderate	High	Very low	Very low	120	Prevalence: 40% (31% - 49%) Presumed False-Positive: 30% (95% CI, 20%-40%)	Moderate
Manchikanti et al (672)	P, CDB	Very low	Moderate	High	Very low	Very low	397	Prevalence: 31% (27% - 36%) Presumed False-Positive: 27% (95% CI, 22%-32%)	High

Table 13 cont. *Evidence profile using randomized controlled trials of interventions for the same outcome and similar certainty of evidence.*

CERTAINTY ASSESSMENT							Number of Patients	Impact	Certainty
Study	**Study Design**	**Risk of Bias**	**Consistency**	**Indirectness**	**Imprecision**	**Publication Bias**			
Manchukonda et al (673)	RTR, CDB	Very low	Moderate	High	Very low	Very low	303	Prevalence: 27% (22% - 33%) Presumed False-Positive: 45% (95% CI, 36%-53%)	High
Manchikanti et al (368)	P, CDB	Very low	Moderate	High	Very low	Very low	117	Prevalence: 16% (9% – 23%) Presumed False-Positive: 49% (95% CI, 39%–59%)	Moderate
Manchikanti et al (44)	RTR, CDB	Very low	Moderate	High	Very low	Very low	299	Prevalence: 34.1% (95% CI, 28.8%, 39.8%) Presumed False-Positive: 49.8% (95% CI, 42.7%, 56.8%)	High
Cervical									
Lord et al (680)	RA, DB, PC, CDB	None	High	High	None	None	68	Prevalence: 60% (95% CI, 46%, 73%) Presumed False-Positive: NA	High
Aprill & Bogduk (675)	P, SB	Moderate	Low	High	Very low	Moderate	318	Prevalence: 25%-63% Presumed False-Positive: NA	Low
Manchikanti et al (676)	P, CDB	Very low	Moderate	High	Very low	Very low	106	Prevalence: 60% % (95% CI, 50%, 70%) Presumed False-Positive: 40% % (95% CI, 34%-46%)	Moderate
Manchukonda et al (673)	RTR, CDB	Very low	Moderate	High	Very low	Very low	251 of 500	Prevalence: 39% (95% CI, 32%, 45%) Presumed False-Positive: 45% (95% CI, 37%-52%)	High

Table 13 cont. *Evidence profile using randomized controlled trials of interventions for the same outcome and similar certainty of evidence.*

CERTAINTY ASSESSMENT							Number of Patients	Impact	Certainty
Study	**Study Design**	**Risk of Bias**	**Consistency**	**Indirectness**	**Imprecision**	**Publication Bias**			
Manchikanti et al (672)	P, CDB	Very low	Moderate	High	Very low	Very low	255 of 500	Prevalence: 55% (95% CI, 49%, 61%) Presumed False-Positive: 63% (95% CI, 54%-72%)	High
Manchikanti et al (671)	P, CDB	Very low	Moderate	High	Very low	Very low	120	Prevalence: 67% (95% CI 58% , 75%) Presumed False-Positive: 63% (95% CI, 48%-78%)	Moderate
Barnsley et al (652)	RA, DB, CDB	None	Moderate	High	None	None	47	Prevalence: 60% Presumed False-Positive: NA	High
Yin and Bogduk (443)	RTR, CDB	Very low	Moderate	High	Very low	Very low	143	Prevalence: 55% (95% CI, 38%, 62%) Presumed False-Positive: NA	Moderate
Speldewinde et al (577)	RTR, CDB	Very low	Moderate	High	Very low	Very low	97	Prevalence: 36% (95% CI, 27%, 45%) Presumed False-Positive: NA	Moderate
Barnsley et al (678)	P, CDB	None	High	High	None	None	50	Prevalence: 54% (95% CI, 40%, 68%) Presumed False-Positive: NA	High
Barnsley et al (679)	RA, DB, CDB	None	High	High	None	None	55	Prevalence: NA Presumed False-Positive: 27% (95% CI, 15%-38%)	High
Manchikanti et al (43)	RTR, CDB	Very low	Moderate	High	Very low	Very low	294	Prevalence: 49.3 (95% CI, 3.6%, 55%) Presumed False-Positive: 25.6% (95% CI, 19.5%, 32.8%)	High

Table 13 cont. *Evidence profile using randomized controlled trials of interventions for the same outcome and similar certainty of evidence.*

CERTAINTY ASSESSMENT							Number of Patients	Impact	Certainty
Study	**Study Design**	**Risk of Bias**	**Consistency**	**Indirectness**	**Imprecision**	**Publication Bias**			
Thoracic									
Manchikanti et al (681)	P, CDB	Very low	Moderate	High	Very low	Very low	46	Prevalence: 48% (95% CI; 34%-62%) Presumed False-Positive: 58% (95% CI, 38%-78%)	Moderate
Manchikanti et al (672)	P, CDB	Very low	Moderate	High	Very low	Very low	72	Prevalence: 42% (95% CI; 30%-53%) Presumed False-Positive: 55% (95% CI, 38%-78%)	High
Manchukonda et al (673)	RTR, CDB	Very low	Moderate	High	Very low	Very low	65	Prevalence: 34% (95% CI; 22%-47%) Presumed False-Positive: 42% (95% CI, 36%-53%)	High

Table 14. *Data on the prevalence and false-positive rate of facet joint pain by diagnostic blocks in the lumbar spine.*

Study	**Methodological Criteria Score**	**GRADE Criteria and Scoring**	**Number of Patients**	**Criterion Standard of Percent Relief**	**Prevalence Estimates with 95% Confidence Intervals**	**Presumed False-Positive Rate with 95% Confidence Intervals**
Single Blocks						
Pang et al (431)	High (8/12)	Low	100	90%	48%	NA
Controlled Blocks						
Schwarzer et al (438)	High (9/12)	High	57 of 63	Placebo control ≥ 50%	40% (27% - 53%)	NA
Schwarzer et al (433,434)	High (9/12)	High	176	≥ 50%	15% (10% - 20%)	38% (95% CI, 30%-46%)
Manchikanti et al (637)	High (9/12)	High	181	≥ 50% ≥ 80%	61% (53% - 81%) 31% (26% - 35%)	17% (95% CI, 10%-24%) 42% (95% CI, 35%-50%)
Manchikanti et al (565)	High (9/12)	High	200	≥ 75%	42% (35% - 42%)	37% (95% CI, 32%-42%)
DePalma et al (440)	High (9/12)	High	156	≥ 75%	31% (24% - 38%)	NA

669,671), totaling 857 patients, and one study met high-quality QAREL and low-quality GRADE criteria (431), totaling 100 patients. Thus, a total of 3,026 patients were included. Only one study employed a placebo control (438).

Since the publication of the previous systematic review in 2015 (5,660), a single additional study evaluating prevalence and false-positive rates and introducing a paradigm shift from an acute to a chronic pain model for lumbar diagnostic facet joint nerve blocks was published by Manchikanti et al. (44). This differed from earlier reviews in which the average duration of pain relief at 50% and 80% exceeded the expected pharmacological duration of the local anesthetics. In this chronic pain model, the prevalence of lumbar facet joint pain was 34.1% (95% CI, 28.8%, 39.8%) (44), with a presumed false-positive rate of 49.8% (95% CI, 42.7%, 56.8%). The average duration of > 80% pain relief with lidocaine was 6 days, and the duration of total relief > 50% was 32 days. With bupivacaine, the average duration of > 80% relief was 30 days, and total relief > 50% lasted 55 days.

Overall, 18 studies assessed the prevalence of lumbar facet joint pain, including one single-block study (431) and 16 dual-block studies (44,368,432-434,438,440,565,583,637,667-673). The single-block study (431), using ≥ 90% pain relief as the criterion standard, reported a prevalence of 48% among 100 patients.

Controlled diagnostic

Table 14 cont. *Data on the prevalence and false-positive rate of facet joint pain by diagnostic blocks in the lumbar spine.*

Study	Methodological Criteria Score	GRADE Criteria and Scoring	Number of Patients	Criterion Standard of Percent Relief	Prevalence Estimates with 95% Confidence Intervals	Presumed False-Positive Rate with 95% Confidence Intervals
Manchikanti et al (667)	High (9/12)	Moderate	100 I: (<65 years) = 50 II:(>65 years) = 50	≥ 75%	I: 30% (17% - 43%) II: 52% (38% - 66%)	I: 26% (95% CI, 11%-40%) II: 33% (95% CI, 14%-35%)
Manchikanti et al (668)	High (9/12)	Moderate	100 I: (BMI<30) = 50 II: (BMI >30) = 50	≥ 75%	I: 36% (22%, 50%) II: 40% (26%, 54%)	I: 44% (95% CI, 26%-61%) II: 33% (95% CI, 16%-51%)
Manchikanti et al (583)	High (9/12)	Moderate	120	≥ 75%	45% (36% - 54%)	41% (95% CI, 29%-53%)
Manchikanti et al (669)	High (9/12)	Moderate	180	≥ 75%	36% (29% - 43%)	25% (95% CI, 21%-39%)
Manchikanti et al (432)	High (9/12)	Moderate	120	≥ 80%	40% (31%–49%)	47% (95% CI, 35%-59%)
Manchikanti et al (670)	High (9/12)	High	300 I: Single region II: Multiple regions	≥80%	I: 21% (14%-27%) II: 41% (33%-49%)	I: 17% (95% CI, 10%-24%) II: 27% (95% CI, 18%-36%)
Manchikanti et al (671)	High (9/12)	Moderate	120	≥ 80%	40% (31% - 49%)	30% (95% CI, 20%-40%)
Manchikanti et al (672)	High (9/12)	High	397	≥ 80%	31% (27% - 36%)	27% (95% CI, 22%-32%)
Manchukonda et al (673)	High (9/12)	High	303	≥ 80%	27% (22% - 33%)	45% (95% CI, 36%-53%)
Manchikanti et al (368)	High (9/12)	Moderate	117	≥ 80%	16% (9% – 23%)	49% (95% CI, 39%–59%)
Manchikanti et al (44)	High (9/12)	High	299	≥ 80%	34.1% (95% CI, 28.8%, 39.8%)	49.8% (95% CI, 42.7%, 56.8%)

NA = not applicable; CI = confidence interval

Table 15. *Data on the prevalence and false-positive rate of facet joint pain by diagnostic blocks in the cervical spine.*

Study	Methodological Criteria Score	GRADE Criteria and Scoring	Number of Patients	Criterion Standard of Percent Relief	Prevalence Estimates with 95% Confidence Intervals	Presumed False-Positive Rate with 95% Confidence Intervals
Single Blocks						
Aprill & Bogduk (675)	Moderate (5/12)	Low	318	≥ 50%	25%-63%	NA
Controlled Blocks						
Lord et al (680)	High (9/12)	High	68	Placebo control 100%	60% (95% CI, 46%, 73%)	NA
Manchikanti et al (676)	High (9/12)	Moderate	106	≥ 75%	60% (95% CI, 50%, 70%)	40% (95% CI, 34%-46%)
Manchukonda et al (673)	High (9/12)	High	251 of 500	≥ 80%	39% (95% CI, 32%, 45%)	45% (95% CI, 37%-52%)
Manchikanti et al (672)	High (9/12)	High	255 of 500	≥ 80%	55% (95% CI, 49%, 61%)	63% (95% CI, 54%-72%)
Manchikanti et al (671)	High (9/12)	Moderate	120	≥ 80%	67% (95% CI 58% , 75%)	63% (95% CI, 48%-78%)
Barnsley et al (652)	High (9/12)	High	47	100%	60%	NA
Yin and Bogduk (443)	High (9/12)	Moderate	143	100%	55% (95% CI, 38%, 62%)	NA
Speldewinde et al (577)	High (9/12)	Moderate	97	100%	36% (95% CI, 27%, 45%)	NA
Barnsley et al (678)	High (9/12)	High	50	100%	54% (95% CI, 40%, 68%)	NA
Barnsley et al (679)	High (9/12)	High	55	100%	NA	27% (95% CI, 15%-38%)
Manchikanti et al (43)	High (9/12)	High	294	≥ 80%	49.3 (95% CI, 3.6%, 55%)	25.6% (95% CI, 19.5%, 32.8%)

NA = not applicable; CI = confidence interval

Table 16. *Data on the prevalence and false-positive rate of facet joint pain by diagnostic blocks in the thoracic spine.*

Study	Methodological Criteria Score	GRADE Criteria and Scoring	Number of Patients	Criterion Standard of Percent Relief	Prevalence Estimates with 95% Confidence Intervals	Presumed False-Positive Rate with 95% Confidence Intervals
Controlled Blocks						
Manchikanti et al (681)	High (9/12)	Moderate	46	≥ 80%	48% (95% CI; 34%-62%)	58% (95% CI, 38%-78%)
Manchikanti et al (672)	High (9/12)	High	72	≥ 80%	42% (95% CI; 30%-53%)	55% (95% CI, 38%-78%)
Manchukonda et al (673)	High (9/12)	High	65	≥ 80%	34% (95% CI; 22%-47%)	42% (95% CI, 36%-53%)

NA = Not Available or Not Applicable; CI = Confidence Interval

block studies employed ≥ 50%, ≥ 75%, or ≥ 80% pain relief as the criterion standard. Three high-quality studies reporting ≥ 50% pain relief (433,438,637), including more than 400 patients, reported variable prevalence. Two early studies by Schwarzer et al. (433,438) reported prevalence rates of 15% and 40% in Australian populations, with a false-positive rate of 38% reported in a related U.S. study (434). In contrast, a subsequent large study (637) reported a prevalence of 61% with a false-positive rate of 17%. Related to this internal inconsistency, the level of evidence for ≥ 50% pain relief as the criterion standard is Level II.

Six studies using ≥ 75% pain relief as the criterion standard (440,565,583,667-669) included 856 patients and reported prevalence rates ranging from 30% to 45%, with false-positive rates ranging from 25% to 44%. Eight studies using ≥ 80% pain relief as the criterion standard (44,368,432,637,670-673), involving 2,147 patients, demonstrated prevalence ranging from 16% to 41% in heterogeneous populations. Subgroup analyses showed a prevalence of 30% in patients younger than 65 years and 52% in those older than 65 years (667), 36% in nonobese patients and 40% in obese patients (668), and 16% in post-surgical patients (368). Based on 7 studies using ≥ 80% relief and 6 studies using ≥ 75% relief as the criterion standard, the level of evidence for diagnosing lumbar facet joint pain with controlled diagnostic blocks is Level I.

7.5.2 Cervical Facet Joint Pain

Table 15 presents the prevalence and presumed false-positive rates of cervical facet joint nerve blocks. Using the QAREL criteria, 11 of 12 studies were rated as high quality (5,43,443,577,652,671-673,676,678,679), and one was rated as moderate quality (675). Based on GRADE criteria, 7 studies were rated as high quality (5,43,652,672,673,678-680), 4 were rated as moderate quality (5,443,577,671,676), and one was rated as low quality (675). Seven studies met both high-quality QAREL and high-quality GRADE criteria (5,43,652,672,673,678,679), including 1,020 patients. Four studies met high-quality QAREL and moderate-quality GRADE criteria (5,443,577,671,676), with 466 patients, and one study met moderate-quality QAREL and low-quality GRADE criteria (675), with 318 patients. A total of 1,804 patients were included.

One placebo-controlled trial using triple blocks reported 100% pain relief (680). Since the previous systematic review (5,660), only one additional prevalence study has been published, by Manchikanti et al. (43), which used a chronic pain model similar to that used in lumbar spine studies. This study reported a prevalence of 49.3% (95% CI, 43.6%, 55.0%) and a presumed false-positive rate of 25.6% (95% CI, 19.5%, 32.8%). The average duration of > 80% relief was 6 days with lidocaine and 12 days with bupivacaine, while the total duration of > 50% relief was 31 days with lidocaine and 55 days with bupivacaine. The single-block prevalence in this cohort was 66.3% (95% CI, 60.9%, 71.7%).

Overall, 12 studies (43,443,577,652,671-673,675,676,678-680) were included, one using a single block (675) and 11 using controlled diagnostic blocks. Among controlled block studies, one used ≥ 75% pain relief as the criterion standard (676), 4 used ≥ 80% relief (43,671-673), and 6 used 100% relief (443,577,652,678-680). The single-block study (675) of moderate quality reported a prevalence range of 25% to 63% in 318 patients.

A study using ≥ 75% relief (676) in 106 patients reported a prevalence of 60% and a false-positive rate of 40%. Four studies using ≥ 80% relief (43,671-673), including more than 920 patients, reported prevalence ranging from 39% to 67%, with false-positive rates ranging from 26% to 63%. Of the 6 studies using 100% relief, only one was conducted in a heterogeneous U.S. population (443) and reported a prevalence of 55%. The remaining studies were from Australia, many of which involved whiplash populations, with prevalence ranging from 36% to 60% (577,652,678-680). The most recent large study (673) of 251 patients reported a prevalence of 39% and a false-positive rate of 45%, consistent with another Australian study (577) of 97 patients, which reported a prevalence of 36%.

Accordingly, the level of evidence for dual-controlled diagnostic blocks in the cervical spine is Level II, reflecting substantial variability and internal inconsistency, with prevalence ranging from 36% to 67% and false-positive rates ranging from 26% to 63%.

7.5.3 Thoracic Facet Joint Pain

Table 16 presents the prevalence and false-positive rates of thoracic facet joint pain from 3 studies conducted by the same group (5,672,673,681), all using ≥ 80% pain relief as the criterion standard. These high-quality studies included 183 patients and reported prevalence ranging from 34% to 48%, with false-positive rates ranging from 42% to 58%.

Using QAREL criteria, all 3 studies (5,672,673,681) were rated as high quality. Based on GRADE criteria, 2 studies (5,672,673) were rated as high quality and

one study (681) was rated as moderate quality. Two studies met both high-quality QAREL and high-quality GRADE criteria, including 137 patients, and one study met high-quality QAREL and moderate-quality GRADE criteria, including 46 patients. In total, 183 patients were evaluated.

Based on these findings, the level of evidence for the diagnostic accuracy of thoracic facet joint nerve blocks is Level II, derived from 3 high-quality controlled diagnostic studies.

7.6 Factors Influencing Diagnostic Accuracy

Understanding the multiple factors affecting diagnostic accuracy is crucial. Numerous articles have been published assessing factors influencing diagnostic accuracy and outcomes. It is generally recognized that facet joint nerve blocks are inherently nonspecific, even when performed precisely with fluoroscopic guidance utilizing low volumes. Multiple confounding factors related to spinal pain have been evaluated in the literature (95,98,368,631,635-637,667,668,685-691,697-699).

7.6.1 A Philosophical Discordance - Paradigm Shift from Acute Pain to Chronic Pain

The philosophical approach with mathematical validation of controlled diagnostic blocks by Bogduk et al. has been extensively studied (650,651), primarily in acute pain models (631,634,652,679). This philosophy is based on investigations and advocacy of comparative local anesthetic blocks as a substitute for placebo controls (685-692). The principle is that patients with genuine pain obtain short-lived relief with short-acting local anesthetics and longer relief with long-acting agents, a paradigm supported by double-blind, randomized, controlled studies demonstrating that bupivacaine has a significantly longer duration of action than lidocaine (685-692). Accordingly, controlled comparative local anesthetic blocks have been extensively validated (1,631,634,652,660,679). However, this model does not account for differences between acute and chronic pain. Bogduk et al. (631,633,634,650,651) postulated that relief exceeding the expected pharmacologic duration, defined as ≤ 2 hours for short-acting and ≤ 8 hours for long-acting anesthetics, represents a false-positive or prolonged placebo response. For practical purposes, pharmacologic durations of 45 minutes for lidocaine and 90 minutes for bupivacaine have been used.

In contrast, chronic pain represents a complex biopsychosocial condition. Manchikanti and colleagues (43,44,635-637,669,693-696,700,701) demonstrated a paradigm shift, showing that local anesthetics produce different and often prolonged effects in chronic pain compared to acute pain. Local anesthetics have been used in interventional pain management for over a century, particularly in epidural injections since 1901 and later with steroids after 1952, as well as in various nerve blocks (702,703). In chronic pain, prolonged relief may result from modulation of peripheral and central mechanisms, including reduction of noxious stimulation, decreased nociceptive input, attenuation of sensitization, and alterations in neurotransmitter release, leading to changes in central processing such as hyperalgesia, windup, nociceptive sensitization, and neural plasticity (702-704). Manchikanti et al. (43,44) demonstrated these relief patterns using a ≥ 80% criterion. In the cervical spine (43), double-block positive patients receiving lidocaine experienced ≥ 80% relief for 6 days with total relief of 31 days, while bupivacaine produced ≥ 80% relief for 12 days with total relief of 55 days. In the lumbar spine (44), lidocaine produced ≥ 80% relief for 6 days with total relief of 32 days, whereas bupivacaine produced ≥ 80% relief for 11.86 days with total relief of 55 days (Tables 17 and 18).

Based on these findings, criticism has been advanced against multiple prior descriptions regarding the appropriateness of criteria for controlled comparative local anesthetic blocks, including 50%, 75%, 80%, or 100% pain relief criterion standards,

Table 17. *Duration of relief with controlled comparative local anesthetic blocks in the diagnosis of cervical facet joint pain.*

Outcome	n	1st Diagnostic Block			2nd Diagnostic Block		
		50-79%	≥ 80%	Total Relief	50-79%	≥ 80%	Total Relief
False positive	50	24.54	6.64	31.18	26.25	0.18	26.43
Negative	99	8.11	0.04	8.15	0.00	0.00	0.00
Positive	145	24.81	6.10	30.91	43.28	11.86	55.29
Total	294	19.14	4.15	23.29	38.71	8.82	47.64

Source: Manchikanti L, Kosanovic R, Cash KA, et al. Assessment of prevalence of cervical facet joint pain with diagnostic cervical medial branch blocks: Analysis based on chronic pain model. *Pain Physician* 2020; 23:531-540 (43).

Table 18. *Duration of relief with controlled comparative local anesthetic blocks in the diagnosis of lumbar facet joint pain.*

Outcome	N	1st Diagnostic Block			2nd Diagnostic Block		
		50-79%	≥ 80%	Total Relief	50-79%	≥ 80%	Total Relief
False positive	101	24.89	5.95	30.83	23.58	3.02	26.60
Negative	96	9.63	0.02	9.65	0.00	0.00	0.00
Positive	102	26.04	6.07	32.11	42.47	12.96	55.44
Total	299	20.38	4.09	24.47	33.07	8.02	41.09

Source: Manchikanti L, Kosanovic R, Pampati V, et al. Low back pain and diagnostic lumbar facet joint nerve blocks: Assessment of prevalence, false-positive rates, and a philosophical paradigm shift from an acute to a chronic pain model. *Pain Physician* 2020; 23:519-530 (44).

along with the duration of relief with diagnostic blocks, the appropriateness of therapeutic facet joint nerve blocks, and multiple procedural aspects of RFA (1-4,14,47,57,635,636,644,645,648,649,660,669,693-696,700-706). Bogduk (634) categorized philosophical approaches into 3 groups. He described a purist approach by him and his colleagues (633,634,652), a second approach by Manchikanti et al. without a specific designation (635,637,701), and a pragmatic approach by Cohen et al. (644,645,649). However, there are substantial contrasts and differences among these approaches.

It is also important to note that Bogduk believes lumbar facet joint pain is uncommon; consequently, he asserts that the only way it can be diagnosed is by performing placebo-controlled blocks, which he considers cost-effective. Bogduk and colleagues, as well as Cohen and colleagues, continue to use an acute pain model, with one group recommending placebo-controlled blocks achieving 100% pain relief, despite using 50% or greater relief as the criterion standard in lumbar spine publications (433,434,438).

7.6.2 Age

The influence of age was assessed in 3 studies (573,667,674); however, only one study included patients with cervical facet joint pain. Manchikanti et al. (674), in assessing 424 patients with either low back or neck pain, reported an overall prevalence of neck pain of 39% with a 45% false-positive rate. They also showed that, in the cervical spine, the lowest prevalence was in younger patients (33%) and the highest in older patients aged 61 to 70 years (42%). In the lumbar spine, they showed the lowest prevalence in the younger age group (18%) and the highest prevalence in those aged 51 to 60 years. However, in contrast to other evaluations, they showed a lower prevalence in those aged 41 to 50 years.

Three other studies also reported age-related influences (440,573,667). In 2 studies, DePalma et al. (440,573) assessed 153 patients and found that lumbar facet joint pain was the most likely source of chronic low back pain in men approximately 54 years of age, regardless of body mass index (BMI). However, for women who were 65 years of age, facet joint pain was most likely. Manchikanti et al. (667) reported a significantly higher prevalence of facet joint pain in patients older than 65 years in a study of 100 patients.

7.6.3 Psychological Factors

The psychological aspects of chronic musculoskeletal pain have been extensively discussed (707-712). Cognitive and emotional factors have a surprisingly important influence on pain perception, and these relationships are interrelated with the regions of the brain that control pain perception, attention, expectation, and emotional states (712). Multiple studies have shown that patients with chronic pain exhibit alterations in brain regions involved in the cognitive and emotional modulation of pain (707). This interplay has been described over the years as psychogenic rheumatism (708), functional somatic syndromes (709), and polysymptomatic distress (710). The Diagnostic and Statistical Manual of Mental Disorders (DSM-V) has replaced the previous category of somatoform disorders with "somatic symptom disorder (SSD)" (711). The diagnosis is characterized by distressing somatic symptoms, along with abnormal thoughts, feelings, and behaviors in response to the symptoms. Consequently, the influence of psychological factors on the diagnosis and management of facet joint pain is crucial.

The influence of psychological factors was assessed in 2 studies (713,714). Manchikanti et al. (713) assessed 438 patients undergoing controlled comparative local anesthetic blocks, showing that the prevalence of facet joint pain ranged from 25% to 40% in those without psychopathology. In contrast, it ranged from 28% to 43% in those diagnosed with either major depression, generalized anxiety disorder, or somatization disorder, compared to 23% to 39% in patients with a negative

psychological diagnosis. Further, they also showed that regional facet joint pain prevalence and false-positive rates were higher in the cervical region in patients with major depression. However, no differences were identified in the lumbar and thoracic regions. Wasan et al. (714) also assessed the influence of psychological factors on lumbar and cervical facet joint pain in a small sample of 86 patients. They concluded that the low psychopathology group reported a mean 23% improvement in pain at one month, whereas the high psychopathology group reported worsening of pain.

7.6.4 Body Mass Index

The influence of BMI was assessed in 2 studies (573,668). In these assessments, DePalma et al. (573), in a study of 153 patients with chronic low back pain, demonstrated a correlation between significant increases in facet joint pain and BMI. However, Manchikanti et al. (668) reported a similar prevalence of 36% in both groups.

7.6.5 Influence of Surgery

The influence of surgery was assessed in multiple studies of the lumbar spine and in one study of the cervical spine (361,368,369,377-379). Overall, these results showed that the prevalence of facet joint pain was lower in patients after lumbar spine surgical intervention (361,368,377), with no difference observed in the cervical spine (369). The assessment by Manchikanti et al. (368) showed a prevalence of facet joint pain of 16% in these patients. The number of patients studied was too low to reach definitive conclusions in the studies by DePalma and colleagues.

7.6.6 Influence of Opioid Exposure

Many patients present to interventional pain management for long-term opioid therapy. However, there have been relatively few studies evaluating opioid exposure and the subsequent validity of diagnostic blockade or the diagnostic accuracy of facet joint pain using noninvasive measures. Manchikanti et al. (698) assessed the influence of prior opioid exposure on diagnostic facet joint nerve blocks in 438 patients. They divided the patients into no-opioid use, low-opioid use, moderate-opioid use, and heavy-opioid use groups. The results showed no correlation between prior or current opioid use and the diagnostic validity of controlled comparative local anesthetic blocks. The findings also demonstrated no significant difference in patients exposed to opioids before undergoing facet joint nerve blocks. However, Cohen et al. (648) reported that opioid use was associated with failure of lumbar RFA treatment.

7.6.7 Influence of Sedation

The influence of sedation has been discussed extensively and has generated significant debate among proponents and opponents of sedation. Previously published ASIPP guidelines (1) and Medicare LCDs (95,98-100) have restricted mild sedation for all facet joint interventions, except for RFA, for which moderate sedation or monitored anesthesia care may be administered. General anesthesia is not advised for any facet joint interventions.

Multiple authors have investigated the need for sedation and its potential influence on the diagnostic validity of facet joint nerve blocks (641,642,697,715-718). Patel et al. (719) published a 2024 study evaluating the effect of sedation on diagnostic lumbar medial branch blocks for facet joint pain. In the study, they evaluated 49 patients with sedation and 46 without sedation. They used a 50% pain relief standard with dual blocks and proceeded to RFA with positive blocks. Further, for those patients who received RFA after 2 successful diagnostic medial branch blocks using a 50% pain relief standard, the block was considered false-positive if the patient did not achieve at least 50% pain relief at 4 and 8 weeks following the therapeutic RFA procedure. For sedated patients, 0.5 to 2.5 mg of midazolam was administered. The results showed that, when comparing the absolute difference in pain scores before and after the medial branch block procedure, there was no significant difference between the sedated and non-sedated groups at either medial branch block one or two. They also showed that the frequency of false-positive medial branch blocks in sedated and non-sedated patients was not significantly different at 4 weeks or 8 weeks post-radiofrequency ablation. Overall, 64.5% of patients were considered false-positive at 4 weeks post-radiofrequency ablation, increasing to 73.1% at 8 weeks post-radiofrequency ablation. At 4 weeks, 60% of sedated patients were false-positive, compared with 50% of non-sedated patients. Similarly, 70% of sedated patients were considered false-positive at 8 weeks, compared to 75% of non-sedated patients. They concluded that administering midazolam for sedation did not alter the patient's perceived pain intensity following medial branch blocks or the response to radiofrequency ablation.

Among the previous studies, Manchikanti et al.

(641,642,697,715) assessed the influence of sedation, either with midazolam, fentanyl, or midazolam combined with fentanyl, in multiple controlled trials. In a prospective, randomized, double-blind, placebo-controlled evaluation (715), the authors assessed placebo groups receiving sodium chloride solution and 2 experimental groups receiving either midazolam or fentanyl in patients with a confirmed diagnosis of lumbar facet joint pain. The evaluation was performed before lumbar facet joint nerve block treatment, with a significant return of pain. The results showed that 80% or greater pain relief was observed in 2% of patients in the sodium chloride group, 5% in the midazolam group, and 7% in the fentanyl group.

In contrast, 50% or greater pain relief was observed in 7% of patients in the sodium chloride group, 5% in the midazolam group, and 13% in the fentanyl group. They concluded that using an 80% pain relief standard with the ability to perform previously painful movements was not confounding. However, there may be some confounding, specifically with the administration of fentanyl and the use of 50% pain relief as the standard.

In another study, Manchikanti et al. (697) assessed the role of sedation in cervical facet joint pain using the same protocol described above. The results showed that, when 80% pain relief and the ability to perform previously painful movements were used as the standard, 5% of patients in the sodium chloride group reported pain relief, compared with 8% in the midazolam group and 8% in the fentanyl group. However, when 50% relief was considered the standard, 8% of patients in the sodium chloride group, 13% in the midazolam group, and 27% in the fentanyl group were shown to be positive. Consequently, with 80% pain relief, there was no major confounding; however, there was significant confounding with 50% pain relief.

Manchikanti et al. (641) also assessed similarities among populations with involvement of both the cervical and lumbar regions and the effect of sedation. Overall, in these patients with combined cervical and lumbar facet joint pain, 50% of patients in the placebo group were relaxed or sedated, and 10% reported ≥ 80% relief and the ability to perform previously painful movements. In contrast, 100% of patients in the midazolam and fentanyl groups were relaxed or sedated. As many as 10% of patients reported significant relief (80% or greater) with the ability to perform previously painful movements. Thus, patients with lumbar facet joint pain alone, cervical facet joint pain alone, or a combination of lumbar and cervical facet joint pain exhibit distinct patterns of behavior.

In addition, Manchikanti et al. (642) assessed the role of placebo and nocebo effects associated with perioperative administration of sedatives and opioids in interventional pain management. Surprisingly, they found that between 13% and 30% of patients across all 3 groups in the study reported that their pain relief following injection was better than their previous experience. A smaller proportion, ranging from 3% to 8% of patients in all 3 groups, rated their experience following injection as worse than their previous experience. The majority of patients, ranging from 67% to 79%, regardless of group, described no significant differences compared to their previous experience with sedation and treatment for cervical or lumbar facet joint pain.

Cohen et al. (716) described the effect of sedation on diagnostic accuracy and treatment outcomes for diagnostic injections, including sacroiliac joint injections and sympathetic blocks. They concluded that the use of sedation during diagnostic injections may increase the rate of false-positive blocks, potentially leading to misdiagnosis and unnecessary procedures, although it does not affect satisfaction with outcomes. However, they also discussed scenarios in which the judicious use of anxiolytics and even analgesics may enhance accuracy, including technically challenging procedures such as those in obese patients, extremely anxious individuals, and cognitively impaired patients who may not be able to distinguish their index pain from procedure-induced discomfort.

In another study (717), the question of whether sedation was indicated before spinal injections was evaluated in 301 consecutive spinal injection patients. The results showed that 58% of patients chose sedation. Patients who requested sedation were more anxious. The majority of patients were satisfied with their decision regarding sedation, and diazepam effectively controlled anxiety in 90% of patients. They concluded that routine sedation does not appear to be required for patients receiving spinal injections; however, more anxious patients benefit from sedation before injection. In a survey evaluating conscious sedation with epidural and zygapophysial injections (718), 500 consecutive patients undergoing spinal injections were assessed. In this survey, only 17% of patients requested sedation before an injection; however, 28% stated that they would request sedation if they were to undergo a second injection.

Thus, opinions remain highly variable depending on philosophy, practice type, and facility availability. Kaye et al. (720) also published guidelines for sedation and fasting for patients undergoing interventional pain management procedures, discussing numerous issues related to complications associated with monitored anesthesia care and heavy sedation.

Overall, there is no literature supporting the use of monitored anesthesia care, specifically with separate personnel from an anesthesia department, as it requires additional resources and expenditures and is neither indicated nor beneficial in any setting. All LCDs and medical policies state that sedation is not necessary; however, they continue to reimburse for it, thereby increasing the cost of interventional techniques.

7.6.8 Volume of Injection

Volume of injections for diagnostic blocks has been a frequently discussed issue (5,432,434,438,631-634). It has been recommended that volumes of less than 0.5 mL per level be used for diagnostic blocks. In one study, Cohen et al. (699) evaluated the effect of different injectate volumes in the cervical spine and paradoxically reported results contradictory to the hypothesis that low volumes must be used, demonstrating a higher prevalence of 55% facet joint pain when low volume was utilized, in contrast to a prevalence of 25% when high volume was utilized.

Cervical medial branch block volume and dispersion patterns were studied by Wahezi et al. (721). In this cadaveric study of 6 cervical spines, cervical medial branch blocks were performed bilaterally in the mid-cervical spine using a posterior approach under fluoroscopic guidance with 0.25 or 0.5 mL of Omnipaque 180 mg iodine/mL and 1% medical-grade methylene blue. They performed post-injection CT imaging and gross dissection to assess injectate spread. The results suggested that 0.5 mL injections of local anesthetic during cervical medial branch blocks contacted many unintended targets, thereby decreasing the specificity of targeted diagnostic cervical medial branch blocks. They also demonstrated that 0.25 mL of injectate reliably blocked the medial branches without extensive extravasation, suggesting fewer local anesthetic effects on distant tissues, increasing the specificity of cervical medial branch blocks, and likely improving RFA planning.

7.6.9 Influence of Diagnostic Blocks on Their Outcomes

Multiple authors have studied the value and validity of diagnostic blockade, not only for diagnosing facet joint pain, but also for subsequent therapeutic outcomes. The multiple issues raised include the role of single blocks versus dual blocks, pain relief thresholds of 50%, 80%, or 100%, medial branch blocks versus intraarticular injections, and involvement of a single region versus 2 regions or multiple regions. The validity of lumbar facet joint nerve blocks as a gold standard for diagnosing lumbar facet joint pain remains questionable. Various reference standards applied in surgical situations, such as biopsy, surgery, or autopsy, are difficult to apply in diagnosing chronic low back pain of facet joint origin, and pain relief following diagnostic blocks, even with provocation testing, continues to be viewed with skepticism. Long-term follow-up remains the only standard for confirming the validity of facet joint nerve blocks and establishing them as the gold standard. This has been achieved in numerous studies. However, outcomes have also been evaluated specifically by assessing diagnostic accuracy across multiple studies.

Pampati et al. (635) assessed the accuracy of diagnostic lumbar facet joint nerve blocks with follow-up for 2 years after a positive diagnosis. In this study, a total of 491 patients were assessed, yielding a prevalence rate of 31% and a false-positive rate of 42%, with 152 dual block-positive patients. Subsequently, these patients underwent therapeutic lumbar facet joint nerve blocks. At the end of one year, 93% of the patients continued to respond to therapeutic facet joint nerve blocks, and at the end of 2 years, 89.5% of the patients were considered to have lumbar facet joint pain.

Manchikanti et al. (637) also assessed the implications of 50% relief and 80% relief with single-block or controlled diagnostic blocks. In this assessment, they compared the data from Pampati et al. (635) on 152 patients with a sustained diagnosis of lumbar facet joint pain at the end of 2 years, with 89.5% achieving at least 80% relief when the diagnosis was established with dual blocks. In this evaluation, they compared the results of 110 patients undergoing lumbar facet joint nerve blocks who met the criteria of at least 50% relief and completed a 2-year follow-up. In this group, at the end of 2 years, the diagnosis of lumbar facet joint pain was sustained in only 51% of patients, compared with 89.5% of patients with 80% pain relief. The study also showed that single blocks resulted in inordinately high positive rates, with a 50% relief standard producing a single-block prevalence of 73%, whereas dual blocks yielded 61%. In contrast, with the 80% pain relief

standard, single-block prevalence was 53%, whereas dual-block prevalence was 31% (649,698).

In contrast, Cohen et al. (645,648,649) have published multiple articles contradicting the prognostic effectiveness of facet joint nerve blocks and the role of dual blocks with 80% pain relief. All of their studies used only a 50% pain relief standard with a single block. In a study evaluating medial branch blocks or intraarticular injections as a prognostic tool before lumbar facet joint radiofrequency denervation (648), they showed that 70.3% of medial branch block patients experienced 50% or greater pain relief at 3-month follow-up, compared with 60.8% in those who underwent intraarticular injections. Even though they postulated various theories regarding the response to radiofrequency ablation, they nevertheless demonstrated that diagnostic facet joint injections provide significant long-term relief. Cohen et al. (649) also assessed the optimal cutoff for diagnostic lumbar facet blocks in a prospective correlational study. They concluded that there were no significant differences in radiofrequency outcomes across any medial branch block relief cutoff above 50%. Cohen et al. (645) further assessed the role of 0, 1, and 2 diagnostic medial branch block treatment paradigms before lumbar facet radiofrequency denervation. In this analysis, they clearly showed that dual blocks were associated with superior responses, yet they continued to claim that a single block or no block was effective in managing facet joint pain. In another study (644), they assessed the effectiveness of lumbar facet joint blocks before RFA and again demonstrated some improvement with diagnostic blocks. They also used criteria for a positive outcome at one month before radiofrequency neurolysis. Once again, they propagated the theory that facet joint nerve blocks are not therapeutic based on what has been described as a flawed theory.

The role of facet joint pain prevalence was also studied in patients with involvement of a single region or multiple regions (671). Manchikanti et al. (671), in a study evaluating the correlation between facet joint pain in the lumbar and cervical spine in patients with involvement of both regions, showed that cervical facet joint pain was present in 67% of patients, with a false-positive rate of 63% with a single block. In contrast, the prevalence of lumbar facet joint pain was observed in 40% of patients, with a 30% false-positive rate using a single block in patients presenting with chronic low back pain. No significant difference was noted in prevalence or false-positive rate based on involvement of a single region or both cervical and lumbar regions. However, in chronic low back pain of facet joint origin with involvement of single or multiple regions, the prevalence of lumbar facet joint pain in patients with low back pain alone was only 21%, compared with 41% in patients with low back pain and involvement of other spinal regions receiving controlled comparative local anesthetic blocks. A false-positive rate of 17% in patients with low back pain alone and 21% in patients with involvement of multiple spinal regions was demonstrated with single blocks (670). The authors concluded that the incidence of facet joint pain is lower when only a single spinal region is involved than when multiple regions are involved (21% versus 41%).

7.6.10 Conservative Therapy Before Diagnostic Blocks

Conservative therapy includes pharmacologic and nonpharmacologic modalities of treatment, including physical therapy, occupational therapy, massage, and structured exercise programs. Drug therapy includes non-opioid pharmacologic therapies such as nonsteroidal anti-inflammatory agents, muscle relaxants, antidepressants, anticonvulsants, local anesthetics, and, finally, opioids. Nonpharmacologic and noninterventional techniques for managing chronic pain include exercise programs, physical and occupational therapy, massage, transcutaneous electrical nerve stimulation, extracorporeal shockwave therapy, and osteopathic as well as chiropractic treatments.

It is recommended that diagnostic blocks be performed only after 3 months from the onset of pain and following failure of multiple modalities of conservative management. As shown in Section 4 on the prevalence of healthcare modalities for managing spinal pain, all modalities demonstrate some degree of effectiveness, with occasional long-term benefit and no requirement for further management. Consequently, based on available guidance, medical policies, and LCDs (1,98,102-104,383,385,387,388), conservative management and failure of conservative therapy must be documented before diagnostic blocks are performed.

7.7 Strength of Evidence and Recommendations

1. Lumbar Spine: The **level of evidence is I to II** with **moderate to strong strength of recommendation** for the diagnosis of lumbar facet joint pain by performing lumbar diagnostic facet joint nerve blocks.
2. Cervical Spine: The **level of evidence is II** with

moderate strength of recommendation for the diagnosis of cervical facet joint pain by performing cervical diagnostic facet joint nerve blocks.

3. Thoracic Spine: The **level of evidence is II** with **moderate strength of recommendation** for the diagnosis of thoracic facet joint pain by performing thoracic diagnostic facet joint nerve blocks.
    - The **level of evidence is II** that interventional diagnostic approaches should be applied in the chronic phase after 3 months from onset and following failure of conservative management modalities, including medical therapy, structured exercise programs, and physical therapy, with noninvasive diagnostic assessment leading to diagnostic facet joint nerve blocks, with **strong strength of recommendation**.
    - The **level of evidence is III** regarding the influence of psychological factors affecting the diagnosis, with a moderate strength of recommendation to exercise caution in patients with combined depression, anxiety, and somatization disorder.
4. The **level of evidence is II** that intraoperative opioids may affect the diagnostic validity of facet joint nerve blocks, with a **strong strength of recommendation** to avoid opioids.
5. The **level of evidence is II** showing that benzodiazepines do not affect the validity of diagnostic facet joint nerve blocks, with a **moderate strength of recommendation** that they may be utilized for mild sedation in low doses.
    - The **level of evidence is III** that mild sedation may be required and utilized during the performance of facet joint interventions, with **moderate strength of recommendation** to provide sedation during therapeutic interventions.
    - The **level of evidence is III** that moderate sedation or monitored anesthesia care may be required for RFA, with **moderate strength of recommendation**.
    - The **level of evidence is III** indicating that the prevalence of facet joint pain and false-positive results may be higher in patients with involvement of multiple regions, that the prevalence of facet joint pain is lower in post-surgical syndrome, and that prevalence is higher in the older population, with a **moderate strength of recommendation** to consider these factors when providing appropriate diagnosis and therapy.

8.0 Therapeutic Facet Joint Interventional Techniques

Key Question 6: What is the evidence for the effectiveness of commonly utilized therapeutic facet joint interventional therapies, including radiofrequency ablation, facet joint nerve blocks, and intraarticular injections, in the management of chronic spinal pain?

For therapeutic purposes, 3 interventions are available: intraarticular injections, facet joint nerve blocks, and RFA (2-4,35,38,47,48,51,56-58,69-73,693-890). Multiple systematic reviews, RCTs, observational studies, and guidelines have been published. The latter 2 interventions have been shown to be clinically appropriate with favorable clinical evidence and cost utility.

8.1 Methods

Methodology included identification of systematic reviews and studies, including relevant RCTs and observational studies with descriptions of appropriate outcomes and follow-up. All studies were required to include the primary outcome parameter of pain relief and other secondary outcomes such as improvement in functional status. For therapeutic modalities, short-term relief was defined as any improvement in pain and function lasting less than 6 months, whereas long-term improvement in pain relief and function was defined as lasting at least one year.

8.1.1 Literature Search

All available literature in all languages from all countries providing appropriate management with outcome evaluations were considered for inclusion. Searches were performed from the following sources without language restrictions:

1. PubMed from 1966 www.ncbi.nlm.nih.gov/sites/entrez?db=pubmed
2. Cochrane Library www.thecochranelibrary.com/view/0/index.html
3. Google Scholar https://scholar.google.com/
4. US National Guideline Clearinghouse (NGC) www.guideline.gov/
5. Previous systematic reviews and cross references
6. Clinical Trials www.clinicaltrials.gov/
7. All other sources including non-indexed journals and abstracts

The search period was from 1966 through October 2025.

8.1.2 Search Strategy

The search strategy emphasized chronic cervical, mid back, and low back pain, facet or zygapophysial joint pain, and cervical, thoracic, and lumbar facet joint interventions, including RFA, intraarticular injections, and facet joint nerve blocks.

Search criteria were as follows: ("chronic low back pain" OR "chronic back pain" OR "chronic neck pain" OR "chronic thoracic pain" OR "disc herniation" OR "discogenic pain" OR "facet joint pain" OR "herniated lumbar discs" OR "nerve root compression" OR "lumbosciatic pain" OR "postlaminectomy" OR "lumbar surgery syndrome" OR "radicular pain" OR "radiculitis" OR "sciatica" OR "spinal fibrosis" OR "spinal stenosis" OR "zygapophysial" AND "facet joint" OR "zygapophyseal" OR "zygapophysial" OR "medial branch block" OR "diagnostic block" OR "radiofrequency" OR "intraarticular injection").

8.1.3 Methodologic Quality or Bias Assessment

Methodologic quality assessment utilized Cochrane review criteria (Appendix Table 5) (722) and Interventional Pain Management Techniques - Quality Appraisal of Reliability and Risk of Bias Assessment (IPM-QRB) for RCTs (Appendix Table 6) (723).

8.1.4 Data Collection Analysis

Data collection and analysis, including appropriate inclusion and exclusion criteria, methodologic quality assessment, data extraction and management, measurement of treatment effects in data synthesis with qualitative and quantitative analysis, and analysis of evidence, were performed as described in previous guidelines and systematic reviews (1,15,45,65,66,123,129). The data analysis was conducted utilizing best evidence synthesis with 5 levels of evidence ranging from strong (Level I) to opinion- or consensus-based (Level V), as shown in Table 3 (130-133).

Criteria utilized for the Cochrane review were categorized as high quality, moderate quality, and low quality with scores of 8 to 13, 4 to 7, and less than 4, respectively. For IPM-QRB and IPM-QRBNR criteria, scores of 32 to 48 were considered high quality, 16 to 31 moderate quality, and less than 16 low quality. Analysis was performed only if new studies were available since the previous publications.

8.1.5 Grading of Evidence

The grading of evidence and recommendations was based on a qualitative modified approach to grading of

evidence as described by ASIPP (132,724), the GRADE method (133,134), and the AHRQ strength of recommendations (129,131). Table 3 provides a modified qualitative approach to grading evidence described by ASIPP (132). Table 4 provides a guide for the strength of recommendations developed by the NEATS instrument (130), as modified by the opioid guideline panel (15), and adapted by the present guideline panel.

The grading of evidence for facet joint interventions in spinal pain is based on RCTs, observational studies, and other clinical reports. Systematic reviews and meta-analyses were also utilized. These grading systems specify levels of scientific evidence and provide an approach for judging the quality of evidence and the strength of recommendations, similar to AHRQ (129-131,133,134).

8.1.6 Assessment Based on Grading of Recommendations Assessment, Development and Evaluation (GRADE) Criteria

GRADE is a transparent framework for developing and presenting evidence summaries, providing a systematic approach for making clinical practice recommendations (133,134). It is the most widely adopted tool for grading evidence quality and making recommendations. GRADE includes 4 levels of evidence, also referred to as certainty or quality of evidence: very low, low, moderate, and high, as shown in Table 1. Certainty of evidence is based on risk of bias or the methodologic quality of the studies, imprecision, inconsistency, indirectness, and publication bias. Based on these factors, confidence in the evidence may be increased or decreased. Reasons for rating certainty of evidence upward or downward are shown in Table 2.

8.1.7 Outcome Measures

An outcome is considered clinically significant if a 2-point reduction on the pain scale is achieved using the VAS or NRS, or if at least a 50% reduction in pain and improvement in functional status is achieved in 50% of the treatment group. A positive study is considered clinically significant and effective when the primary outcome is statistically significant at a p-value ≤ 0.05.

8.1.8 Analysis of Evidence

The evidence was analyzed utilizing qualitative and quantitative evidence synthesis. When applicable, quantitative evidence synthesis was performed using conventional and single-arm meta-analyses. Previous analyses were utilized when analyses had been performed recently and no additional interval studies were available.

8.1.9 Qualitative Analysis

The qualitative analysis was performed based on best-evidence synthesis. The analysis was modified and collated using multiple criteria, including the Cochrane Review criteria and USPSTF criteria as illustrated in Table 3 (132). The analysis utilized 5 levels of evidence, ranging from strong to opinion- or consensus-based.

8.1.10 Meta-Analysis

8.1.10.1 Dual-Arm Meta-Analysis

Software Review Manager [Computer program], version 5.4 from The Cochrane Collaboration, 2020, was used for dual-arm meta-analysis. Data from the studies were reported as standardized mean differences (SMD) with 95% confidence intervals (CI) for pain and functional improvement. Data were plotted using forest plots to evaluate treatment effects utilizing random-effects models. Heterogeneity was interpreted using I2 statistics.

8.1.10.2 Single-Arm Meta-Analysis

For single-arm meta-analysis, Comprehensive Meta-Analysis software, version 3.0, was utilized (Biostat Inc., Englewood, NJ). Data from the studies were reported as mean differences with 95% CI for pain and functional improvement. Data were plotted using forest plots to evaluate treatment effects. Heterogeneity was interpreted using I2 statistics.

8.2 Methodologic Quality and Risk of Bias Assessment

Key recommendations included transparency and reproducibility of judgments, separation of risk of bias from other constructs such as applicability and precision, and evaluation of risk for each outcome.

8.2.1 Randomized Controlled Trials (RCTs)

8.2.1.1 Scoring Cochrane Review Criteria

Utilizing Cochrane Review criteria (722), as shown in Appendix Table 5, studies meeting the inclusion criteria and scoring at least 9 of 13 criteria were considered high quality; studies scoring 5 to 8 criteria were considered moderate quality; and studies scoring fewer than 5 criteria were deemed low quality and excluded.

8.2.1.2 Scoring IPM-QRB Criteria

Based on IPM-QRB criteria for randomized trials (723), as shown in Appendix Table 6, studies meeting the inclusion criteria and scoring from 32 to 48 were considered high quality, studies scoring from 16 to 31 were considered moderate quality, and studies scoring less than 16 were considered low quality and were excluded.

8.3 Results

Based on comprehensive search criteria there were multiple studies considered for inclusion (56-58,693,694,701,706-712,725-805). The results are shown in Fig. 17.

8.3.1 Radiofrequency Ablation

Radiofrequency ablation utilizes electrical current to generate heat, interrupting pain transmission by modulating neural structures through thermal energy (806-809). In 1931, the first reported use of RFA for pain management occurred when Kirchner performed RFA of the Gasserian ganglion for trigeminal neuralgia (810). In the 1950s, with the development of commercial radiofrequency generators, the clinical use of RFA expanded (811). Subsequently, in the 1990s, when pulsed and cooled RFA techniques emerged, publications became more widespread, increasing in number into the early 2000s (807,812,813).

There are multiple RFA subtypes, including continuous radiofrequency (CRF), pulsed radiofrequency (PRF), and cooled radiofrequency ablation (CRFA). CRF was introduced in 1974. This method of ablation uses an electrical generator to produce heat at 90° for 90 to 120 seconds, damaging both peripheral and central nerves (808). Historically, CRF was used to treat facet joint pain; however, since its development, its applications in pain management have expanded. Earlier models had limitations due to the risk of deafferentation syndrome, which caused patients to experience pain at sites other than the treatment area and produced re-

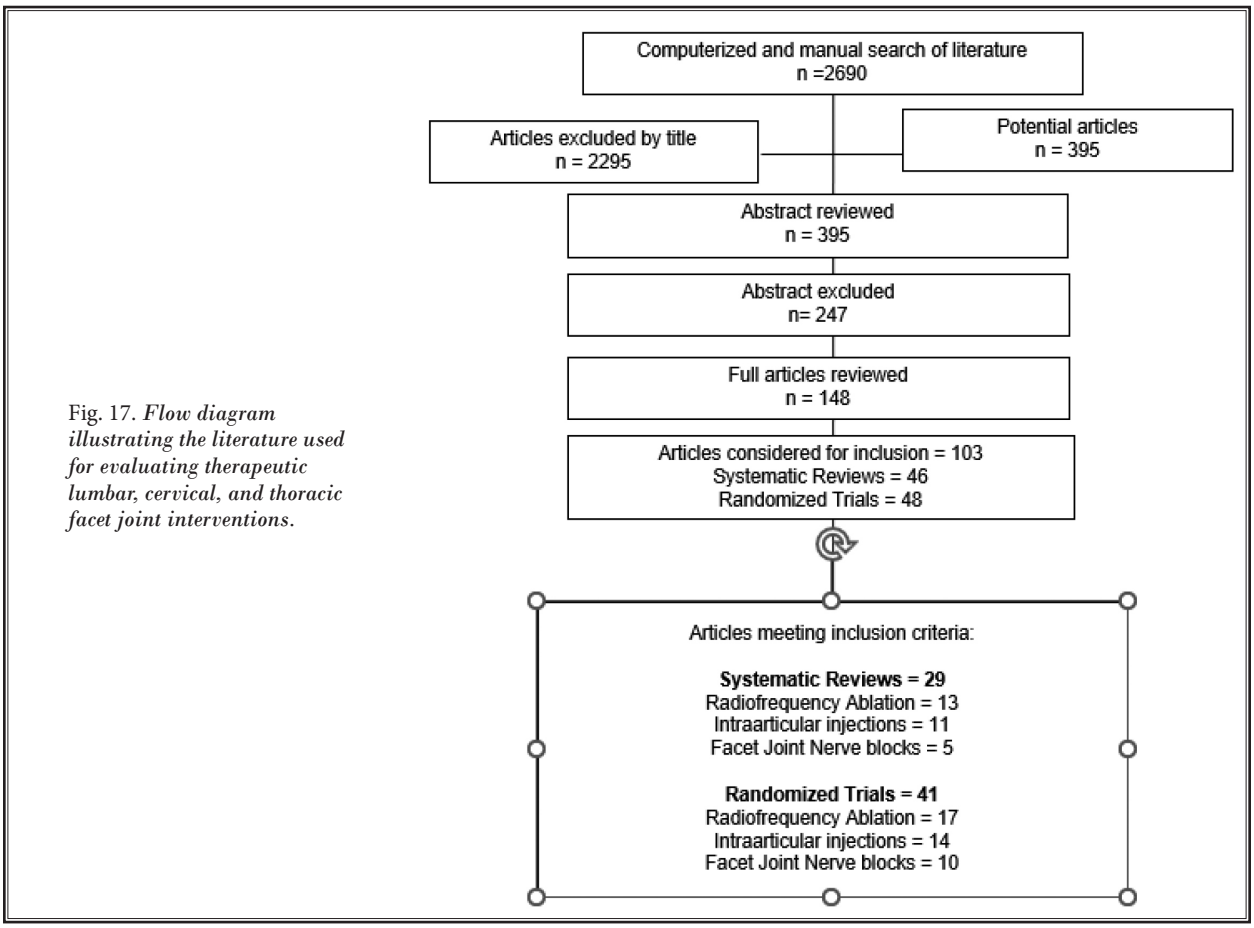


Fig. 17. *Flow diagram illustrating the literature used for evaluating therapeutic lumbar, cervical, and thoracic facet joint interventions.*

gional motor deficits (808,814). To date, with the ability to modify both temperature and probe size based on the size of the target lesion, CRF has become a highly precise and minimally invasive procedure (808).

PRF was introduced as an alternative to CRF. By delivering low-intensity, short-duration pulses to sensory nerves at a maximum temperature of only 45° for 2 to 4 minutes, the nerves are modulated but not destroyed, thereby avoiding the complications of deafferentation pain syndrome (808,815).

Cooled radiofrequency ablation is an alternative to both CRF and PRF. This technique utilizes a larger probe size and lower temperatures than CRF and PRF, allowing larger tissue areas to be targeted (808,816-818). With CRFA, probe size, temperature, and duration of current can all be modified to control lesion size.

Since its inception, there have been a number of modifications to the RFA probe or cannula. One variation is the multi-tined cannula. Upon appropriate placement of the probe, 3 tines are deployed from the tip, increasing the cannula's active surface and thereby producing a larger area of ablation (819).

Cryoneurolysis has also been employed as an alternative therapy to RFA (820). With cryoneurolysis, cold temperatures between -60° and -88° are applied near the targeted nerve to create an ice ball, which disrupts nerve conduction pathways through Wallerian degeneration while preserving the epineurium, perineurium, and endoneurium, thereby allowing for nerve regrowth (820-823). Additionally, a technique that transects the medial branch nerve under direct visualization to treat facet joint syndrome has been described using endoscopic rhizotomy ablation (749,824-826). Finally, a newer needleless version of ablation is emerging that utilizes High Intensity Focused Ultrasound (HIFU).

Following its introduction, there was a gradual increase in the utilization of RFA for the management of facet joint pain, which grew exponentially through 2020. RFA subsequently demonstrated a plateau and later a decline in utilization (1,4,6,8-10,14,35,38,47,48).

8.3.1.1 Systematic Reviews

Search criteria yielded 13 acceptable systematic reviews of RFA filtered using highly variable methodological assessments. The conclusions were mixed.

Manchikanti et al. (4), in a systematic review and meta-analysis, identified 17 RFA RCTs meeting inclusion criteria (58,60,727-731,740,761,764,827-830). All studies underwent quality assessment using both the Cochrane review criteria and the IPM-QRB instrument. Applying a best-evidence synthesis approach incorporating both qualitative and quantitative analyses, along with the GRADE framework and clinical applicability criteria, the resulting evidence was found to be valuable, relevant, and clinically applicable.

In performing quantitative analysis utilizing dual-arm conventional meta-analysis at 6 months, only 6 trials (58,727,731,764,827,828) with 559 patients were eligible for inclusion. These studies compared RFA versus control. There was one placebo- or sham-controlled trial (727) including 40 patients. The results of this analysis showed a statistically significant difference in pain levels between the 2 groups [SMD -0.69 (-0.89, -0.50), $P < 0.001$], as shown in Fig. 18A.

Similarly, a 6-month analysis of functionality in control versus steroid groups was performed utilizing 3 trials (58,731,827) with 339 patients. There were no placebo- or sham-controlled trials. The results did not show a statistically significant difference in functionality levels between the 2 groups [SMD -0.28 (-0.50, -0.07), $P = 0.90$] (Fig. 18B).

Twelve-month analysis was performed including 4 trials (58,764,827,828) with 463 patients evaluating RFA versus control. There were no placebo- or sham-controlled trials. The results showed a statistically significant difference in pain levels between the 2 groups [SMD -0.46 (-0.69, -0.23), $P < 0.001$] (Fig. 19).

In contrast, a 6-month single-arm conventional meta-analysis was performed with inclusion of 7 studies (58,730,731,740,761,828,830) evaluating pain relief. There was only one placebo- or sham-controlled trial (730), which involved 60 patients, as shown in Fig. 20. The pooled mean difference in pain scores from baseline to the 6-month follow-up was a significant 3.419-point decrease (95% CI: -4.736 to -2.101, $P < 0.0001$).

A 12-month analysis including 4 studies (58,730,761,828) demonstrated a mean difference in pain scores from baseline to the 12-month follow-up of 4.190 points (95% CI: -5.748 to -2.632, $P < 0.0001$) (Fig. 21).

The analysis incorporated GRADE criteria utilizing 5 levels of evidence and assessing factors as shown in Table 19. Overall, 2 studies (727,772) demonstrated a high level according to GRADE assessment, whereas 6 studies (729-731,740,761,764) were rated as moderate and 9 studies (58,60,728,748,827-831) showed low or very low grading. Overall, 8 of the 17 studies demonstrated moderate or higher grading.

In 2023, Manchikanti et al. (47) published a systematic review and meta-analysis evaluating the effective-

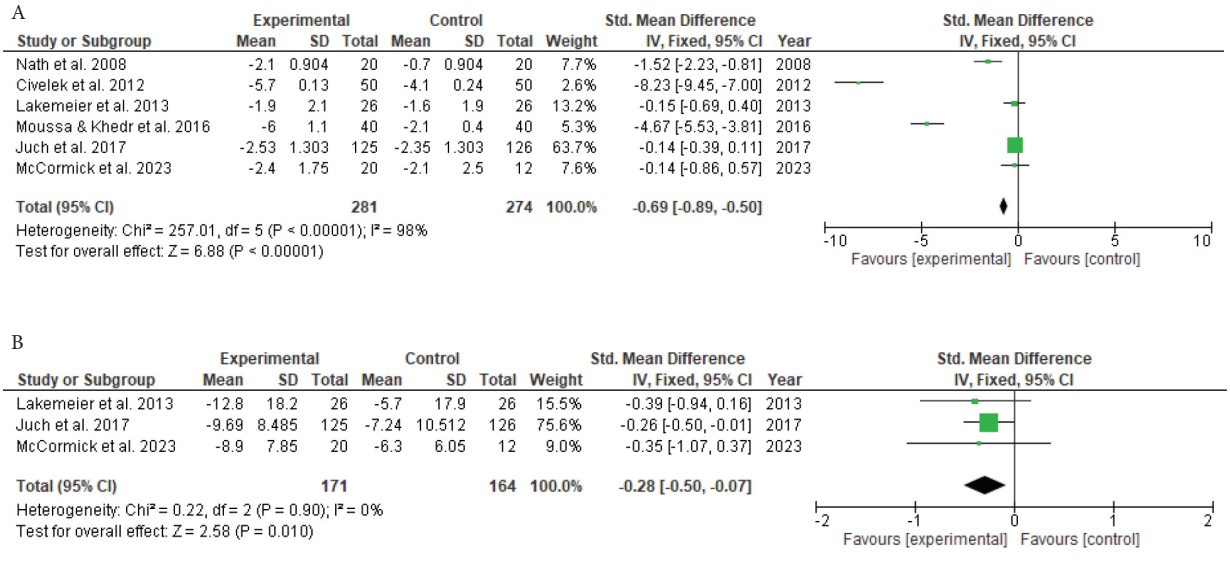


Fig. 18. *Outcome results of radiofrequency ablation at 6 month follow-up with functionality.*
A. 6 Months NRS radiofrequency ablation vs. control.
B. 6 month functionality (ODI) radiofrequency ablation vs. control.
Twelve-month analysis was performed including 4 trials (58,764,827,828) with 463 patients

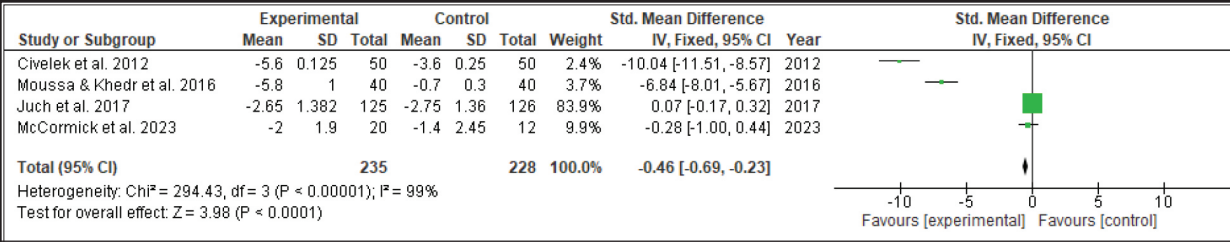


Fig. 19. *Results of 12-month outcomes of radiofrequency with pain relief*

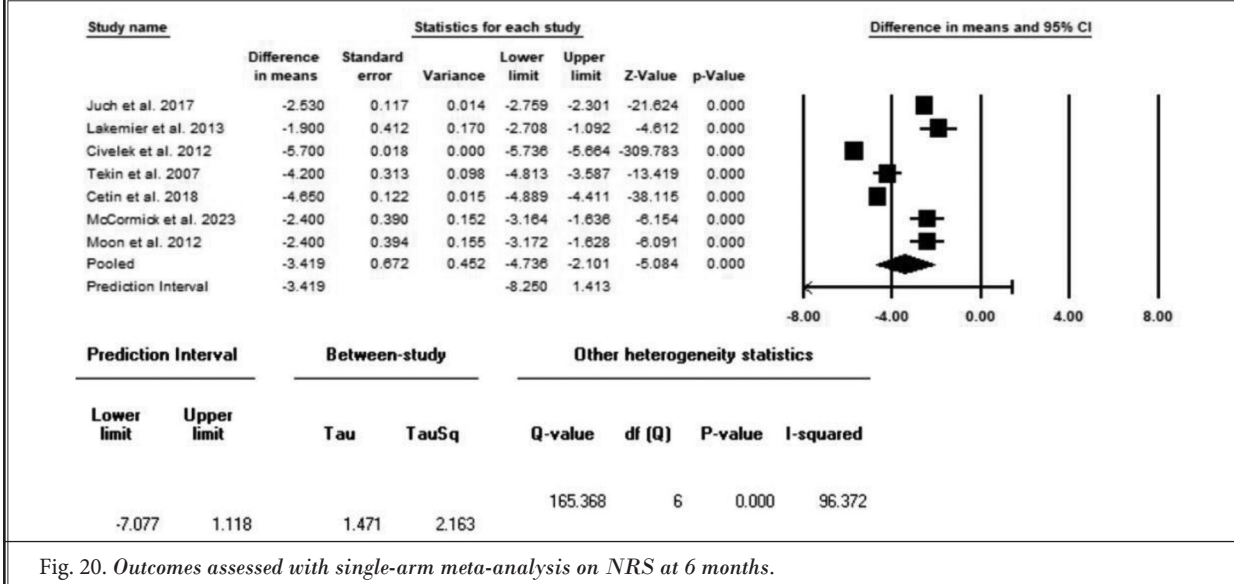


Fig. 20. *Outcomes assessed with single-arm meta-analysis on NRS at 6 months.*

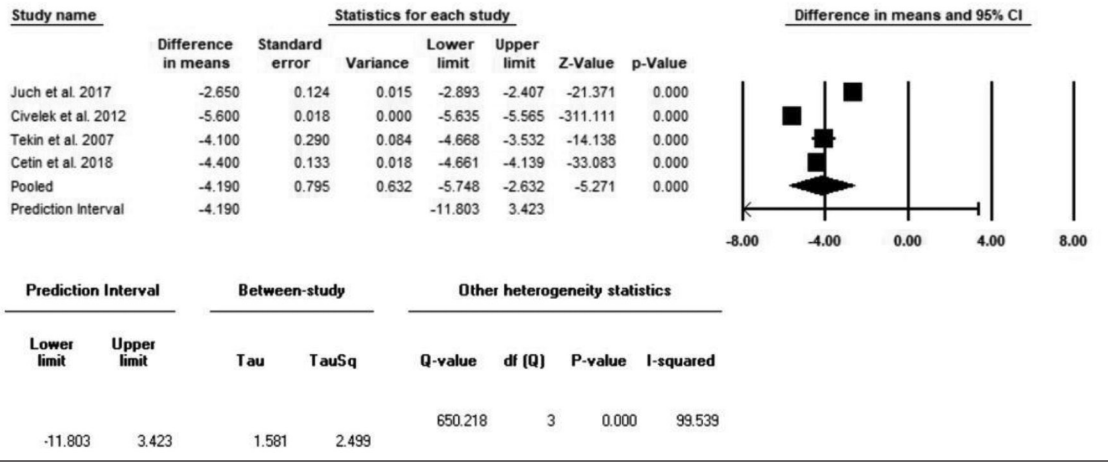


Fig. 21. *Outcomes assessed with single-arm meta-analysis on NRS at 12 months.*

ness of RFA in managing chronic neck pain. This review included literature through September 2021. Five RCTs and 15 nonrandomized studies met the inclusion criteria. Only 2 RCTs evaluating radiofrequency in the cervical spine (772,829) and 2 evaluating headache (783,832) were utilized for the meta-analysis. The methodologic quality was highly variable among the 2 cervical spine trials. Methodologic quality and variability were also significant in the 2 headache RCTs, which were limited by the small number of patients. Dual analysis was not performed. A single-arm meta-analysis was performed separately for all observational studies evaluating neck pain and headache management (Figs. 22, 23, and 24).

For qualitative analysis of neck pain treated with RFA, 11 studies were included. Of these, 5 studies totaling 201 patients utilized 100% pain relief as the standard for inclusion. In 4 of the 5 studies, 4 to 6 RFA lesions were created, resulting in complete pain relief in 58% to 74% of patients (772,781,783,789). In the fifth study, only 2 RFA lesions were created (833), producing relief in 54% of patients.

Three of the original 11 studies used at least 80% pain relief as the inclusion criterion (50,775,777). One of the 3 studies, totaling 361 patients, utilized controlled diagnostic blocks to produce 3 lesions (777). This study reported complete relief in 39% of patients and at least 50% relief in 79% at one year. Another study in this group involved a prospective assessment (775) in which a minimum of 2 lesions were created in 30 litigant patients and 30 non-litigant patients. Only 46% of litigant patients demonstrated improvement, whereas 73% of non-litigant patients improved. The study was judged to be positive for non-litigant patients. The third clinical study (50) compared cervical medial branch block improvement with RFA improvement after the creation of one lesion. Significant pain relief was recorded in 100%, 94%, and 81% of patients in the medial branch block group, whereas it was 100%, 69%, and 64% in the radiofrequency neurotomy group at 3-, 6-, and 12-month follow-up, with significant differences at 6 and 12 months.

One study (834), utilizing 50% pain relief as the standard, created 4 lesions. This study reported 100% pain relief in 42% of patients at 6-month follow-up and 50% pain relief in 68% of patients at 6-month follow-up. Two studies (723,829), including one RCT (829), evaluated the effects of RFA alone. The RCT compared a control group receiving bupivacaine only with RFA plus bupivacaine utilizing a 30% improvement criterion for pain relief. Although significant differences between RF denervation combined with local anesthetic injection and local anesthetic injection alone were not observed at 6-month follow-up, a significant difference favoring RFA was demonstrated in the long-term effect. Level of Evidence: II.

Among 5 included studies assessing pain relief with diagnostic blocks (772,775,781,789,794), only 3 demonstrated superior pain relief (772,781,789). Only one of these studies, totaling 28 patients, utilized at least 50% pain relief as the inclusion criterion. This study demonstrated at least 50% relief in 68% of patients, similar to other categories, with moderate clinical utility based on the production of 4 lesions.

In summary, one RCT (772) with 12 patients in the treatment group and 8 positive observational studies (50,775,777,781,783,789,833,834) totaling 589 patients

Table 19. *Evidence profile using randomized controlled trials for spinal facet joint nerve radiofrequency ablation for the same outcome and similar certainty of evidence (GRADE assessment).*

CERTAINTY ASSESSMENT								Number of Patients	Impact	Certainty
Study	**Study Design**	**Methodologic Quality**	**Risk of Bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Publication Bias**			
LOW BACK										
Lakemeier et al, 2013 (731)	RA, DB, AC	Cochrane: 9/13 (high) IPM-QRB: 37/48 (high)	Low	Low	NS	NS	None	n = 56 Intervention n = 27 Control n = 27	Moderate	Moderate
McCormick et al, 2023 (827)	P, RA, comparative	Cochrane: 11/13 (high) IPM-QRB: 30/48 (moderate)	Very low	Very low	NS	NS	None	n = 32 Intervention n = 20 Control n = 12	Low	Low
Civelek et al (828)	RA, AC	Cochrane: 9/13 (high) IPM-QRB: 28/48 (moderate)	Low	Low	NS	NS	None	n = 100 Intervention n = 50 Control n = 50	Very low	Very low
Juch et al, 2017 (58)	MINT RA, pragmatic trial	Cochrane: 6/13 (moderate) IPM-QRB: 26/48 (moderate)	Very low	Very low	NS	NS	None	n = 251 Intervention n = 125 Control n = 126	Very low	Very low
Nath et al, 2008 (727)	RA, DB, sham control	Cochrane: 13/13 (high) IPM-QRB: 28/48 (moderate)	Very low	Very low	NS	NS	None	n = 40 Intervention n = 20 Control n = 20	Moderate	High
Tekin et al, 2007 (730)	RA, DB, AC & sham control	Cochrane: 12/13 (high) IPM-QRB: 26/48 (moderate)	Very low	Very low	NS	NS	None	n = 60 Intervention n = 40 Control n =20	Moderate	Moderate

Table 19 cont. *Evidence profile using randomized controlled trials for spinal facet joint nerve radiofrequency ablation for the same outcome and similar certainty of evidence (GRADE assessment).*

CERTAINTY ASSESSMENT								Number of Patients	Impact	Certainty
Study	**Study Design**	**Methodologic Quality**	**Risk of Bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Publication Bias**			
van Wijk et al, 2005 (728)	RA, DB sham control	Cochrane: 13/13 (high) IPM-QRB: 38/48 (high)	Very low	Very low	NS	NS	None	n = 81 Intervention n = 40 Control n = 41	Low	Low
van Kleef et al, 1999 (729)	RA, DB sham control	Cochrane: 13/13 (high) IPM-QRB: 37/48 (high)	Very low	Very low	NS	NS	None	n = 31 Intervention n = 15 Control n = 16	Moderate	Moderate
Çetin & Yektaş, 2018 (761)	RA, DB, AC	Cochrane: 12/13 (high) IPM-QRB: 39/48 (high)	Very low	Very low	NS	NS	None	n = 118 Intervention n = 43 Control n = 75	Moderate	Moderate
McCormick et al, 2019 (830)	RA, SB, controlled	Cochrane: 10/13 (high) IPM-QRB: 36/48 (high)	Very low	Very low	NS	NS	None	n = 43 Intervention n = 22 Control n = 21	Low	Low
Moon et al, 2013 (740)	RA, AC, comparative	Cochrane: 9/13 (high) IPM-QRB: 41/48 (high)	Low	Low	NS	NS	None	n = 82 Intervention n = 41 Control n = 41	Moderate	Moderate
Moussa & Khedr, 2016 (764)	RA, DB, AC	Cochrane: 10/13 (high) IPM-QRB: 41/48 (high)	Low	Low	NS	NS	None	n = 120 Intervention n = 40 Control n =40 n = 40	Moderate	Moderate

Table 19 cont. *Evidence profile using randomized controlled trials for spinal facet joint nerve radiofrequency ablation for the same outcome and similar certainty of evidence (GRADE assessment).*

CERTAINTY ASSESSMENT								Number of Patients	Impact	Certainty
Study	**Study Design**	**Methodologic Quality**	**Risk of Bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Publication Bias**			
Song et al, 2019 (60)	RA, SB, AC	Cochrane: 6/13 (moderate) IPM-QRB: 29/48 (moderate)	High	High	NS	NS	None	n = 40 Intervention n = 20 Control n = 20	Low	Low
Xue et al, 2020 (831)	RA, AC	Cochrane: 7/13 (moderate) IPM-QRB: 32/48 (high)	High	Moderate	NS	NS	None	n = 60 Intervention n = 30 Control n =30	Low	Low
NECK										
van Eerd et al (829)	RA, AC	Cochrane: 13/13 (high) IPM-QRB: 39/48 (high)	Very low	Very low	NS	NS	None	n = 76 Intervention n = 37 Control n = 39	Low	Low
Lord et al, 1996 (772)	RA, DB, sham control	Cochrane: 13/13 (high) IPM-QRB: 45/48 (high)	Very low	Very low	NS	NS	None	n = 24 Intervention n = 12 Control n = 12	High	High
THORACIC										
Joo et al, 2013 (748)	RA, AC	Cochrane: 12/13 (high) IPM-QRB: 38/48 (high)	Very low	Very low	NS	NS	None	n = 40 Intervention n = Control n =	Low	Low

AC = active controlled; DB = double-blind; NS = Not serious; P= prospective; RA = randomized; SB = single-blind

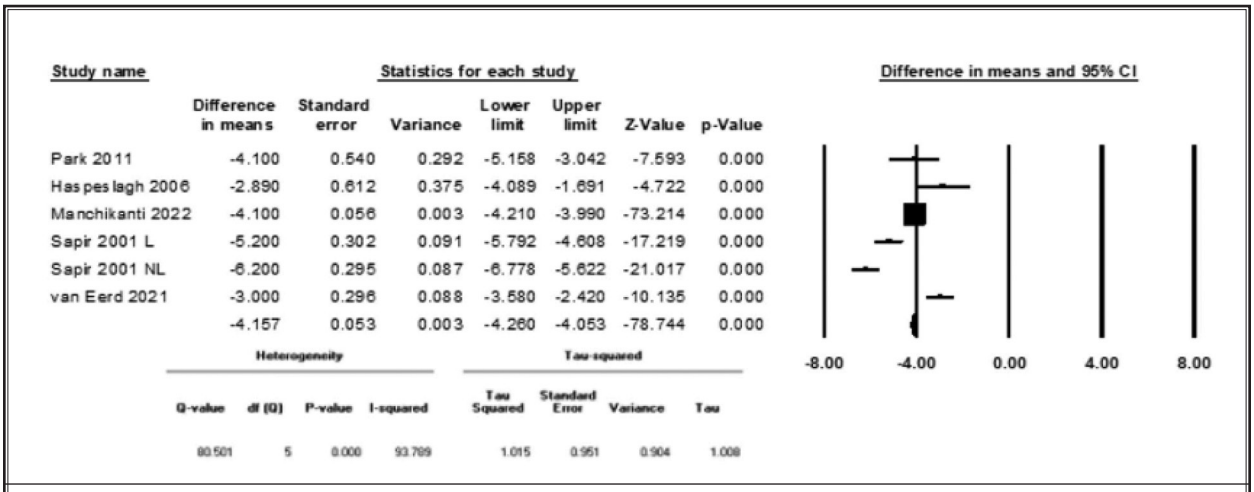


Fig. 22. *Single-arm meta-analysis for pain relief at 6-month follow-up: RFA*

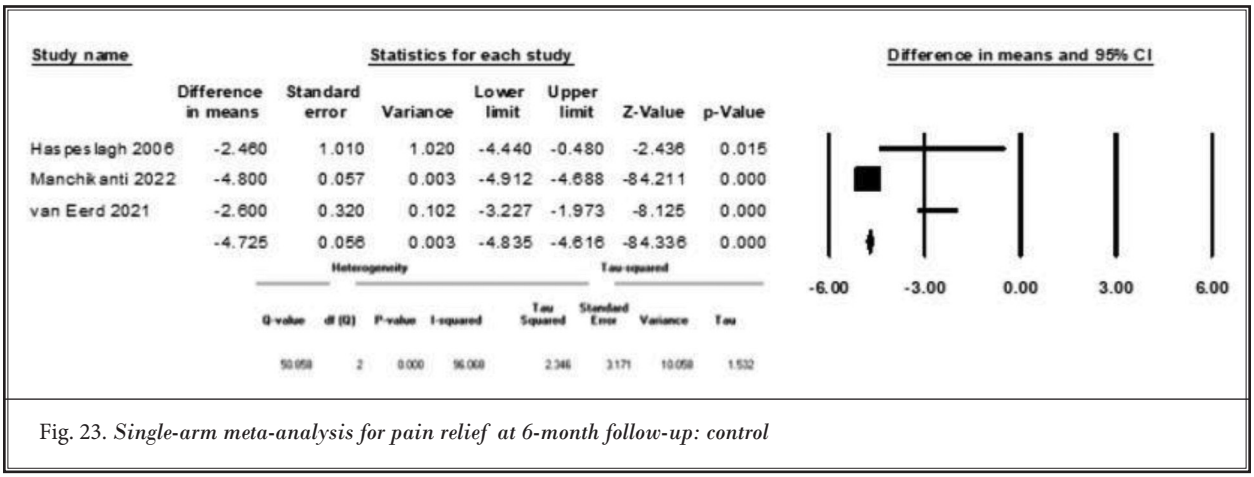


Fig. 23. *Single-arm meta-analysis for pain relief at 6-month follow-up: control*

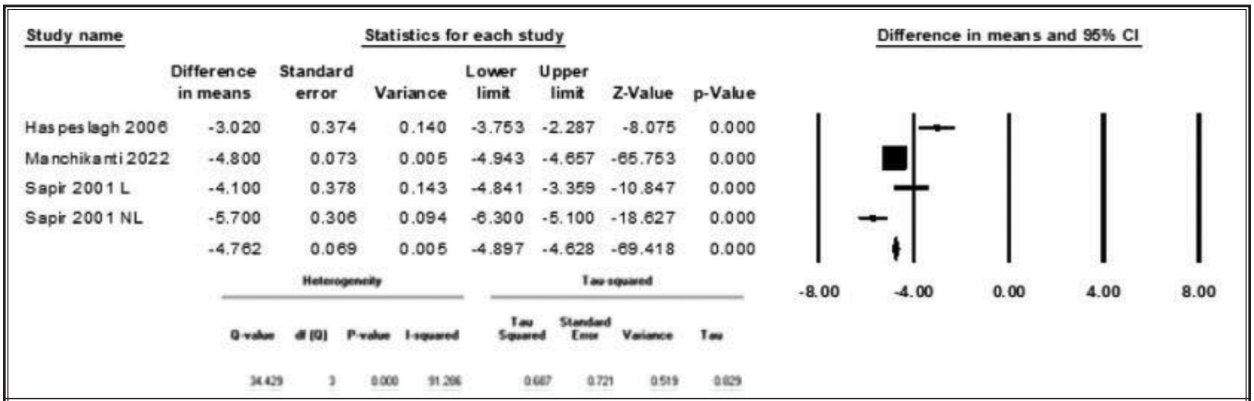


Fig. 24. *Single-arm meta-analysis for pain relief at 12-month follow-up: RFA.*

demonstrated positive outcomes with moderate to high clinical applicability. Two studies (829,835) totaling 106 patients showed negative short-term results but promising long-term results. One study was an RCT with low clinical applicability downgraded per GRADE criteria. The evidence for this RCT was Level II with a moderate recommendation for cervical RFA in managing neck pain (47).

Engel et al. (57) evaluated the effectiveness and risks of fluoroscopically guided cervical medial branch RFA using a systematic review and comprehensive analysis of the published data. Limitations of their review included lack of methodologic quality and bias assessment, in addition to author bias embedded in society and procedural guidelines rather than clinical guidelines. Engel et al. (57) demonstrated that the majority of RFA patients were pain free at 6 months and more than one-third remained pain free at one year. The number needed to treat for complete relief at 6 months was 2. The authors contended that the evidence of effectiveness was high quality based on 8 primary radiofrequency publications.

Engel et al. (836), in another systematic review of cervical RFA literature, included RCTs and observational studies. The results were variable based on selection criteria, including triple placebo-controlled medial branch blocks, dual comparative medial branch blocks, single medial branch blocks, intraarticular blocks, and physical examination findings or symptoms alone. Their data demonstrated a greater degree of pain relief more frequently in patients selected by triple placebo-controlled medial branch blocks or dual comparative medial branch blocks in which patients achieved 100% pain relief. Whether triple or dual comparative blocks were performed, the degree of pain relief was similar.

The studies were stratified according to their selection criteria. For placebo-controlled blocks, success was defined as complete relief, which at 6 months was achieved in 58% of patients (95% CI: 30%-86%). There were 64 patients in this group. At 6 months, the pooled success rate was 52% (95% CI: 40%-64%). The body of evidence constituted high-quality evidence according to GRADE criteria. For comparative blocks, a pooled success rate of 61% with a narrow CI (95% CI: 52%-72%) was achieved. There were 125 patients in this group. In contrast, when utilizing 75% relief with comparative blocks, pooled results including 234 patients demonstrated a success rate of 31% (95% CI: 25%-37%) with complete relief versus a 44% success rate with 80% relief (95% CI: 37%-51%) and a 59% success rate with greater than 50% relief (95% CI: 52%-66%). Only one study included outcome data for patients who achieved 50% relief from comparative blocks. Most patients in this study had 75% relief, whereas one patient reported 100% relief. However, 6 patients in this study demonstrated only 50% relief. As a single study, according to GRADE criteria, this study could not be graded. Engel et al. (836) demonstrated complete relief for comparative blocks at the highest level of 61% and 70% at the upper limit of the 95% CI.

Manchikanti et al. (35), in 2023, evaluated the effectiveness of medial branch blocks and RFA in managing chronic thoracic pain. The search criteria extended through December 2022 and identified 11 studies meeting inclusion criteria, including 3 RCTs and 8 observational studies. Of the 3 RCTs, 2 assessed medial branch blocks and one assessed RFA for thoracic pain. Quality assessment and risk of bias were evaluated utilizing Cochrane review criteria, IPM-QRB, and IPM-QRBNR instruments. The evidence for management of thoracic pain, utilizing qualitative analysis, single-arm meta-analysis, and GRADE appraisal, included 2 RCTs and 3 observational studies for medial branch blocks and was determined to be Level II. For RFA, including one RCT totaling 20 patients in the treatment group and 5 observational studies, the evidence was Level III for managing thoracic pain. The authors discussed the paucity of literature, including the limited number of RCTs and pragmatic real-world controlled trials. Additional observational studies had small sample sizes, providing inadequate clinically applicable results. The remaining available studies demonstrated significant heterogeneity with respect to inclusion and exclusion criteria, endpoint definitions, and effectiveness (Figs. 25 and 26).

In a meta-analysis of 33 studies, Xu et al. (837) compared RFA and corticosteroid injections for spinal facet and sacroiliac joint pain. Their results demonstrated greater pain relief with RFA at 3 and 6 months; however, no significant difference was observed at 12 months. For cervical facet joint pain, patients treated with corticosteroids had higher functional disability scores than those receiving RFA at 3 months; however, the difference was not statistically significant.

Janapala et al. (38) performed a literature search through September 2020 that included 12 RCTs. In their systematic review and meta-analysis of RFA in chronic low back pain, published in 2021, they performed quality assessments of the RCTs utilizing Cochrane review criteria and IPM-QRB. The level of evidence for effec-

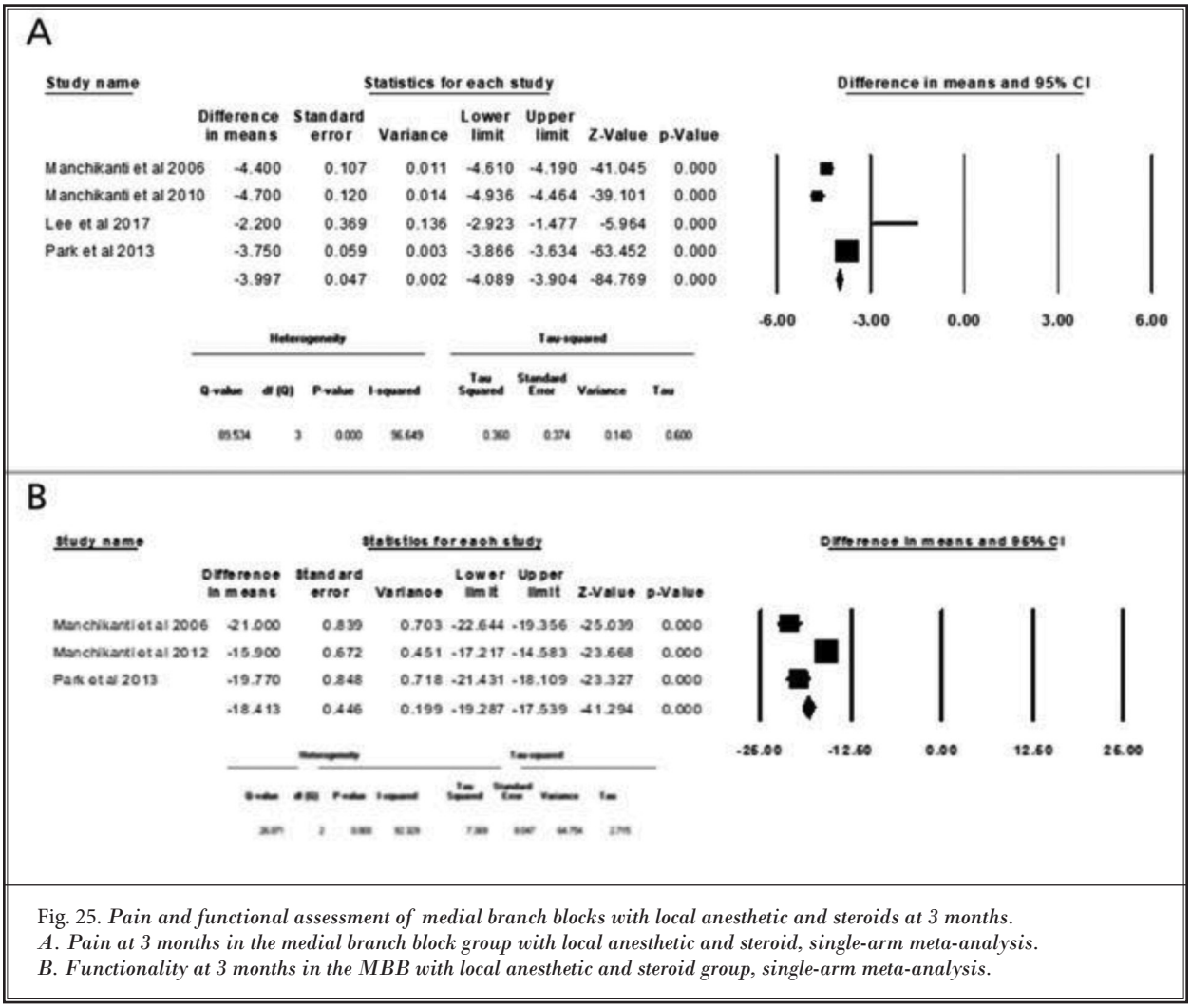


Fig. 25. *Pain and functional assessment of medial branch blocks with local anesthetic and steroids at 3 months.*
A. Pain at 3 months in the medial branch block group with local anesthetic and steroid, single-arm meta-analysis.
B. Functionality at 3 months in the MBB with local anesthetic and steroid group, single-arm meta-analysis.

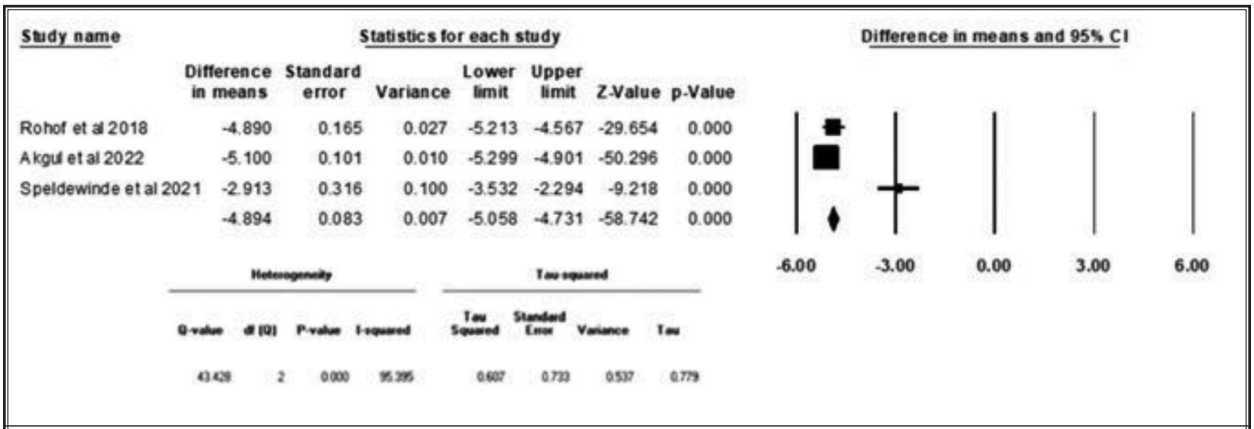


Fig. 26. *Pain at 3 months in conventional RFA groups with single-arm meta-analysis.*

tiveness was classified into 5 levels ranging from Level I to Level V. Both qualitative and quantitative analyses were performed. For quantitative analysis, both dual-arm and single-arm meta-analyses were conducted. For the conventional dual-arm analysis, 3 of the 5 studies were included (58,727,730). Two studies (728,729) were excluded because of the lack of availability of appropriate data. Figure 27 shows short-term follow-up data of 6 months or less with inclusion of the 3 trials (727,730,764). The cumulative analysis demonstrated that RFA with CRFA reduced pain scores by 1.98 points (95% CI: -0.5 to 4.47) compared with a sham procedure. However, the results were not statistically significant, with a p-value of 0.12.

For the 12-month data, only 2 of the 5 trials (58,727-730) were available for inclusion, specifically studies (58,730), as shown in Fig. 27.

Overall, there were 4 sham-controlled trials described as "placebo-controlled" (727-729,764). Among these, one study (728) demonstrated negative results for both short-term and long-term improvement. One study presented only short-term results with improvement at 6 months (727). Two studies demonstrated both short-term and long-term positive results (729,764). Thus, 3 of the 4 placebo-controlled trials demonstrated positive results for short-term improvement, and 2 of the 4 demonstrated positive results for both short-term and long-term improvement. The results of this analysis favored CRFA at 12 months.

Conventional dual-arm analysis was also performed at 6 and 12 months for active-control trials. Overall, 6 of the 7 available studies were included (Fig. 28).

The analysis demonstrated results favoring CRFA at 6 months; however, at 12 months, the results favored the active control group.

Functional status utilizing ODI scores was reported in only 2 of the 5 trials (58,730) at the 6-month follow-up, as shown in Fig. 29. At 12 months, functional status was assessed utilizing ODI in only 2 trials (58,730).

Outcome results of sham-controlled trials and active-controlled trials have been described in the qualitative analysis.

A single-arm cumulative analysis was performed using data from 10 RCTs in which patients in at least one arm of the study underwent RFA. The cumulative analysis compared initial and final pain VAS scores at the 6-month follow-up in the CRFA arm of the studies.

In the single-arm cumulative analysis performed at the end of 6 months, as shown in Fig. 30A, CRFA reduced pain VAS scores by 3.43 points (95% CI: 2.66 to 4.19). This reduction was statistically significant with a p-value of < 0.00001.

Similarly, a single-arm cumulative analysis was performed for 5 RCTs at the 12-month follow-up (Fig. 30B). The single-arm cumulative analysis performed at the end of 12 months showed that CRFA reduced pain VAS scores by 3.68 points (95% CI: 2.34 to 5.02). This reduction was also statistically significant with a *P*-value of < 0.00001.

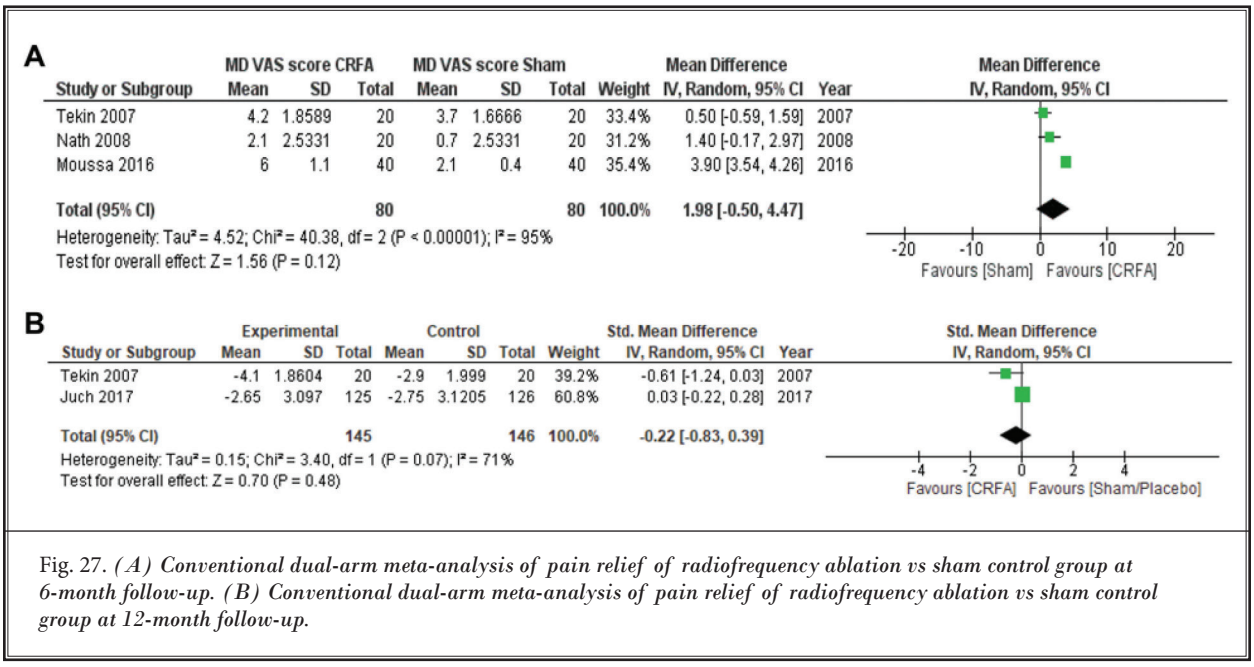


Fig. 27. *(A) Conventional dual-arm meta-analysis of pain relief of radiofrequency ablation vs sham control group at 6-month follow-up. (B) Conventional dual-arm meta-analysis of pain relief of radiofrequency ablation vs sham control group at 12-month follow-up.*

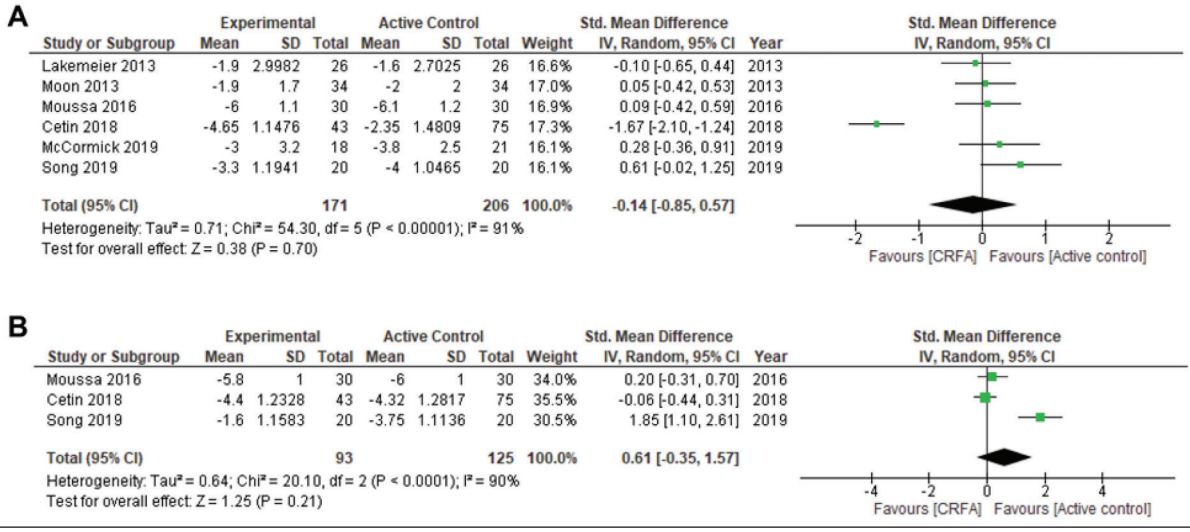


Fig. 28. *(A) Conventional dual-arm meta-analysis of pain relief of radiofrequency ablation of active control trials at 6 -month follow-up. (B) Conventional dual-arm meta-analysis of pain relief of radiofrequency ablation of active control trials at 12-month follow-up.*

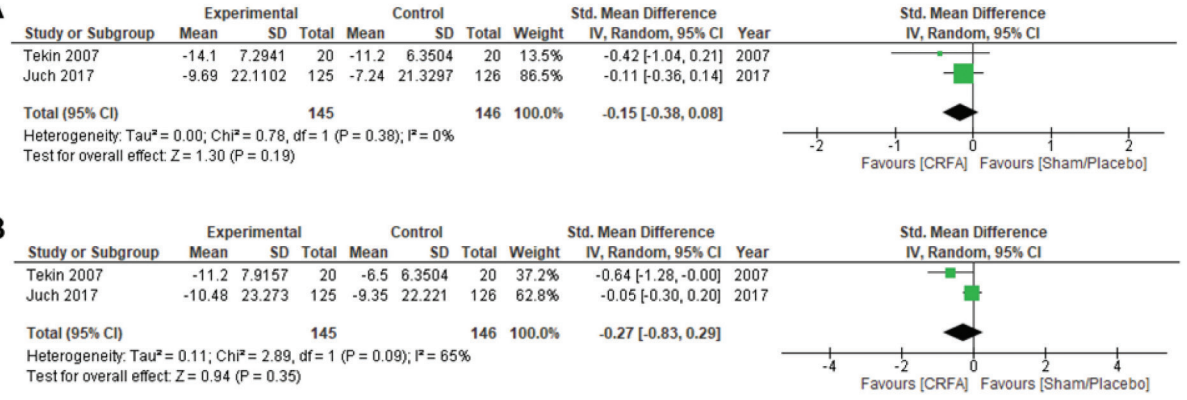


Fig. 29. *(A) Conventional dual-arm meta-analysis of functional status (ODI) of radiofrequency ablation vs sham control group at 6-month follow-up. (B) Conventional dual-arm meta-analysis of functional status (ODI) of radiofrequency ablation vs sham control group at 12-month follow-up.*

Single-arm analysis was also performed on functional status at 6 and 12 months utilizing ODI scores. Only 2 studies met inclusion criteria at both 6 and 12 months. As shown in Fig. 31, the data demonstrated significant improvement in functional status in the CRFA group at both 6 and 12 months.

The evidence of efficacy based on dual-arm and single-arm meta-analyses of CRFA with placebo-controlled and active-controlled trials is Level II evidence (moderate), demonstrating improvement in pain and function for both short-term and long-term follow-up.

There are other systematic reviews that provide discordant opinions. Maas et al. (56) demonstrated a lack of effectiveness. Leggett et al. (734), in an earlier systematic review, analyzed 6 sham-controlled RCTs performed between 1994 and 2008. They found high variability in selection criteria and outcomes, with inconclusive effectiveness. In contrast, Poetscher et al. (735) evaluated 9 RCTs comparing radiofrequency treatment with other forms of treatment and placebo.

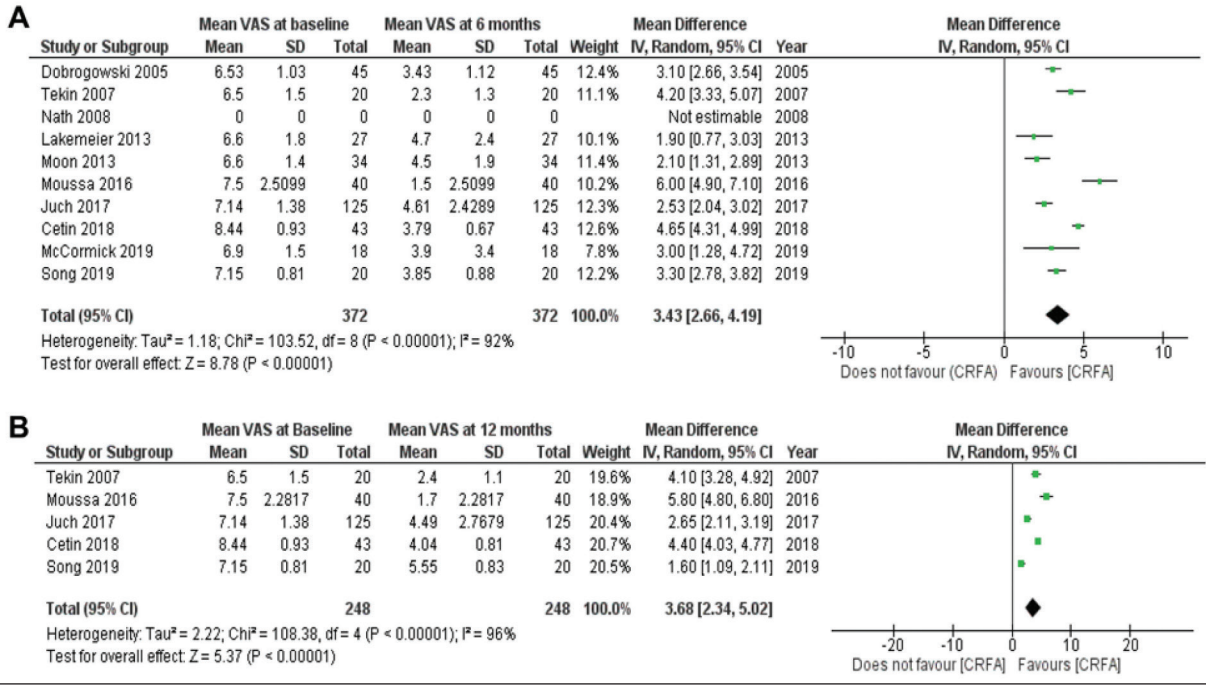


Fig. 30. *(A) Single arm meta-analysis of pain relief of radiofrequency ablation at baseline vs at 6-month follow-up of active-controlled trials. (B) Single arm meta-analysis of pain relief of radiofrequency ablation at baseline vs at 12-month follow-up of active control trials.*

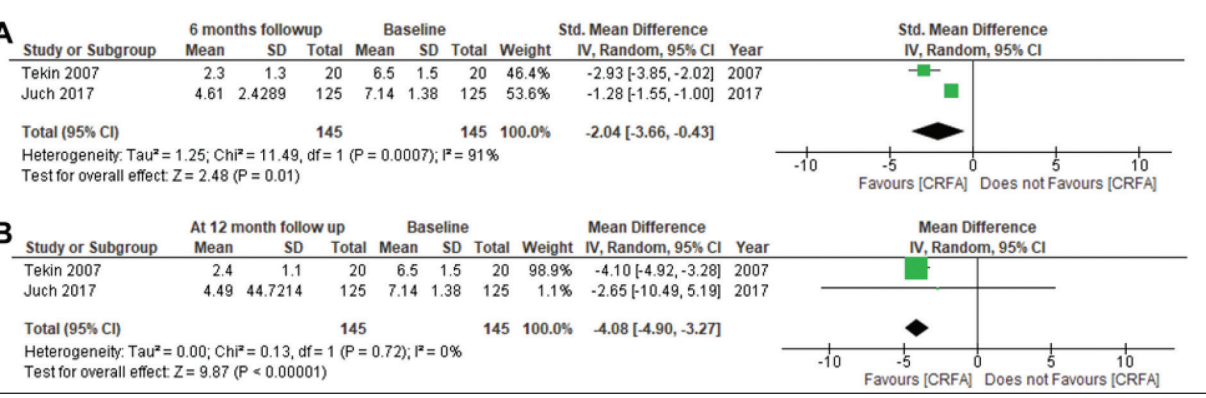


Fig. 31. *(A) Single-arm meta-analysis of functional status (ODI) of radiofrequency ablation at 6-month follow-up in sham control trials. (B) Single-arm meta-analysis of functional status (ODI) of radiofrequency ablation at 12-month follow-up in sham control trials.*

They found that radiofrequency denervation was more effective than placebo and steroid injection. However, they concluded that the evidence should be interpreted with caution.

Schneider et al. (706) performed a systematic review of the effectiveness of lumbar medial branch thermal ablation stratified by diagnostic methods and procedural techniques based on different selection criteria. They demonstrated that at 6 months, 26% of patients selected after receiving a single medial branch block using a perpendicular approach achieved at least 50% pain relief. In contrast, 49% of patients selected following controlled diagnostic medial branch blocks and treated using a parallel technique achieved at least

50% pain relief. The most rigorous patient selection and technique, utilizing 2 diagnostic medial branch blocks with parallel electrode placement, resulted in 56% of patients experiencing 100% pain relief at 6 months. They also assessed patients achieving 70% to 80% pain relief after diagnostic blocks, demonstrating that 57% of patients achieved at least 50% relief at 6 months after RFA, whereas 22% achieved at least 80% relief (706). However, the review was limited by significant issues related to author bias favoring a parallel technique, 100% relief with diagnostic blocks, and 100% relief as a treatment response. Furthermore, appropriate methodologic quality assessment was not performed, and no meta-analysis was conducted. Lack of bias assessment and the authors' bias toward their own society and procedural guidelines rather than clinical guidelines also limited this review.

Lee et al. (838) evaluated the efficacy of conventional RFA in patients with chronic facet joint low back pain. They included data from 7 trials involving 454 patients. A total of 231 patients underwent RFA, whereas 223 patients received control treatments such as sham procedures or epidural blocks. At one-year follow-up, the radiofrequency group demonstrated significantly greater improvement in back pain scores compared with the control group. The average improvement in VAS scores exceeded the minimum clinically important difference (MCID), with the lower limit of the 95% CI encompassing the MCID. A subgroup of patients received diagnostic blocks, and these patients responded particularly well, demonstrating significant improvements in back pain relative to control groups. Overall, the authors concluded that conventional RFA resulted in significant reductions in facet joint low back pain, especially in patients who had received diagnostic blocks during the first 12 months. Patients who underwent diagnostic blocks demonstrated the best response compared with sham procedures.

Park et al. (839) performed a systematic review and network meta-analysis of RFA for lumbar facet joint syndrome. In this analysis, treatments were ranked using surface under the cumulative ranking curve (SUCRA) values. They included 25 RCTs involving 1,969 patients. Quality was mixed with regard to risk of bias, although most studies demonstrated low risk of bias across most domains. They demonstrated effectiveness of medial branch thermal radiofrequency; however, their findings emphasized that endoscopic neurotomy consistently ranked highest in terms of pain reduction and ODI improvement at 1, 3, 6, and 12 months. At one and 6 months, endoscopic ablation had the highest SUCRA value for pain reduction, followed by medial branch thermal radiofrequency. However, review of the evidence for the 2 endoscopic ablation studies (60,831) showed that both studies were very small, involving 50 patients, single-blinded, single-center, and one study (60) utilized a single diagnostic block for diagnosis.

Mazmudar et al. (840) provided an economic evaluation of lumbar spine facet interventions, including intraarticular injections, medial branch blocks, and RFA. Their 2020 review concluded that while evidence for intraarticular injections was limited, there was moderate evidence supporting the use of medial branch blocks and RFA.

In 2021, Ambrosio et al. (69) conducted a systematic review of minimally invasive treatments for lumbar facet joint syndrome. Eighteen studies with a total of 1,496 patients were included. RFA outcomes were slightly superior to or comparable with intraarticular corticosteroids, physical therapy, and sham procedures. Corticosteroids combined with oral diclofenac produced better outcomes than corticosteroids or diclofenac alone, but not better than local anesthetic plus Sarapin. Unfortunately, the review misclassified facet joint nerve blocks as intraarticular injections, thereby compromising the validity of its conclusions (841).

8.3.1.2 Clinical Studies – Cervical Spine

Two RCTs evaluated the efficacy of RFA in the cervical spine (772,829). Additional RCTs evaluated cervicogenic headache with or without associated neck pain (786,832).

Manchikanti et al. (47), in a systematic review and meta-analysis, evaluated the effectiveness of RFA as therapy for chronic cervical facet jointneck pain. Their study demonstrated Level II evidence for RFA on a long-term basis in managing chronic neck pain. There was Level III to IV evidence for managing cervicogenic headaches.

Lord et al. (772) performed the highly regarded first RCT in patients with chronic post-whiplash facet joint pain utilizing a sham control versus multilesion RFA. There were 12 patients in each group (n = 24). The source of pain was confirmed using double-blind, placebo-controlled local anesthetic blocks producing 100% pain relief as the criterion standard. The results demonstrated that the median time before pain returned to at least 50% of the preoperative level was 263 days in the active treatment group and 8 days in the control group (P = 0.04). They also showed that

at 27 weeks, 7 patients (58%) in the active treatment group were pain free. Technical details included use of a 10 cm, 22-gauge electrode with a 4 mm exposed tip introduced in 2 planes, producing 5 to 6 lesions to accommodate possible variation in the course of the nerve. The duration of the procedure was reported as 3 hours per patient (787). They also reported that the original pain returned immediately following the procedure in 6 patients (50%) in the control group and 3 patients (25%) in the active treatment group. Major strengths of this trial included meticulous patient selection and technique. Limitations included the small sample size and prolonged operative duration resulting from performing 5 to 6 lesions per level, which is not a clinically feasible practice.

van Eerd et al. (829) conducted the second trial assessing the efficacy and long-term effect of RFA in patients with clinically diagnosed cervical facet joint pain. A total of 76 patients were included. They compared RFA plus bupivacaine injection with sham RFA plus bupivacaine injection. A single lesion was produced using a 5 cm needle with a 5 mm active tip. Positive results were achieved in the RFA group, with 55.6% achieving greater than 30% pain reduction versus 51.3% of patients in the sham RFA group, who reported no significant postintervention pain difference. The Neck Disability Index (NDI) was 15 ± 8.7% in the RFA group compared with 16.5 ± 7.2% in the sham RFA plus anesthetic group. Median duration of treatment success was 42 months in the radiofrequency group compared with 12 months in the bupivacaine group, representing a significant difference. This study illustrates the importance of medial branch blocks (MBBs) with local anesthetic alone producing significant pain improvement at 3 months, 6 months, and up to one year. These MBB findings were extensively described by Manchikanti et al. (700,842) in multiple studies in which average pain relief of 14 to 16 weeks was achieved. The van Eerd study (829) was limited by use of a 30% pain reduction criterion rather than 50% or greater pain reduction with improvement in function.

A prospective evaluation by Sapir and Gorup (775) assessed cervical RFA in litigant and non-litigant patients with cervical whiplash. Inclusion criteria were based on ≥ 80% pain relief following diagnostic MBBs. Overall, 50 patients met inclusion criteria and 46 completed the study. There were 32 litigants and 18 non-litigants. Overall reductions in cervical whiplash symptoms and VAS pain scores were significant both immediately after treatment and at one-year follow-up. Improvement was greater one year after treatment, with NRS scores of 2.5 in non-litigants versus 3.6 in litigants. The authors postulated that differences between litigants and non-litigants in symptom severity and treatment response existed; however, the differences did not reach statistical significance. Thirteen of the 32 litigant patients settled their cases after treatment. These patients also reported recurrent pain one year after treatment. Overall, 21 patients reported recurrence of pain within one year. Time to recurrence, defined as 50% return of pain, was 8 ± 2 months.

Manchikanti et al. (50) evaluated the clinical outcomes and cost utility of therapeutic MBBs versus RFA in managing chronic facet jointneck pain. Overall, 295 patients met inclusion criteria, with 132 patients receiving cervical MBBs and 163 patients receiving cervical RFA. One hundred seven patients in the cervical medial branch group and 105 patients in the radiofrequency group completed one-year follow-up. There was significant improvement in both groups from baseline to 12 months with ≥ 50% pain relief. Average duration of pain relief from each cervical MBB procedure was 13 to 14 weeks, whereas duration of pain relief for RFA was 20 to 25 weeks. Significant pain relief was recorded in 100%, 94%, and 81% of patients in the MBB group versus 100%, 69%, and 64% in the RFA group at 3-, 6-, and 12-month follow-up. Differences were significant at 6 and 12 months. Cost utility analysis demonstrated an average cost per QALY of $4,994 for cervical MBBs compared with $5,364 for cervical RFA. Six of 132 patients (5%) in the cervical medial branch group and 53 of 163 patients (33%) in the cervical RFA group were converted to other treatments because of side effects in 6 patients (4%) or inadequate relief in 47 patients (29%).

In an observational study, Speldewinde (777) evaluated 151 patients undergoing cervical RFA. This was a single-author, single-practice data collection study. Selection criteria required at least 80% pain relief following controlled comparative local anesthetic blocks. Outcome assessment was appropriate. Patients treated from 2001 to 2007 were designated cohort A, whereas those treated from 2007 to 2009 were designated cohort B. There were 104 patients in cohort A and 47 in cohort B, totaling 151 patients. The cohorts differed based on use of a 22-gauge, 10 cm active-tip cannula during earlier years, later changed to an 18-gauge cannula. The first cohort utilized conventional RFA at 80° for 90 seconds, whereas the second cohort utilized an 18-gauge cannula at 80° for 60 seconds. A minimum of

3 contiguous lesions was created for each target nerve. Overall, significant improvement greater than 50% was reported in 76% of patients, including 79% in cohort A and 85% in cohort B. Successful patients reportedly experienced relief lasting more than 18 months, with an average duration of 27.5 months (range 18 to 68 months). The authors also assessed psychological and functional status, both of which improved significantly in patients with successful pain relief.

MacVicar et al. (789) studied 104 patients selected from 2 separate practices. Inclusion criteria required complete pain relief following controlled diagnostic MBBs. Strict outcome measures were utilized, with successful outcomes defined as complete pain relief or at least 80% pain relief for a minimum of 6 months, complete restoration of activities of daily living, no need for additional healthcare, and return to work. They utilized a 16-gauge cannula with a 10 cm active tip and produced at least 3 lesions at 80° to 85°C for 90 seconds. Treatment of a single facet joint required 2 hours, and treatment of the third occipital nerve required 1.5 hours. Sixty-six percent of subjects met treatment criteria at 6 months. No complications were reported.

Among other observational studies, Shin et al. (834) evaluated 28 patients undergoing conventional RFA and reported improvement in 68% of patients. Barnsley (781) assessed the role of RFA for chronic neck pain by evaluating outcomes in a consecutive patient series. Results demonstrated that 36 of 45 patients (80%) achieved significant pain relief lasting 36 weeks, and 74% achieved 100% pain relief. Only one serious adverse event, consisting of local infection, was reported.

Multiple studies focused on cervicogenic headaches associated with neck pain. Stovner et al. (832) assessed RFA of facet joints at C2-C6 for cervicogenic headache in a randomized, double-blind, sham-controlled study with 6 patients randomized into each group. The treatment group received RFA producing 3 to 4 lesions with a 50 mm, 22-gauge needle. One milliliter of local anesthetic was injected prior to treatment. Two patients in each group, including the sham-controlled group, demonstrated greater than 50% improvement at 3 months. Major limitations of this study included lack of diagnostic block inclusion criteria, extremely small sample size, and prolonged time required to produce 3 to 4 RF lesions.

Haspeslagh et al. (786) evaluated the effectiveness of cervical radiofrequency lesioning in an RCT. Thirty patients with cervicogenic headache according to Sjaastad diagnostic criteria were randomized into 2 equal groups receiving either cervical RFA followed by cervical dorsal root ganglion lesions when necessary (Group 1) or injection of local anesthetic with steroid to the greater occipital nerve followed by TENS when necessary (Group 2). Group 1 demonstrated improvement with at least a 2-point decrease in VAS and/or a global perceived effect of +2 or +3, with a success rate of 66.7% at 16 weeks, whereas the success rate in Group 2 was 53.3%. Using the same criteria at one-year follow-up, improvement was observed in 53.3% of Group 1 and 46.7% of Group 2. A large number of patients withdrew or lacked available data. Consequently, this trial was judged negative.

Among the remaining studies, Wallis et al. (787) evaluated the role of pain relief following RFA in the resolution of psychological distress in patients with whiplash 3 months after the procedure. The study sample was derived from the Lord et al. (772) radiofrequency study. Of the 24 patients in that study, 17 patients with a single painful cervical zygapophysial joint were included. All patients with complete pain relief demonstrated resolution of their preoperative psychological distress, whereas all but one patient without pain relief continued to experience psychological distress.

Table 20 shows study characteristics of randomized trials and observational studies assessing cervical RFA.

8.3.1.3 Clinical Studies – Thoracic Spine

The literature for the thoracic spine is sparse. In a randomized active-controlled trial, Joo et al. (748) evaluated repeat RFA for the treatment of thoracic pain, recognizing repeat procedures as a standard process for providing pain relief lasting extended periods, often at least 6 months. However, they raised the question of how frequently and how many times patients should undergo repeated interventions throughout their lifetime. Consequently, they compared alcohol ablation with repeat thermal RFA for long-term pain relief. Their study demonstrated that alcohol ablation provided longer-lasting relief than RFA.

Gungor and Candan (773) evaluated the effectiveness and safety of cooled radiofrequency in the treatment of chronic thoracic facet joint pain. In this study, 974 patients were diagnosed with thoracic facet joint-related pain based on clinical evaluation. Sixty-three patients demonstrated positive responses to dual diagnostic blocks. Of these, 38 patients underwent cooled RFA; however, 15 patients were lost to follow-up. Consequently, only 23 patients undergoing

Table 20. *Study characteristics of randomized trials and observational studies assessing cervical radiofrequency ablation.*

Study Study Characteristic Methodological Quality Scoring	**Number of Patients & Selection Criteria**	**Control**	**Interventions**	**Outcome Measures**	**Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
Lord et al, 1996 (772) Randomized, sham control, double-blind Quality Scores: Cochrane = 12/13 IPM-QRB = 45/48	24 patients selected in a specialty cervical spine research unit in Australia suffering with chronic pain of cervical facet joint origin after whiplash injury and have failed conservative management. The diagnosis was confirmed with the use of double-blind, placebo-controlled local anesthetics with complete pain relief.	Sham control with placement of the needles with injection of local anesthetic without RF ablation	RF group 90 second lesion at 80°C of medial branch; control group received sham treatment with electrode insertion. Authors also produced multiple lesions at each level.	0 to 5 of 100 on VAS; word count 3 or less on McGill Pain questionnaire.	3, 6, and 12 month follow-up	Median time to return of pain in treatment group was 263 days; 8 days in control group; 10 patients underwent second procedures with varying results.	Highly controlled design with meticulous diagnostic techniques and RF ablation	Small group size and has been criticized for creative statistical analysis.	Efficacy was shown even though study has been criticized for small group size and variations with creative statistical analysis. This study is a landmark evaluation to show efficacy of RF ablation in the cervical spine.
Sapir & Gorup, 2001 (775) Prospective Quality Score: IPM-QRBNR = 40/48	32 litigants and 18 non-litigants underwent RF ablation. Patients with cervical whiplash who remained symptomatic after 20 weeks of conservative management were included. Inclusion criteria were 80% reduction in pain with controlled comparative local anesthetic blocks. 50 patients underwent RF ablation and 46 patients completed the study.	No control available.	The details for RF ablation were not provided.	VAS and self-report of improvement.	1 year	66% of the patients in the litigation group and 71% of the patients in the non-litigation group reported relief for more than one year. Time to recurrence defined as 50% return of pain was 8.0 ± 2.0 months. The frequency of recurrence of pain was similar in both groups.	Appropriate selection criteria with outcomes assessment in a prospective study.	Nonrandomized study with rather small number of patients.	The results were positive in both litigants and non-litigants; however, only 32 litigants and 18 non-litigants undergoing RF ablation. Difference between groups in the degree of symptomatology or response to treatment did not reach significance.

Table 20 cont. *Study characteristics of randomized trials and observational studies assessing cervical radiofrequency ablation.*

Study Study Characteristic Methodological Quality Scoring	Number of Patients & Selection Criteria	Control	Interventions	Outcome Measures	Time of Measurement	Results	Strengths	Weaknesses	Conclusions
MacVicar et al, 2012 (789) Prospective Quality Score: IPM-QRBNR =38/48	104 total patients selected on the basis of complete pain relief following controlled, diagnostic, medial branch blocks treated with RF ablation. Performed at 2 New Zealand centers. Patients selected following the controlled comparative local anesthetic blocks with 100% pain relief concordant with duration of local anesthetic.	No control available.	RF ablation was performed by placing the needles parallel to medial branches, with creation of sufficient lesions in the sagittal and in an oblique plain, with 16-gauge 10 cm electrodes with 5 mm exposed tips. RF was performed at 80°C or 85°C for 90 seconds for each lesion.	Successful outcome was defined as complete relief of pain, or at least 80% relief, for at least 6 months, with complete restoration of activities of daily living, no need for any further health care, and return to work.	1 year, 2 years and 3 years	In the 2 practices, 74% and 61% of the patients achieved a successful outcome. Relief lasted 17 to 20 months from the first RF ablation and 15 months for repeat treatments. Patients maintained relief for a median duration of 20 to 26 months, with 60% still having relief at follow-up.	The rigorous study was performed utilizing a rigorous criteria in a practical setting in New Zealand with impressive results.	Observational study performed in 2 different practices.	Positive results in a long-term follow-up with strict inclusion criteria with a meticulous technique with impressive results.
Speldewinde, 2011 (777) Prospective Quality Score: IPM-QRBNR = 39/48	151 total procedures were performed in the cervical spine on 130 patients. From 2001 to 2010, patients were selected for RF thermal ablation in whom a diagnosis of cervical zygapophysial joint pain had been established with at least 2 fluoroscopically guided diagnostic medial branch nerve or intraarticular injections providing at least 80% relief in the index pain for the duration of action of local anesthetic used.	No control available.	RF was performed at 80°C for 90 seconds for medial branches.	Numeric Rating Scale, Functional Rating Index, Activities of Daily Living, General Health Questionnaire, psychiatric morbidity	12 months	Cervical RF ablation was successful in 76% of the patients. The outcomes were similar in all 3 regions. A significant proportion of patients had relief for longer than one year. Average pain relief was 12 months in the cervical spine with average of 88% pain relief.	Even though study was prospective, design was appropriate and strict inclusion criteria with meticulous technique were utilized. Excellent outcome measures	Observational study.	Positive results. The study was performed in a community setting giving more of a practical setting in Australia.

40 treatments were included in the final analysis. They reported pain reduction of 21% during the early follow-up period of 4 to 8 weeks. During the second follow-up period from 2 to 6 months, they reported a 53% improvement in pain scores, whereas during the third follow-up period from 6 to 12 months, pain score improvement was 38%. Their primary outcome measure, defined as adequate pain reduction (≥ 50%), was achieved only during the intermediate-term relief period of 2 to 6 months, during which patients experienced a 53% reduction in NRS pain scores. Patients required repeat radiofrequency procedures at 24 to 36 months, with the shortest duration of pain relief lasting 30 weeks and the longest lasting 112 weeks.

Rohof and Chen (774) evaluated the effectiveness of bipolar medial branch RFA for treating chronic thoracic facet joint pain. The study included 71 patients with a mean age of 57.9 ± 11.2 years. Mean duration of pain was 23 ± 10.5 months. The majority of patients (82%) experienced pain reduction greater than 50% at 12 months after bipolar RFA. NRS scores decreased significantly from a baseline of 7.75 ± 1.25 to 2.86 ± 1.53 at 3 months and 2.82 ± 1.29 at 12 months ($P < 0.001$ and $P < 0.001$, respectively).

Speldewinde (843) evaluated 39 patients undergoing dual diagnostic intraarticular blocks with at least 50% relief before undergoing thermal RFA. Average duration of relief was 7.8 months, with 46% of patients demonstrating greater

Table 20 cont. *Study characteristics of randomized trials and observational studies assessing cervical radiofrequency ablation.*

Study Study Characteristic Methodological Quality Scoring	Number of Patients & Selection Criteria	Control	Interventions	Outcome Measures	Time of Measurement	Results	Strengths	Weaknesses	Conclusions
Kucukbingoz, 2026 (224) Quality Score: IPM-QRBNR-34/48	Single-center, retrospective cohort study comparing the technical success, procedure time, and clinical efficacy (pain and function) of ultrasound vs. fluoroscopy for cervical medial branch interventions at C3–C6 levels.	Traditional fluoroscopy-guided medial branch injections. (n=120)	Ultrasound guided cervical medial branch injections. (n=104)	Technical success, procedure duration; complications, VAS, Neck Disability Index (NDI), and radiation exposure.	1, 3, 6, and 12 months	The difference in technical success was not statistically significant (ultrasound 90.4% vs. fluoroscopy 90.8%), though formal non-inferiority was not strictly met due to the study being slightly underpowered (72% power). VAS: Decreased from ~7.4 to ~4.0 at 12 months in both groups (p > 0.05 between groups). NDI: Decreased from ~41.3 to ~29.2 in both groups (p > 0.05 between groups)	Long term follow-up. Analyzes real world data.	The study did not meet its primary end-point due to being underpowered. Retrospective, single-center study (limited generalizability).	Ultrasound-guided cervical medial branch interventions are a safe and effective alternative to fluoroscopy. While fluoroscopy remains the "gold standard", ultrasound offers the advantages of ability to visualize critical soft tissue structures such as blood vessels, no radiation exposure and shorter procedure times with comparable long-term clinical outcomes in pain and functional improvement.

than 50% relief for more than 6 months. Secondary outcomes evaluating physical and psychological function utilizing the Functional Rating Index (FRI) and the Depression Anxiety Stress Scale (DASS) demonstrated significant improvements with small to moderate effect sizes, all achieving greater than 36% improvement.

Akgul and Akgun (844) compared cervical, thoracic, and lumbar RFA. Of the 774 patients undergoing RFA, 156, 184, and 434 patients had pain in the cervical, thoracic, and lumbar/lumbosacral regions, respectively. The control groups, consisting of patients who did not undergo RFA, included 108, 122, and 270 patients, respectively. No significant differences in baseline demographic variables were observed between the groups ($P > 0.05$). Significant improvement was observed in both VAS and quality-of-life (QoL) scores when comparing pre- and post-RFA outcomes within the RFA groups. In addition, significant improvement was demonstrated in the RFA groups compared with control groups. RFA made it possible to achieve satisfactory results in all 3 spinal regions.

Hambraeus et al. (845) described a practical approach for the diagnosis and treatment of thoracic facet joint pain. They compared health-related QoL using the validated EQ-5D instrument in 82 patients who underwent thoracic facet RFA and found that survival analysis for health-related QoL improvements demonstrated effectiveness in at least 65% of treated patients. Improvement in EQ-5D index scores was maintained for 12 months or longer in 47% to 51% of patients. Their results suggested that RFA for facet joint thoracic pain is as effective as RFA for facet joint lumbar and cervical pain.

Table 21 shows the study characteristics of randomized trials and observational studies assessing thoracic RFA.

8.3.1.4 Clinical Studies –Lumbar Spine

Lumbar facet pain has been studied extensively utilizing RFA, including 15 RCTs and multiple additional studies involving both the cervical and lumbar spine. Among these, 4 trials were considered placebo- or sham-controlled.

Nath et al. (727), in a randomized, double-blind, sham-controlled trial, evaluated 40 patients with chronic low back pain of at least 2 years' duration utilizing an 80% criterion standard for controlled MBBs. There were 20 patients in each group. The active group received conventional lumbar facet joint RFA at 85° for 60 seconds. Sham control consisted only of needle placement and local anesthetic injection. At 6-month follow-up, they demonstrated significant reductions not only in back and leg pain, but also in functional improvement, opioid intake, and employment status in the active group. Limitations of the trial included short-term follow-up and small sample size.

Tekin et al. (730), in a randomized, sham-controlled, double-blind trial, utilized methodology similar to Nath et al. (727). They evaluated 60 patients with chronic low back pain randomized into 3 groups with 20 patients in each group after performing a single diagnostic MBB with 0.3 mL of lidocaine. Their criterion standard was only 50% pain relief. Patients receiving RFA were divided into 2 groups, one receiving pulsed radiofrequency at 42° for 4 minutes and the other receiving conventional RFA at 80° for 90 seconds. The sham control group received only local anesthetic injection. Results demonstrated decreases in VAS and ODI scores in all 3 groups. However, reduction in pain scores was maintained at 6 months and one year only in the conventional RFA group, whereas significant improvement in the pulsed radiofrequency group lasted only 6 months. The study demonstrated superiority of conventional RFA over both sham control and pulsed RF. Limitations included small sample size, use of only a single MBB, and 50% pain relief as the inclusion criterion. Although no significant differences were observed initially in short-term outcomes, conventional RFA demonstrated significant improvement at one year.

In another randomized, double-blind, sham-controlled trial, van Wijk et al. (728) evaluated 81 patients with chronic low back pain. The control group consisted of 41 patients receiving only a single MBB with 0.5 mL of 2% lidocaine. The criterion standard was 50% pain relief. The comparative group consisted of 40 patients receiving conventional RFA lesioning at 80° for 60 seconds utilizing parallel needle placement. At 3 months, results demonstrated no difference between the RFA and sham groups. Weaknesses of this trial included poor patient selection utilizing only a single diagnostic block with a 50% pain reduction criterion.

Finally, among the sham-controlled trials, van Kleef et al. (729) performed a randomized, double-blind, sham-controlled trial in 31 patients. Fifteen patients in the conventional RF treatment group received conventional RF lesioning at 80° for 60 seconds utilizing perpendicular needle placement. The sham control group consisted of 16 patients receiving only local anesthetic injection. Study selection criteria were limited because a single diagnostic block with 50% relief was utilized

Table 21. *Study characteristics of randomized trials and observational studies assessing thoracic radiofrequency ablation.*

Study Study Characteristic Methodological Quality Scoring	Number of Patients & Selection Criteria	Control	Interventions	Outcome Measures	Time of Measurement	Results	Strengths	Weaknesses	Conclusions
Joo et al, 2013 (748) Randomized, double-blind, active control Quality Scores: Cochrane = 10/13 IPM-QRB = 38/48	40 patients with recurrent thoracolumbar facet joint pain after successful thermal radiofrequency ablation (RFA) defined as a numeric rating scale (NRS) score of 7 or a revised ODI (ODI) of 22% were randomly allocated to 2 groups receiving either the same repeated RFA (n = 20) or alcohol ablation (AA) (n = 20).	Active control with alcohol.	Patients were provided with similar interventions with placement of radiofrequency needles, electric stimulation, contrast medium injection, local anesthetic injection followed by either RFA for 90 seconds at 90°C or injection of 1 mL volume over a period of 15 seconds.	The recurrence rate was assessed with NRS and ODI and adverse events	1 year and 2 years	After RFA and AA, one and 17 patients, respectively, were without recurring thoracolumbar facet joint pain. The median effective periods in the RFA and AA groups were 10.7 (range 5.4–24) and 24 (range 16.8–24) months, respectively (p = 0.000).	Randomized, double-blind, active control trial with appropriate outcomes assessment.	Small sample size. Selection criteria which included only the patients who required repeat thoracolumbar facet joint ablation after prior successful procedure.	This trial is the first of its nature for the thoracic spine in a randomized fashion with active control design. Specific importance is that they selected only the patients who had responded successfully with the first radiofrequency treatment for at least 6 months and then randomized them to assess the differences between alcohol injection and RFA. Alcohol treatment was superior to radiofrequency for recurrent pain; however, this also shows effectiveness of RFA though inferior to alcohol with long-term follow-up of 24 months.
Gungor & Candan, 2020 (773) Observational study Quality Scores: IPM-QRBNR = 29/48	23 patients underwent thoracic CRFA for treatment of chronic thoracic facet joint pain. 40 treatments were performed. All patients underwent dual diagnostic medial branch blocks prior to cooled radiofrequency being performed.	None	Cooled radiofrequency procedure was performed with a 17 gauge, 75 mm, 5.5 mm active tipped CRFA electrodes after placing them over the medial branches. Patients also received 1% lidocaine prior to the injection.	Numeric Rating Scale, significant relief was determined as a decrease of ≥ 50% of mean NRS. Secondary outcome was time to repeat treatment with subsequent CRFA. Outcomes monitored for 6 and 12 months. 3 follow-ups with third follow-up from 6 to 12 months.	1-12 months	Total number of procedures performed were 40 and 23 patients. Primary outcome measure determined as the adequate reduction of pain scores 50% or more was achieved only during the intermediate term pain relief period 2-6 months, with 53% reduction in NRS pain scores.	This the first study to publish the role of cooled radiofrequency in thoracic facet joint pain.	Small number of patients in a retrospective, observational study	It appears that thoracic radiofrequency is not effective in the near term; however, the effectiveness starts at a later date. The results do not appear to be superior to either therapeutic medial branch blocks or prognostic diagnostic medial facet joint nerve blocks, medial branch blocks, pulsed RFA, and conventional RFA

Table 21 cont. *Study characteristics of randomized trials and observational studies assessing thoracic radiofrequency ablation.*

Study Study Characteristic Methodological Quality Scoring	Number of Patients & Selection Criteria	Control	Interventions	Outcome Measures	Time of Measurement	Results	Strengths	Weaknesses	Conclusions
Rohof & Chen, 2018 (774) Retrospective study Quality Scores: IPM-QRBNR = 31/48	71 patients were treated with bipolar RFA for thoracic facet joint pain established by controlled diagnostic blocks.	None	RFA of medial branches including a bipolar system for thoracic facet joints. 2 needles were placed at each level and RFA was performed for 90 seconds at 80°.	NRS and Pain Disability Index	3, 6, and 12 months	• The majority of the patients, 82%, had pain reduction of more than 50% at 12 months after bipolar RFA. • NRS decreased significantly from baseline of 7.75 ± 1.25 to 2.86 ± 1.53 at 3 months and with similar reductions at 12 months post procedure which was significant. • The Pain Disability Index improved significantly. There were no serious adverse effects.	This is a first study performed utilizing a bipolar system for thoracic facet joint pain. Bipolar systems are utilized usually in patients with implantables. The results seem to be superior to conventional radiofrequency with single needle.	Retrospective assessment with small number of patients.	This study shows the effectiveness of thoracic RFA with bipolar system, superior to conventional single-needle placement with mono-polar lesioning.

as the criterion standard. Results demonstrated success rates for RFA versus sham groups of 60% versus 25% at 3 months, 47% versus 19% at 6 months, and 47% versus 13% at 12 months. The differences were statistically significant. Weaknesses included use of a single MBB with a 50% pain relief criterion, small sample size, and criticism of perpendicular needle placement.

Thus, overall, 3 of the 4 sham-controlled trials utilizing only local anesthetic injection as control demonstrated positive results (727,729,730). The solitary negative study had only 3-month follow-up. It is also noteworthy that perpendicular versus parallel needle placement for RFA did not demonstrate significant differences (727,728,730). Data regarding the number of lesions produced were not clearly identifiable.

Among the remaining 10 RCTs utilizing active-control designs, Civelek et al. (828) evaluated 100 patients in a randomized active-controlled trial utilizing clinical selection criteria; however, patients did not undergo pre-RFA diagnostic blocks. The intervention group consisted of 50 patients receiving conventional RFA at 80° for 120 seconds in combination with high-dose local anesthetic and steroids. The control group consisted of 50 patients receiving facet joint MBBs with local anesthetic and steroids. Results demonstrated that at one year, 90% of patients in the RF group versus 69% in the MBB group achieved significant improvement, compared with 92% and 75%, respectively, at 6-month follow-up. Weaknesses included lack of pre-RFA diagnostic blocks and injection of high-dose steroids and local anesthetic in both groups. However, this study demonstrated efficacy not only in 92% of RFA patients at 12 months, but also in 69% of patients receiving MBBs.

Cohen et al. (645), in a randomized, double-blind, active-control trial, evaluated 151 patients with chronic low back

pain. Selection criteria included 51 patients in group 0 receiving RFA based only on clinical findings without pre-RFA MBBs, 50 patients in group 1 receiving RFA following a single diagnostic block, and 50 patients in group 2 receiving RFA after positive comparative blocks utilizing lidocaine and bupivacaine. Conventional RFA was performed at 80° for 90 seconds in 149 patients, with 2 patients dropping out. Outcome measures were limited to 3 months. Overall success rates in groups 0, 1, and 2 were 33%, 16%, and 26%, whereas radiofrequency success rates were 33%, 39%, and 64%, respectively. A positive outcome was predefined as ≥ 50% pain relief coupled with a positive global perceived effect persisting for 3 months.

Moon et al. (740), in a randomized active-control comparative analysis, evaluated 82 patients with low back pain. There were 41 patients in each group receiving RFA utilizing either parallel or perpendicular needle placement. Selection criteria included concordant pain relief following comparative local anesthetic blocks at 50%. The active-control group received RFA with perpendicular needle placement, whereas the intervention group received RFA with parallel placement. RFA was performed at 80° for 90 seconds in both groups. Results at 6 months demonstrated significant reductions in NRS and ODI scores from baseline in both groups, with no significant differences between groups. Although limitations included active-control design without placebo and short- to medium-term follow-up, the study demonstrated equivalent outcomes with parallel versus perpendicular needle placement. Some superiority was noted with perpendicular needle placement, supporting traditional placement techniques.

Lakemeier et al. (731) compared RFA at 80° for 90 seconds with intraarticular injection of local anesthetic and steroids in 56 patients. Twenty-nine patients received intraarticular steroid injection and 27 received RFA. Diagnosis was established using a single MBB with local anesthetic producing at least 50% pain reduction. Six-month follow-up demonstrated improvement in both groups with no significant differences between groups.

McCormick et al. (830) evaluated 6-month outcomes for pain, function, psychometrics, and medication usage in patients undergoing MBBs and cooled RFA (CRFA) versus MBBs and traditional RFA for lumbar zygapophysial joint pain. Their study demonstrated a success rate of 50%, defined as greater than 75% pain relief, for both CRFA and traditional RFA with improvement in both pain and physical function. Although success rates for CRFA were higher than traditional RFA, the difference was not statistically significant.

Juch et al. (58), in the Mint randomized, nonblinded, pragmatic clinical trial, evaluated 251 patients. One hundred twenty-six patients in the control group received exercise programs, whereas 125 patients received RFA. At 12-month follow-up, no significant difference was observed between the RFA group and the exercise program group. Although this was a large-scale study involving multiple investigators, it received extensive criticism because of numerous weaknesses. Criticisms included inappropriate selection criteria utilizing 50% pain relief for only a few hours, which is not recommended. The study was also criticized for use of thin RFA electrodes.

Çetin and Yektaş (761) performed a randomized, double-blind, active-controlled trial comparing pulsed RF with conventional RFA. Although both forms of RFA provided significant pain relief, quality of life and daily activities improved more with conventional radiofrequency.

McCormick et al. (827), in a randomized, single-blinded, active-controlled trial utilizing a selection criterion of 75% pain relief, demonstrated at 6-month follow-up that greater than 50% reduction in NRS scores occurred in 52% of CRFA patients compared with 44% of traditional RFA patients. Both groups demonstrated successful outcomes, with greater pain relief observed in the CRFA group.

Moussa and Khedr (764), in a randomized, double-blind, active-control trial, randomized 120 patients into 3 groups. Selection criteria required 100% pain relief following 2 diagnostic blocks. One group of 40 patients received conventional RFA. A second group of 40 patients received RF denervation of the facet joint capsule. A third group of 40 patients received a sham procedure in which electrodes and thermocouple probes were positioned but no RF current was delivered. All patients received 1 mL of 0.5% bupivacaine and Depo-Medrol 40 mg/mL at the conclusion of the procedure. Follow-up extended to 36 months. At one year, VAS improvement was 6 ± 1 in the RF capsule group, 5.8 ± 1 in the RF medial branch group, and only 0.7 ± 0.3 in the sham group. Results demonstrated that both medial branch RFA and facet capsule coagulation produced significant alleviation of chronic low back pain and functional disability in selected patients for up to one year without significant differences between procedures. Superior therapeutic benefit from facet capsule tar-

geting became evident beginning at 2-year follow-up and persisted at 3 years. Weaknesses included relatively small sample size and substantial patient loss to follow-up at one, 2, and 3 years.

Song et al. (60) evaluated 40 patients in a randomized, single-blind, active-control trial utilizing either traditional RFA or endoscopic ablation of lumbar medial branches. Twenty patients were included in each group. Selection criteria required 80% pain relief following a single diagnostic block. Results demonstrated traditional RFA effectiveness for one year, whereas endoscopic ablation remained effective for 2 years. Weaknesses included very small sample size, single-blinded single-center design, and use of only a single diagnostic block. Both traditional RFA and endoscopic ablation demonstrated effectiveness; however, endoscopic ablation is not currently an approved procedure.

Xue et al. (831), in a randomized active-control trial, compared 30 patients receiving traditional RFA with 30 patients receiving endoscopic ablation. Selection criteria included 80% pain relief following controlled diagnostic blocks. Despite small sample size, 6- and 12-month follow-up demonstrated superior outcomes with endoscopic ablation. However, this procedure is not currently approved.

Multiple observational studies have also evaluated RFA. In one study, Manchikanti et al. (49) assessed clinical outcomes and cost utility of therapeutic lumbar facet joint nerve blocks with L5 dorsal ramus block compared with RFA in managing chronic low back pain of facet joint origin. A total of 326 patients met inclusion criteria, with 99 patients receiving lumbar facet joint nerve blocks and 227 receiving lumbar RFA. Forty-eight patients in the nerve block group and 148 patients in the RFA group completed one-year follow-up. Patients demonstrated significant improvement in both groups from baseline to 12 months, where significant pain relief was defined as ≥ 50%. At 3, 6, and 12 months, significant pain relief was recorded in 100%, 99%, and 79% of patients in the nerve block group and 100%, 74%, and 65% in the RFA group, respectively. Significant differences were observed at 6 months. Cost utility analysis demonstrated average QALY costs of $4,664 for lumbar facet joint nerve blocks and $5,446 for lumbar RFA. Twelve patients (12%) in the nerve block group and 79 patients (35%) in the RFA group were converted to other treatments because of side effects or inadequate relief.

Table 22 shows study characteristics of randomized trials and observational studies assessing lumbar RFA.

8.3.2 Therapeutic Intraarticular Injections

Intraarticular facet joint injections are utilized as both diagnostic and therapeutic procedures in all 3 spinal regions, including the cervical, thoracic, and lumbar spine.

Therapeutic intraarticular facet joint injections have been utilized for many years and have been included in coverage policies, clinical guidelines, RCTs, and observational studies.

8.3.2.1 Systematic Reviews

The literature search yielded 11 updated systematic reviews. A systematic review and meta-analysis of randomized trials evaluating therapeutic intraarticular facet joint injections in chronic axial spinal pain by Manchikanti et al. in 2025 (3) identified 14 RCTs. In this evaluation, the authors performed quality assessment utilizing Cochrane review criteria and IPM-QRB criteria. They also utilized GRADE assessment and performed qualitative analysis. However, conventional dual-arm quantitative analysis was not feasible. Consequently, they performed a single-arm analysis utilizing active control with triamcinolone, which included 3 trials (746,827,846) (Fig. 32A). The pooled mean difference in pain scores from baseline to 3-month follow-up was a 2.769-point decrease (95% CI: -3.273 to -2.266, P = 0.804), which was not statistically significant.

In addition, Fig. 32B shows results utilizing active control with dexamethasone, which included 3 trials (733,847,848). The pooled mean difference in pain scores from baseline to 3 months was a 2.510-point decrease (95% CI: -3.177 to -1.843, P = 0.054).

Four trials with 6-month follow-up, as shown in Fig. 33A, resulting from single-arm meta-analysis utilizing active control with triamcinolone (726,746,827,849), demonstrated a pain score difference from baseline of a 3.604-point decrease (95% CI: -5.578 to -1.630, P < 0.001). This result was statistically significant.

Additionally, as shown in Fig. 33B, active-control results utilizing dexamethasone, which included 3 trials (733,847,848), demonstrated a mean score difference from baseline to 6-month follow-up of a 2.698-point decrease (95% CI: -3.394 to -2.002, P = 0.038).

Consequently, while conventional dual-arm meta-analysis was not feasible, the single-arm analysis yielded modest results. At 3-month follow-up, there was an average pain score reduction of 2.769 points, with slightly greater improvement observed at 6 months utilizing triamcinolone, showing a 3.604-point decrease. Similarly, dexamethasone was associated with

Table 22. *Study characteristics of randomized controlled trials assessing lumbar facet joint nerve radiofrequency ablation.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Facet Joint Radiofrequency**	**Comparator**	**Outcome Measures and Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
LUMBAR PLACEBO/SHAM CONTROLLED								
Nath et al, 2008 (727) RA, DB, sham control trial Quality Scores: Cochrane = 13/13 IPM-QRB = 28/48	40 patients with chronic low back pain for at least 2 years with 80% relief of low back pain after controlled medial branch blocks. The patients were randomized into an active and control group.	n = 20 The 20 patients in the active group received conventional lumbar facet joint radiofrequency neurolysis at 85°C for 60 seconds.	n = 20 Sham control with placement of the needles with injection of local anesthetic without RFA..	NRS, global functional improvement, reduced opioid intake, employment status. 6 months	Significant reduction not only in back, and leg pain; functional improvement; opioid reduction; and employment status in the active group compared withcompared with the control group.	Randomized, double-blind trial after the diagnosis of facet joint pain with triple diagnostic blocks	Short-term follow-up with small number of patients	Efficacy of RFA was shown compared withcompared with local anesthetic injection and sham lesioning.
Tekin et al, 2007 (730) RA, DB, AC, sham control Quality Scores: Cochrane = 12/13 IPM-QRB = 26/48	60 patients with chronic low back pain randomized into 3 groups with 20 patients in each group. Single diagnostic block of facet joint nerves with 0.3 mL of lidocaine 2% with 50% or greater relief.	n = 40 Either pulsed radiofrequency (42°C for 4 minutes) or conventional RFA (80°C for 90 seconds) in 20 patients in each group.	n = 20 Sham control with local anesthetic injection	VAS and ODI 3, 6, and 12 months	VAS and ODI scores decreased in all groups from 3 procedural levels. Decrease in pain scores was maintained in the conventional radiofrequency group at 6 months and one year. However, in pulsed radiofrequency group, the improvement was significant only at 6 months, but not one year.	Randomized, double-blind, controlled trial comparing control, pulsed radiofrequency, and conventional RFA. Authors also utilized a parallel needle placement approach	Small sample size with a single block and 50% relief as inclusion criteria. Authors did not report significant improvement percentages.	Efficacy with conventional RFA up to one year, whereas efficacy with local anesthetic block with sham control RFA and pulsed RFA at 6 months only.
van Wijk et al, 2005 (728) RA, DB, sham control trial Quality Scores: Cochrane = 13/13 IPM-QRB = 38/48	81 patients with chronic low back pain were evaluated with RFA with 41 patients in the control group with at least 50% relief for 30 minutes with a single block	n = 40 40 patients received conventional radiofrequency lesioning at 80°C for 60 seconds and 41 patients received sham lesioning.	n = 41 Sham lesion procedure with intraarticular injection of 0.5 mL lidocaine 2%.	Pain relief, physical activities, analgesic intake, GPE, SF-36, quality of life measures 3 months	GPE improved after radiofrequency facet joint denervation. The VAS in both groups improved. The combined outcome measures showed no difference between radiofrequency facet joint denervation (27.5% vs. 29.3% success rate).	Double-blind, sham control, randomized trial	Poor selection with a single diagnostic block of 50% pain reduction even though 17.5% of the patients were tested positive. Authors described that the needle was positioned parallel.	Lack of efficacy with methodologic deficiencies and a short-term follow-up.

Table 22 cont. *Study characteristics of randomized controlled trials assessing lumbar facet joint nerve radiofrequency ablation.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Facet Joint Radiofrequency**	**Comparator**	**Outcome Measures and Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
Van Kleef et al, 1999 (729) RA, DB, sham control trial Quality Scores: Cochrane = 13/13 IPM-QRB = 37/48	31 patients with a history of at least one year of chronic low back pain randomly assigned to one of 2 treatment groups. Single diagnostic block with 50% relief.	n = 15 The 15 patients in the conventional radiofrequency treatment group received an 80° C radiofrequency lesion for 60 seconds.	n = 16 Sham control of radiofrequency after local anesthetic injection in 16 patients	VAS, pain scores, GPE, ODI 3, 6, and 12 months	After 3, 6, and 12 months, the number of successes in the lesion and sham groups was 9 of 15 (60%) and 4 of 16 (25%), 7 of 15 (47%) and 3 of 16 (19%), and 7 of 15 (47%) and 2 of 16 (13%) respectively. There was a statistically significant difference.	Double-blind, randomized, sham controlled trial	A single block with a small sample with inclusion criteria of 50% pain relief to enter the study. The study has been criticized that electrodes were placed at an angle to the target nerve, instead of parallel.	Efficacy shown in a small sample with a single diagnostic block
LUMBAR ACTIVE CONTROL								
Lakemeier et al, 2013 (731) RA, DB, AC Quality Scores: Cochrane = 9/13 IPM-QRB = 37/48	n = 56 Patients were randomized into 2 groups receiving intraarticular steroid injections or radiofrequency denervation after the diagnosis was made with intraarticular injection of local anesthetic (0.5 mL of bupivacaine) with a single block	n = 27 Radiofrequency denervation was performed after placing the 20-gauge curved RF needle with 10 mm active tip after confirmation of correct placement using electrostimulation, followed by injection of 1 mL of 0.5% bupivacaine through the cannula	n = 29 Intraarticular injection of local anesthetic 0.5 mL of 0.5% bupivacaine and 1 mL of betamethasone 3 mg was injected into the target joint after placing the radiofrequency needle with confirmation with contrast.	RMDQ, VAS, ODI, analgesic intake 6 months	Pain relief and functional improvement were observed in both groups There were no significant differences between the 2 groups for pain relief and functional status improvement RFA had a lower VAS than patients after steroid injection after 6 months The decrease in VAS appears to be less than 2 in steroid group and approximately 2.5 or 3 points in radiofrequency group.	Lack of placebo group. Relatively short-term follow-up	Single diagnostic block with intraarticular injection	Positive Radiofrequency was superior to intraarticular injections

Table 22 cont. *Study characteristics of randomized controlled trials assessing lumbar facet joint nerve radiofrequency ablation.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Facet Joint Radiofrequency**	**Comparator**	**Outcome Measures and Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
McCormick et al, 2023 (827) P, RA, comparative Quality Scores: Cochrane = 11/13 IPM-QRB = 30/48	n = 32 Patients with chronic low back pain and confirmed facet joint pain with dual medial branch blocks 32 patients met eligible criteria out of 1,128 patients 32 patients were randomized into 2 groups with 12 patients undergoing intraarticular facet steroid injection, 12 patients undergoing facet intraarticular injection, and 20 patients undergoing cooled lumbar medial branch RFA	n = 20 Cooled lumbar medial branch RFA performed for 165 seconds, with the RFA generator temperature set to 60°C For bilateral low back pain, a maximum of four facet joints (two on each side) were denervated by cooled lumbar medial branch RFA For unilateral low back pain, a maximum of three facet joints were denervated by cooled lumbar medial branch RFA	n = 12 Intraarticular facet steroid injection utilizing 0.5 mL of 40 mg/mL Kenalog and 0.5 mL of 2% preservative-free lidocaine per facet joint A maximum of 4 facet joints (two on each side) were injected for bilateral low back pain For unilateral low back pain, up to 3 facet joints were injected	NRS, ODI, PGIC 1, 3, 6, & 12 months	In the cooled lumbar medial branch RFA group, 70% (95% CI 48-85), 55% (95% CI 34-74), and 45% (95% CI 26-66) of participants met the NRS responder definition, compared withcompared with 25% (95% CI 9-53), 25% (95% CI 9-53), and 17% (95% CI 5-45) in the intraarticular facet steroid injection group at 3, 6, and 12 months, respectively ($p = .014$ at 3 months) The PGIC responder proportion was higher in the cooled lumbar medial branch RFA compared with intraarticular facet steroid injection group at 3 and 6 months ($p < .05$)	RCT with selection criteria of dual diagnostic blocks and 12-month follow-up	Small sample size Active control trial	Positive trial CRFA was superior compared withcompared with intraarticular injections
Civelek et al, 2012 (828) RA, AC Quality Scores: Cochrane = 9/13 IPM-QRB = 28/48	100 patients with chronic low back pain with failed conservative therapy and strict selection criteria; however, without diagnostic blocks	n = 50 50 patients were treated with conventional RFA at 80°C for 120 seconds in combination with high dose local anesthetic and steroids	n = 50 50 patients were treated with facet joint nerve blocks	Visual NRS, NASS patient satisfaction questionnaire, Euro-Qol in 5 dimensions and ≥ 50% relief One month, 6 months, 12 months	At one year, 90% of patients in the radiofrequency group and 69% of the patients in the facet joint nerve block group showed significant improvement compared with 92% and 75% at 6-month follow-up	Randomized with 50 patients in each group	No diagnostic blocks were performed. High dose steroids and local anesthetics were utilized in both groups	Positive long-term results Efficacy was shown even without diagnostic blocks, both for facet joint nerve blocks and RFA

Table 22 cont. *Study characteristics of randomized controlled trials assessing lumbar facet joint nerve radiofrequency ablation.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Facet Joint Radiofrequency**	**Comparator**	**Outcome Measures and Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
Juch et al, 2017 (58) MINT RA, non-blinded, pragmatic clinical trial Quality Scores: Cochrane = 6/13 IPM-QRB = 26/48	A total of 251 patients were randomized into facet trial with 126 patients in the control group receiving exercise program as randomized. 125 patients were randomized to intervention group. Selection Criteria: At least 50% relief with a single block of facet joint nerves with pain reduction within 30 to 90 minutes after the block.	n = 125 Patients in the intervention group received RFA RFA was performed with a conventional RFA procedure with a 22 gauge electrode. Co-interventions except standardized exercise program were not allowed for 3 months. Over-the-counter analgesics were allowed.	n = 126 Patients randomized to control group received exercise program as randomized.	NRS, global perceived recovery, ODI, EuroQol 5D Health Questionnaire, Rand-36, West Haven-Yale Multidimensional Pain Inventory 3, 6, 9, 12 months	There was no significant difference between RFA group compared withcompared with exercise program group in the control.	A large randomized clinical trial	There are numerous weaknesses in this trial. Inappropriate selection criteria with 50% relief for a few hours which is not recommended by any guidelines. Not a blinded procedure. The electrode was too thin with exposed tip may or may not be over the nerve utilizing a perpendicular placement of the electrode. Outcome measures were inappropriate. This study received extensive correspondence and negative comments all over for its defective design and performance.	A poorly designed and performed trial showing negative results.
Çetin & Yektaş, 2017 (761) RA, DB, AC Quality Scores: Cochrane = 12/13 IPM-QRB = 39/48	118 patients were randomized to Group 1 to receive pulsed radiofrequency and Group 2 with 45 patients receiving conventional radiofrequency.	n = 43 Conventional RFA was performed at 80° for 90 seconds. Bupivacaine was injected prior to the procedure and following the procedure, 2 mg of methylprednisolone was injected through RF needle at each level in both groups.	n = 75 Pulsed radiofrequency was performed at 42° for 3 minutes. Bupivacaine was injected prior to the procedure and following the procedure, 2 mg of methylprednisolone was injected through RF needle at each level in both groups.	VAS, Odom criteria 1, 3, 6 months, 1 year, 2 years	Conventional RFA provided significantly better relief at 6 months, one year, and 2 years.	Randomized, double-blind control trial	Active control trials	This trial shows good outcomes with conventional RFA over a period of 2 years.

Table 22 cont. *Study characteristics of randomized controlled trials assessing lumbar facet joint nerve radiofrequency ablation.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Facet Joint Radiofrequency**	**Comparator**	**Outcome Measures and Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
McCormick et al, 2019 (830) RA, SB, AC Quality Scores: Cochrane = 10/13 IPM-QRB = 36/48	43 patients were randomized to two groups, 21 received cooled RFA while 22 received traditional RFA of medial branch nerve. Patients who had at least 75% pain relief on a diagnostic block were included in study.	n = 21 Received traditional percutaneous RFA of medial branch nerve.	n = 22 Received cooled percutaneous RFA of medial branch nerve.	Primary outcome: ≥50% NRS reduction at 6 months. Secondary outcomes: NRS, ODI and patient global impression of change. 6 months	A ≥50% decrease in NRS was observed in 52% (95% CI 31% to 74%) and 44% (95% CI 22% to 69%) in the cooled RFA and traditional RFA respectively with no significant difference between the groups (p=0.75).	Randomized, single blinded.	Relatively small sample size, up to 7% participants outcomes were not reported. Followed only for 6 months. Not a double blinded study.	Study showed both CRFA and traditional RFA had over 50% success rates in reducing pain and improving function at 6 months. However, there was no significant difference between the groups.
Moon et al, 2013 (740) RA, AC Quality Scores: Cochrane = 9/13 IPM-QRB = 41/48	82 patients were included with low back pain with 41 patients in each group either with a parallel placement of the needle or perpendicular placement of the needle. Concordant pain relief of >50% after a comparative local anesthetic block.	n = 41 41 patients in each group were treated with radiofrequency (80°C for 90 seconds). The needle was positioned utilizing a parallel placement.	n = 41 An active control trial with needle placement with perpendicular approach. RFA at 80°for 90 seconds	NRS, ODI One month and 6 months	Patients in both groups showed a statistically significant reduction in NRS and ODI scores from baseline to that of the scores at one and 6 months (all $p < 0.0001$, Bonferroni corrected).	Randomized, double-blind, controlled trial. The major strength is that authors have proven that parallel approach may not be the best as has been described. Diagnosis of facet joint pain by dual blocks.	Active controlled trial without placebo group. Short-term follow-up.	Positive results in an active controlled trial, in a relatively short-term follow-up of 6 months, with positioning of the needle either with perpendicular placement or with parallel placement. There was superiority with perpendicular approach. This trial abates any criticism of needle positioning one way or the other and the traditional needle positioning appears to be superior to parallel needle placement.

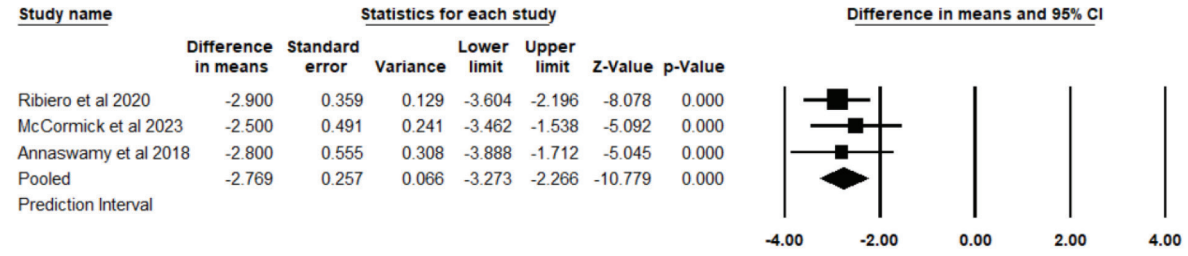
Table 22 cont. *Study characteristics of randomized controlled trials assessing lumbar facet joint nerve radiofrequency ablation.*

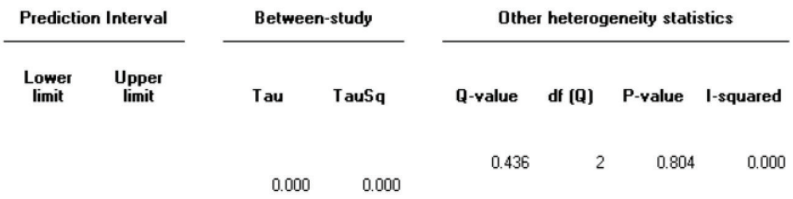
Study Study Characteristic Methodological Quality Scoring	Number of Patients & Selection Criteria	Facet Joint Radiofrequency	Comparator	Outcome Measures and Time of Measurement	Results	Strengths	Weaknesses	Conclusions
Moussa and Khedr, 2016 (764) RA, DB, AC Quality Scores: Cochrane = 10/13 IPM-QRB = 41/48	120 patients were randomized to three groups of 40 each. Patients with chronic low back pain for over one year duration despite at least three months of conservative management and who achieved near complete pain reduction after two diagnostic blocks.	n = 40 Intervention group received RFA with denervation of medial branches	n = 40 Control group received percutaneous radiofrequency coagulation of the facet joint capsule n = 40 A third group with 40 patients received sham lesion procedure after local anesthetic injection	Several outcome measures were measured VAS, ODI, and GPE. However, the primary outcome was determined by a predefined multidimensional COM at one year follow-up. 3, 6, 12, 24, and 36 months.	Success measured by COM at 1 year in the radiofrequency coagulation of joint capsule, denervation of medial dorsal branch and sham groups were 67.5%, 57.5% and 10% respective which was statistically significant (p=0.038).	Randomized double blinded. All the interventional procedures were done by one neurosurgeon reducing potential operator-dependent confounding. patients diagnosed with facet joint pain by dual blocks.	Relatively small sample size, average. 8, 13 and 20% of patients lost to follow up at 1, 2 and 3 years respectively.	Study showed that both radiofrequency coagulation of facet joint capsule and medial branch nerve significantly improved pain in chronic low back pain patients at one year compared withcompared with the sham group. However, these benefits were seen at 2- and 3-years follow-up for group in which the facet joint capsule was targeted but diminished in the group in which medial branch nerve was targeted.
Cohen et al, 2010 (645) RA, DB, AC Quality Scores: Cochrane = 8/13 IPM-QRB = 28/48	151 chronic low back pain 51 patients with no diagnostic block 50 patients a single diagnostic block 50 patients in double diagnostic block.	RF neurotomy in patients without diagnostic blocks.	Conventional RF neurotomy at 80° C for 90 seconds in all patients; however, in 2 groups with either a single block paradigm or a double block paradigm testing for positive results.	≥ 50% pain relief coupled with a positive global perceived effect persisting for 3 months. 3 months	Denervation success rates in Groups 0, 1, and 2 were 33%, 39%, and 64% respectively.	Multicenter, RCT with or without diagnostic blocks	Authors misinterpreted cost-effectiveness without consideration of many factors reported.	Results showed efficacy when double diagnostic blocks were utilized.

Table 22 cont. *Study characteristics of randomized controlled trials assessing lumbar facet joint nerve radiofrequency ablation.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Facet Joint Radiofrequency**	**Comparator**	**Outcome Measures and Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
Song et al, 2019 (60) RA, SB (investigator), AC Quality Scores: Cochrane = 6/13 IPM-QRB = 29/48	40 patients were randomized to two groups of 20 each. One group received RFA while the other group underwent endoscopic ablation. Patients who had at least 3 months of chronic low back pain and showed at least 80% pain relief following a single diagnostic block.	n = 20 The intervention group underwent fluoroscopy assisted RFA of lumbar medial branch nerve.	n = 20 The control group underwent endoscopic ablation of lumbar medial branch nerve.	VAS and ODI scores were measured. 3 weeks, 6 months, 1 and 2 years.	Radiofrequency group showed significant effectiveness at 3 weeks, 6 months, and 1 year but not significantly effective at 2 years. Endoscopy group showed significantly effective even at 2 years but the efficacy declined. There was no significant difference between the groups 3 weeks after the procedure however, at 6 months and longer the endoscopy group showed significantly better outcomes.	Randomized, investigator blinded study.	Very small sample size, single blinded (investigator only), single center, and patients' medication and physiotherapy were not taken into account. Single diagnostic block was used for diagnosis.	Both RFA and endoscopic ablation of the medial branch nerve were effective but endoscopic ablation has better and longer lasting outcomes.
Xue et al, 2020 (831) RA, AC Quality Scores: Cochrane = 7/13 IPM-QRB = 32/48	60 patients were randomized to 2 groups of 30 each. One group received traditional percutaneous RFA, while the other group underwent percutaneous RFA under endoscopic guidance. Patients who had chronic low back pain for longer than 3 months; failed 2 months of conservative treatment; and more than 80% pain relief after controlled differential medial branch block	n = 30 Medial branch traditional radiofrequency	n = 30 Endoscopic ablation	1 day, 1 month, 3 months, 6 months, and 12 months VAS, MacNab score	Both groups with traditional RFA and endoscopic rhizotomy showed significant improvement up to 3-months. After that, endoscopic RFA showed significantly better results at 6-months and 12-months. Complication rate was higher with lack of skin sensation analgesia in 9 patients in the radiofrequency group and 2 patients in the endoscopy group	RCT, dual diagnostic blocks for selection criteria	Small sample size, active control, without blinding, single center There were no reports of percentage of patients with greater than 50% relief.	Negative trial for RFA with 3 months of relief. Overall, endoscopic radiofrequency yielded better results with lesser complications

A





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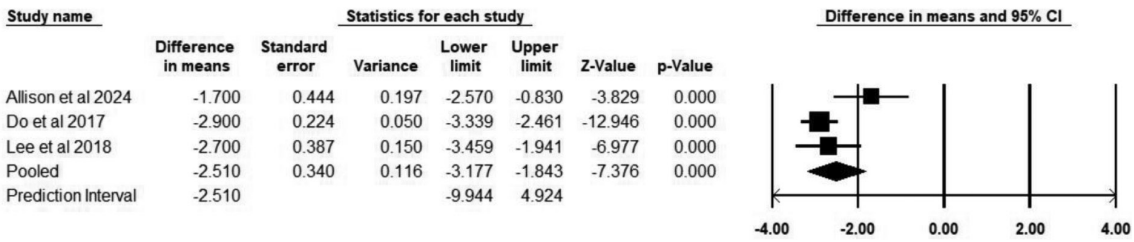


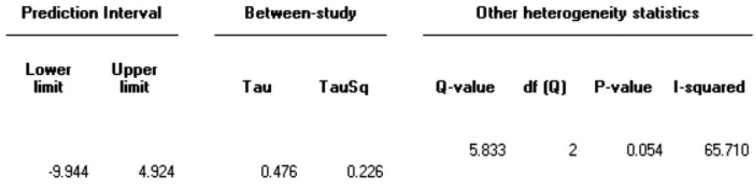


Fig. 32. *Results of pain relief at 3-month follow-up with intraarticular triamcinolone or dexamethasone.*
A. Outcomes of intraarticular injection of triamcinolone NRS at 3 months.
B. Outcomes of intraarticular injection of dexamethasone NRS at 3 months.

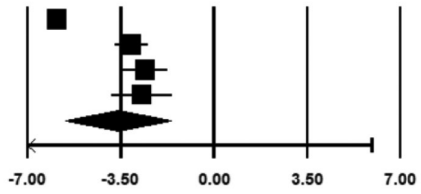
a 2.510-point reduction at 3 months and a 2.698-point reduction at 6 months. No significant differences were identified between triamcinolone and dexamethasone. Additionally, only 4 trials met eligibility criteria for inclusion in these analyses (733,847,849,850).

GRADE assessment, as shown in Table 23, demonstrated moderate certainty and impact in 4 studies (725,779,847,849), whereas 8 studies were rated as having low certainty and impact (723,731,733,746,778,827,850,851). Two studies demonstrated low impact with very low certainty (846,848). Overall, based on combined qualitative and quantitative analyses and GRADE evidence synthesis, the summary evidence was **Level IV** for intraarticular steroid injections, indicating low certainty and **weak strength of recommendation**.

Fogarty et al. (852) reviewed fluoroscopically guided lumbar facet steroid injections in 2025. Their review included both randomized and observational studies; however, meta-analysis was not performed. They evaluated methodological quality and conducted GRADE

A

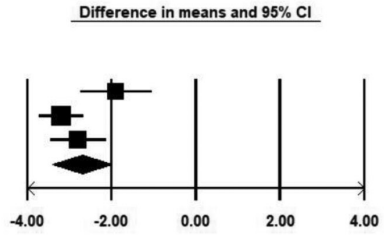
Study name	Difference in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Anshul et al 2023	-5.900	0.164	0.027	-6.221	-5.579	-35.976	0.000
Fuchs et al 2021	-3.100	0.320	0.102	-3.727	-2.473	-9.688	0.000
McCormick et al 2023	-2.600	0.433	0.187	-3.449	-1.751	-6.005	0.000
Annaswamy et al 2018	-2.700	0.583	0.340	-3.843	-1.557	-4.631	0.000
Pooled	-3.604	1.007	1.014	-5.578	-1.630	-3.579	0.000
Prediction Interval	-3.604			-13.138	5.930		



Prediction Interval		Between-study		Other heterogeneity statistics			
Lower limit	Upper limit	Tau	TauSq	Q-value	df (Q)	P-value	I-squared
-13.138	5.930	1.974	3.896	111.262	3	0.000	97.304

B

Study name	Difference in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Allison et al 2024	-1.900	0.433	0.187	-2.749	-1.051	-4.388	0.000
Do et al 2017	-3.200	0.268	0.072	-3.725	-2.675	-11.940	0.000
Lee et al 2018	-2.800	0.336	0.113	-3.459	-2.141	-8.333	0.000
Pooled	-2.698	0.355	0.126	-3.394	-2.002	-7.600	0.000
Prediction Interval	-2.698			-10.593	5.196		



Prediction Interval		Between-study		Other heterogeneity statistics			
Lower limit	Upper limit	Tau	TauSq	Q-value	df (Q)	P-value	I-squared
-10.593	5.196	0.510	0.260	6.527	2	0.038	69.358

Fig. 33. *Results of pain relief at 6-month follow-up with intraarticular triamcinolone dexamethasone and PRP.*
A. Outcomes of intraarticular injection of triamcinolone NRS at 6 months.
B. Outcomes of intraarticular injection of dexamethasone NRS at 6 months.

assessments. Among the 21 included studies, success rates for ≥ 50% pain relief ranged from 13% to 74%. Functional improvement of ≥ 30% at one month was reported in only one study. Mean improvements ranged from 11% to 59% for pain and 8% to 58% for function. Subgroup analysis of studies utilizing diagnostic blocks demonstrated pain relief rates ranging from 23% to 67% and functional improvement from 15% to 58% at one month. However, the overall quality of evidence was rated as very low because of high risk of bias, study heterogeneity, and methodological inconsistencies.

Baroncini et al. (853), in a 2021 systematic review evaluating the management of facet joint osteoarthritis associated with chronic low back pain, included data from 487 patients across 8 studies with a mean follow-up of 12.4 ± 10.5 months. Utilizing Cochrane methodological quality criteria, which demonstrated overall low risk of bias, they concluded that medial branch blocks yielded more consistent results compared withcompared with intraarticular facet joint injections. Treatments utilizing local anesthetics, corticosteroids, and Sarapin, individually or in combi-

Table 23. *Evidence profile using randomized controlled trials for spinal facet joint intraarticular injections for the same outcome and similar certainty of evidence.*

CERTAINTY ASSESSMENT							Number of Patients	Impact	Certainty
Study	Study Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias			
Lee et al, 2018 (847)	RA, AC	Low	NS	NS	NS	Low	n = 40	Moderate	Moderate
Annaswamy et al, 2018 (746)	DB, RA, AC	Moderate	NS	NS	NS	Low	n = 30	Low	Low
Carette et al, 1991 (725)	RA, DB, impure placebo or AC	Moderate	NS	NS	NS	Low	n = 97	Moderate	Moderate
Fuchs et al, 2005 (726)	RA, DB, AC	Moderate	NS	NS	NS	Low	n = 60	Low	Low
Do et al, 2017 (733)	RA, DB, AC	Moderate	NS	NS	NS	Low	n = 60	Low	Low
Wu et al, 2017 (850)	RA, AC	Low	NS	NS	NS	Low	n = 46	Low	Low
Lakemeier et al, 2013 (731)	RA, DB, AC	Low	NS	NS	NS	Low	n = 56	Low	Low
Barnsley et al, 1994 (778)	RA, DB, AC	Low	NS	NS	NS	Low	n = 41	Low	Low
Park & Kim, 2012 (779)	RA, AC	Low	NS	NS	NS	Low	n = 200	Moderate	Moderate
Ribeiro et al, 2013 (846)	RA, DB, AC	Moderate	NS	NS	NS	Low	n = 60	Low	Very low
Allison et al, 2024 (848)	RA, DB	Low	NS	NS	NS	Low	n = 40	Low	Very low
Kotb et al, 2022 (851)	P, RA, single-blind	Low	NS	NS	NS	Low	n = 30	Low	Low
Anshul et al, 2023 (849)	P, single-blind, RA	Moderate	NS	NS	NS	Low	n = 60	Moderate	Moderate
McCormick et al, 2023 (827)	P, RA, comparative	Low	NS	NS	NS	Low	n = 32	Low	Low

AC = active controlled; DB = double-blind; NS = Not serious; P= prospective; PC = placebo controlled; RA = randomized

nation, demonstrated improvement in both pain and disability scores.

Ambrosio et al. (69) conducted a 2021 systematic review of minimally invasive treatments for lumbar facet joint syndrome, including 18 studies with 1,496 patients. Interventions reviewed included intraarticular hyaluronic acid and corticosteroid injections. Radiofrequency denervation demonstrated outcomes slightly superior or comparable to intraarticular corticosteroids, physical therapy, and sham procedures. Corticosteroids combined with oral diclofenac produced better outcomes than corticosteroids or diclofenac alone, but not better than local anesthetic plus Sarapin. However, the review misclassified facet joint nerve blocks as intraarticular injections, compromising the validity of their conclusions (841).

Appeadu et al. (854) evaluated the effectiveness of intraarticular cervical facet steroid injections through a systematic review and meta-analysis. Only 3 studies with a total of 64 patients met inclusion criteria. While results suggested potential effectiveness for cervicogenic headache, the mean effect size on the VAS was 3.299 with 36.11% heterogeneity. Notably, no RCTs were included.

Ashmore et al. (855) assessed ultrasound-guided lumbar MBBs and intraarticular injections, focusing on needle placement accuracy. Their meta-analysis included several RCTs. Pooled results from 7 studies

revealed an 11% rate of incorrect needle placement in ultrasound-guided MBBs confirmed by fluoroscopy. In addition, pooled data from 3 studies demonstrated a 13% error rate for facet joint injections confirmed by CT. They concluded that the overall certainty of evidence was low to very low. They also concluded that US guidance carries a significant risk for incorrect needle placement.

Acosta Julbe et al. (856), in a scoping review, examined predictors of outcomes for lumbar intraarticular facet injections and MBBs. The review included 37 studies and identified key predictive factors such as imaging evidence of facet arthropathy, duration of symptoms, positive single-photon emission computed tomography (SPECT) scans, and, to a lesser extent, depression status. Findings suggested that imaging evidence of facet joint pathology and positive SPECT may help identify patients more likely to benefit from facet-targeted interventions.

Suputtitada et al. (857) conducted a systematic review and meta-analysis involving 3 studies evaluating intraarticular normal saline injections for chronic low back pain. The review concluded that normal saline produced pain relief comparable to that of active substances in both short-term and long-term settings. The included studies by Lilius et al. (756), Carette et al. (725), and Revel et al. (549) are well established in the literature. Their findings also demonstrated that corticosteroid injections for cervical joint pain had a negative, though not statistically significant, effect on functional outcomes compared with RFA at 3-month follow-up.

Xu et al. (837) compared RFA and corticosteroid injections for spinal facet and sacroiliac joint pain in a meta-analysis of 33 studies. Their findings demonstrated greater pain relief with radiofrequency at 3 and 6 months; however, no significant difference was observed at 12 months. For cervical facet pain, patients treated with corticosteroids had higher functional disability scores than those receiving RFA at 3 months, although the difference was not statistically significant.

Mazmudar et al. (840) provided an economic evaluation of lumbar facet interventions, including intraarticular injections, MBBs, and RFA. Their 2020 review concluded that while evidence for intraarticular injections was limited, moderate evidence supported the use of MBBs and RFA.

Noh et al. (51), in 2025, published a systematic review and meta-analysis evaluating the effectiveness of facet joint injections versus medial branch blocks for pain management. They concluded that while facet joint injections and medial branch blocks are effective for chronic spinal pain, facet joint injections may be preferred for patients seeking immediate pain relief with fewer complications. In this systematic review and meta-analysis of RCTs and observational studies, they included studies from all spinal regions. Overall, 10 studies were included in the meta-analysis. Quality assessment and risk of bias were evaluated utilizing the Cochrane Risk of Bias tool for RCTs and ROBINS-I (Risk of Bias in Nonrandomized Studies of Interventions) for observational studies. At 3-month follow-up, MBBs demonstrated greater improvement compared withcompared with facet joint injections. However, at 6-month follow-up, significant improvement was observed in patients receiving facet joint injections. Utilizing ODI, no significant differences were identified between the groups.

Although multiple studies were included, their search criteria did not capture all available RCTs. They concluded that in the cervical spine, MBBs produced significant short-term pain relief with moderate to high patient satisfaction rates; however, they did not include the following RCT and observational studies (700,701). They also stated that follow-up periods were relatively short and that repeated blocks were not performed. In addition, their results demonstrated effective pain reduction with both facet joint injections and MBBs. However, they did not reference one RCT and one active-control trial (695,696). In the lumbar spine, they concluded that facet joint injections and medial branch blocks provided significant improvement in pain and function. They also stated that some studies reported slightly higher satisfaction scores with facet joint injections. They further failed to include 2 additional lumbar spine studies (693,694). Finally, they stated that their findings were generally consistent with prior systematic reviews assessing the effectiveness of facet interventions as reported by Manchikanti et al. (858).

8.3.2.2 Clinical Studies – Cervical Spine

Publications evaluating cervical facet joint intraarticular steroid injections are sparse, as shown in the systematic reviews performed by Manchikanti et al. (3,51,69,837,840,852-857). Three RCTs were identified for assessment of the cervical spine (778,779,848).

Barnsley et al. (778) evaluated the effect of intraarticular corticosteroids for chronic cervical facet joint pain. They included 16 men and 25 women with

pain involving one or more cervical zygapophyseal joints following automobile accidents, with a mean age of 43 years and median pain duration of 39 months. Patients were randomly assigned under double-blind conditions to receive intraarticular injection of either 0.5% bupivacaine or betamethasone 5.7 mg. Patients were followed with regular telephone contact and clinic visits until they reported return of pain to 50% of the pre-injection level. Time from treatment to 50% return of pain was compared between groups utilizing survival analysis. Results demonstrated that fewer than half of the patients reported pain relief lasting more than one week, and fewer than one in five patients reported pain relief lasting more than one month, irrespective of the injected medication. Median time to return of 50% of pre-injection pain was 3 days in the corticosteroid group of 21 patients and 3.5 days in the local anesthetic group of 20 patients (P = 0.42). They concluded that intraarticular betamethasone injections were not effective therapy for cervical facet joint pain following whiplash injury.

Park and Kim (779) assessed the effect of adding cervical facet joint injections to a multimodal treatment program for long-standing cervical myofascial pain syndrome with referral pain patterns suggestive of cervical facet joint syndrome. They evaluated 400 patients presenting over a 6-month period with chronic cervical myofascial pain syndrome and referral patterns consistent with cervical facet joint syndrome. In a randomized clinical trial, 200 patients in group 1 received therapeutic cervical facet joint injections at bilateral C5/C6 and C6/C7 levels following diagnostic controlled double-blind blocks. The same cointerventions, including medication and home exercise programs, were simultaneously applied to both group 1 and the noninjection group. Cervical range of motion (CROM), mean reduction in NRS pain scores, and comorbid tension-type headache were compared between groups during one-year follow-up. Treatment duration and symptom-free periods were also compared according to age group. Results demonstrated that group 1 showed increased CROM, greater mean reduction in NRS pain scores, and decreased incidence of associated tension-type headache compared with the noninjection group during follow-up. Younger patients in group 1 required shorter treatment duration and experienced longer symptom-free periods. They concluded that addition of therapeutic cervical facet joint injections to a multimodal treatment program represents a useful therapeutic modality, particularly in younger patients with long-standing myofascial pain syndrome and referred pain from cervical facet joint syndrome.

Allison et al. (848) compared intraarticular corticosteroid injections with platelet-rich plasma (PRP) for treatment of cervical facetogenic pain in a randomized clinical trial. Their study included 40 participants assigned to receive either leucocyte-poor, low-concentrate PRP injections or corticosteroid injections without local anesthetic into the cervical facet joint under fluoroscopic guidance. Outcomes were collected by telephone at 1, 3, and 6 months to determine treatment effectiveness. Results demonstrated that low-concentrate PRP and corticosteroid injections produced similar effects on cervical facetogenic pain intensity over 6 months, as demonstrated by a nonsignificant group-by-time interaction for NRS scores (P > 0.05). However, both groups demonstrated statistically significant reductions in cervical facetogenic pain intensity at one month compared with baseline (P = 0.02). There was a significant interaction at one month for pain self-efficacy (P = 0.04), with the PRP group demonstrating greater improvement in pain self-efficacy compared with the corticosteroid group. No significant interaction was observed for self-rated disability; however, both groups demonstrated significant reductions in disability at 3 and 6 months compared with baseline (P < 0.01). No significant differences between groups were reported regarding adverse events; however, patients receiving PRP reported significantly less procedural pain (P = 0.02). They concluded that both PRP and corticosteroid injections produced similar improvements in cervical facetogenic pain intensity at one month and self-rated disability at 3 and 6 months. Pain self-efficacy demonstrated significant improvement at one month in the PRP group. In addition, both treatments exhibited similarly low rates of adverse events, although PRP injections were associated with less procedural pain.

Table 24 shows study characteristics of RCTs assessing cervical spinal facet joint intraarticular injections.

8.3.2.3 Clinical Studies – Thoracic Spine

There was only one RCT evaluating thoracic intraarticular facet joint injections (847). Lee et al. (847) published the first and only randomized, double-blind controlled trial. However, this was an active comparative trial with short-term follow-up and a small sample size. For thoracic intraarticular facet joint pain, both steroid injections and therapeutic MBBs utilized 0.5 mL of 0.5% bupivacaine mixed with 10 mg (0.25 mL) of dexamethasone. While both MBBs and intraarticular in-

Table 24. *Study characteristics of randomized controlled trials assessing cervical spinal facet joint intraarticular injections.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Facet Joint Intraarticular Injections**	**Comparator**	**Outcome Measures and Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
Barnsley et al, 1994 (778) RA, DB, AC Quality Scores: Cochrane = 13/13 IPM-QRB = 36/48	n = 41 Patients with involvement of one or more cervical zygapophysial joints after automobile accidents with median duration of pain of 39 months were randomly assigned into 2 groups Selection Criteria: Diagnosis was established by dual diagnostic blocks under fluoroscopic guidance with positive relief considered as complete or definite	n = 21 Intraarticular injection of 5.7 mg betamethasone or 1 mL intraarticular bupivacaine	n = 20 Injection of intraarticular local anesthetic, 1 mL	VAS, MPQ, SCL, MPQ 1, 4, 8, 16 and 20 weeks after the injection	No significant difference in duration of pain relief Median duration of time to return of pain to 50% was 3 days in the steroid group and 3.5 days in the local anesthetic group	RCT	Small sample size Single block for diagnosis	Negative trial Active control trial Lack of effectiveness of local anesthetic and local anesthetic with steroid
Park & Kim, 2012 (779) RA, AC Quality Scores: Cochrane = 6/13 IPM-QRB = 27/48	n = 200 Patients were selected for therapeutic intraarticular injections if they were positive for facet joint pain utilizing dual diagnostic blocks with concordant 80% pain relief	n = 200 Intraarticular injections were performed with 0.5 mL of 1% lidocaine and 5 mg of triamcinolone and 187.5 international units of hyaluronidase Patients also received either OnabotulinumtoxinA or trigger point injections if they required; however, these were of a small number.	n = 200 Conservative management	Cervical range of motion, NRS for pain, comorbid tension type headache 3, 6, & 12 months	Patients receiving intraarticular injections on one occasion showed increased cervical range of motion, increased mean NRS pain reduction, and decreased incidence of combined tension-type headache compared with control group receiving conservative management during follow-up	RCT in a large population of patients	Not blinded Intraarticular injections were compared with conservative management The study was also confounded with multiple deficiencies including trigger point injections and OnabotulinumtoxinA injections in some patients with ≥ 20% withdrawal rate	Indeterminate The study showed effectiveness of intraarticular injections of steroids; however, there were multiple confounding factors including trigger point injections and botulinum toxin injections. Consequently, it is hard to identify to which modality of treatment relief can be attributed.

Table 24 cont. *Study characteristics of randomized controlled trials assessing cervical spinal facet joint intraarticular injections.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Facet Joint Intraarticular Injections**	**Comparator**	**Outcome Measures and Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
Allison et al, 2024 (848) RA, DB Quality Scores: Cochrane = 13/13 IPM-QRB = 40/48	n = 40 Patients with chronic facet joint neck pain were randomized to 2 groups to receive either intraarticular injections or low concentrate PRP Selection Criteria: • Clinical diagnosis • Dual cervical medial branch blocks	n = 19 Intraarticular corticosteroid injections with mixture of 0.5 mL normal saline and 0.5 mL of dexamethasone at each facet joint	n = 21 Intraarticular PRP injections with 1 mL of PRP per facet joint	NRS, PSEQ, NDI 1, 3, and 6 months	At 3 and 6 month follow-up, significant reductions were shown compared with baseline scores in both groups There was no significant difference in the proportion achieving 50% pain relief between the corticosteroid and PRP groups at 3 and 6 months NRS scores of pain intensity were 5.63 ± 1.46 at baseline and 4.89 ± 1.94 at 3-month follow-up PRP group was also similar with 6.24 ± 1.81 at baseline and 4.81 ± 2.77 at 3 months 50% pain relief was achieved in 21% of the patients, or 4 of 19 in the steroid group and 6 of 21 in PRP group	RCT	Active control with small sample size	Negative trial Even though authors concluded that both groups showed improvement from baseline, the clinically relevant outcomes showed improvement in only 21% of the patients

AC = active control; CI = confidence interval; DB = double-blind; IPM-QRB = Interventional Pain Management techniques–Quality Appraisal of reliability and Risk of Bias Assessment; LA = local anesthetic; LBOS = low-back outcomes score; MPQ = McGill Pain Questionnaire; NRS = Numeric Rating Scale; NDI = Neck Disability Index; ODI = Oswestry Disability Index; P= prospective; PDQ = Pain Disability Questionnaire; PRF = platelet-rich fibrin; PGIC = Patient Global Impression of Change ; PRP = platelet-rich plasma; RA = randomized; RCT – randomized controlled trial; RMDQ = Roland-Morris Disability Questionnaire; SCL = Symptom Checklist; SF-36 = Short Form-36; SIP = Sickness Impact Profile; VAS = Visual Analog Scale

jections were effective, the intraarticular steroid group demonstrated superior results, with improvement observed in 65% of patients at 6 months compared with 40% of patients receiving facet joint nerve blocks. Thus, the results of both MBBs and intraarticular injections appeared significant. The findings demonstrated that compared with pretreatment NRS scores, NRS scores at 1, 3, and 6 months after treatment showed significant decreases in patients in both groups.

8.3.2.4 Clinical Studies – Lumbar Spine

In contrast to the cervical and thoracic spine, multiple studies have been performed evaluating management of lumbar facet joint pain. Ten RCTs evaluating intraarticular injections were identified for the lumbar spine (725,726,731,733,746,827,846,849-851).

Carette et al. (725), in a randomized placebo-controlled trial, evaluated the efficacy of facet joint corticosteroid injections for chronic low back pain. Their results demonstrated that after one month, none of the outcome measures evaluating pain, functional status, or back flexion differed clinically or statistically between the steroid and placebo groups. Forty-two percent of patients receiving methylprednisolone and 33% of those receiving placebo reported marked or very marked improvement (95% CI for the difference, -11 to 28 percentage points; $P = 0.53$). Results were similar at 3 months. At 6-month follow-up, patients treated with methylprednisolone reported greater improvement, less pain on the visual analog scale, and less physical disability. However, these differences were reduced when concurrent interventions were considered. Moreover, only 11 patients (22%) in the methylprednisolone group and 5 patients (10%) in the placebo group demonstrated sustained improvement from the first month through the sixth month (95% CI for the difference, -2 to 26; $P = 0.19$). Because of the relatively high placebo success rate, they concluded that injection of methylprednisolone acetate into the facet joints has little value in the treatment of chronic low back pain.

Annaswamy et al. (746), in a double-blind randomized controlled trial, compared intraarticular triamcinolone with hyaluronate injections for low back pain with symptoms suggestive of lumbar zygapophyseal joint arthropathy. Thirty patients were randomly assigned to receive bilateral L3-S1 lumbar facet joint injections with either triamcinolone or Synvisc-One. Pain utilizing VAS and Pain Disability Questionnaire scores were assessed at 1, 3, and 6 months. Results demonstrated no significant intergroup differences ($P > 0.05$) among the 30 recruited patients. They concluded that patients with chronic low back pain suggestive of lumbar facet joint arthropathy responded favorably to both triamcinolone and hyaluronate injections. The Synvisc-One group demonstrated significant short- and long-term functional improvement and short-term pain improvement, whereas the triamcinolone group demonstrated only significant short-term functional benefit without significant short- or long-term pain improvement.

Fuchs et al. (726) evaluated the efficacy and safety of intraarticular sodium hyaluronate compared with intraarticular glucocorticoids utilizing triamcinolone acetonide in the treatment of chronic nonradicular lumbar pain. Sixty patients were randomly assigned to receive either 10 mg sodium hyaluronate or 10 mg triamcinolone acetonide per facet joint. Bilateral facet joints at levels L3-L4, L4-L5, and L5-S1 were treated weekly under CT guidance. Follow-up visits permitted assessment of both immediate effects and carryover effects at 3 and 6 months following completion of treatment. Pain changes were assessed with VAS, whereas function and quality of life were assessed with the Roland Morris Questionnaire (RMQ), Oswestry Disability Questionnaire (ODQ), Low Back Outcome Score (LBOS), and SF-36 questionnaire. Results demonstrated lasting pain relief, improved function, and enhanced quality of life with both treatments. Mann-Whitney analyses of RMQ, ODQ, and LBOS consistently demonstrated that sodium hyaluronate was not inferior to triamcinolone acetonide. Furthermore, sodium hyaluronate efficacy was largely comparable with triamcinolone acetonide on VAS and SF-36 outcomes. No adverse effects were reported. Intraarticular treatment of lumbar facet joints with sodium hyaluronate produced marked reductions in pain with improved function and quality of life, effects that were at least equal to triamcinolone acetonide injections. Sodium hyaluronate-treated patients demonstrated greater long-term benefit. They concluded that intraarticular sodium hyaluronate represents a promising option for treatment of chronic nonradicular lumbar symptoms.

Do et al. (733) compared intraarticular lumbar facet joint pulsed RFA with intraarticular corticosteroid injection. Sixty patients with lumbar facet joint pain were randomized, with 30 patients assigned to intraarticular pulsed radiofrequency and 30 to intraarticular corticosteroid injection. NRS scores were assessed pretreatment and at 2 weeks, one month, 3 months, and 6 months post-treatment. Results demonstrated that compared with pretreatment NRS scores,

both groups experienced significant decreases at all follow-up intervals. Changes in NRS scores differed significantly between groups over time. At 2 weeks and one month, NRS scores following corticosteroid injection were significantly lower than those following pulsed RFA. At 3 and 6 months, decreases in NRS scores were not significantly different between groups. At 6 months, approximately half of patients in both groups reported successful pain relief defined as ≥ 50% relief. They concluded that both intraarticular pulsed RFA and intraarticular corticosteroid injection significantly relieved lumbar facet joint pain, with effects persisting at least 6 months. They further concluded that intraarticular pulsed RFA represents a useful therapeutic option for lumbar facet joint pain.

Lakemeier et al. (731), in a randomized, controlled, double-blind trial, compared L3/L4-L5/S1 intraarticular lumbar facet joint steroid injections with lumbar facet joint RFA in treatment of low back pain. Inclusion criteria required MRI findings demonstrating facet joint hypertrophy and positive response to intraarticular local anesthetic test infiltration. The primary endpoint was RMQ, with VAS and ODI serving as secondary endpoints. Outcomes were assessed at baseline and at 6 months. Fifty-six patients were randomized, with 24 of 29 patients completing follow-up in the steroid injection group and 26 of 27 patients in the denervation group. Pain relief and functional improvement were observed in both groups. No significant differences were identified between groups for the primary endpoint (95% CI, -3 to 4) or secondary endpoints (95% CI for VAS, -2 to 1; 95% CI for ODI, -18 to 0). They concluded that both intraarticular steroid infiltration and RFA appeared successful for chronic function-limiting low back pain of facet origin with favorable short- and midterm results regarding pain relief and functional improvement. Improvements were similar in both groups. However, limitations included small sample size, diagnosis based on a single intraarticular local anesthetic injection of bupivacaine, absence of placebo group, unclear presentation of results, lack of appropriate diagnosis utilizing diagnostic blocks, and use of excessive steroid doses totaling 120 mg per patient. Overall, results were considered indeterminate because VAS reductions were clinically insignificant.

Ribeiro et al. (846) compared effectiveness of facet joint injection versus systemic steroids in 60 patients clinically diagnosed with facet joint syndrome. Diagnostic blocks were not utilized. Patients were randomized into experimental and control groups. The experimental group received intraarticular triamcinolone hexacetonide injections into 6 lumbar facet joints, whereas the control group received intramuscular triamcinolone acetonide injections into 6 lumbar paravertebral points. Groups were similar at baseline. Comparisons demonstrated improvement in the experimental group regarding diclofenac intake, quality of life, and the role-physical domain of the SF-36. At each follow-up interval, the experimental group also demonstrated improvement in RMQ scores, improvement percentage scales, and treatment response utilizing Likert scale assessments. They concluded that both treatments were effective, with slight superiority of intraarticular steroid injections over paravertebral intramuscular injections.

Kotb et al. (851), in a prospective randomized comparative single-blinded study, assessed intraarticular autologous PRP versus corticosteroids for treatment of lumbar facet joint synovitis. Thirty patients with lumbar facet joint disease were divided into 2 equal groups, one receiving intraarticular PRP and the other receiving intraarticular corticosteroid injections. Results demonstrated significant improvement in all parameters at 3-month follow-up in both groups. However, PRP injections produced superior MRI synovitis grading improvement across all lumbar facet joint levels compared with corticosteroids. They concluded that both PRP and corticosteroid injections effectively improved MRI-detected facet joint synovitis while concurrently improving all assessed parameters at 3 months. However, PRP produced superior MRI-detected synovitis improvement, suggesting greater long-term efficacy. Weaknesses included absence of diagnostic blocks, small sample size, and use of a clinically insignificant 10% ODI improvement threshold. Consequently, results were judged indeterminate.

Anshul et al. (849), in a randomized controlled trial, conducted a comparative evaluation of intraarticular facet joint injections versus MBBs in patients with low back pain. Sixty patients with medical evaluations and pain patterns consistent with lumbar facet joint pain were randomized into 2 groups. Group I received fluoroscopic-guided lumbar facet joint injections, whereas group II received fluoroscopic-guided lumbar facet joint nerve blocks. Results demonstrated statistically significant improvement in pain scores following injection in both groups ($P > 0.05$). Mean pain scores in both groups remained below 2 throughout the study period. Excellent patient satisfaction was reported by most patients in both groups at multiple time intervals. The authors concluded that both lumbar facet joint

injections and lumbar facet joint nerve blocks are safe and effective for management of low back pain. Both techniques produced adequate pain relief and disability improvement. Diagnosis was established through clinical assessment, radiographic evidence, and single intraarticular injection. Weaknesses included relatively small sample size, single-blind design without placebo group, and use of a single diagnostic block. Overall, results were considered positive.

Wu et al. (850) conducted a prospective study comparing PRP versus local anesthetic/corticosteroid intraarticular injections for treatment of lumbar facet joint syndrome. Forty-six patients were randomized into group A receiving PRP and group B receiving local anesthetic/corticosteroid injections. Results demonstrated no significant baseline differences between groups. Compared with pretreatment scores, both groups demonstrated significant improvement in VAS pain scores at rest and during flexion, as well as improvements in RMQ and ODI scores ($P < 0.01$). Significant differences between groups were also identified for these parameters ($P < 0.05$). In group B, subjective satisfaction and objective success rates were highest at one month, with 80% and 85%, respectively, but declined to 50% and 20% at 6 months. In contrast, group A demonstrated increasing subjective satisfaction over time. No treatment-related complications occurred in either group. They concluded that both autologous PRP and local anesthetic/corticosteroid intraarticular injections are effective, easy, and safe for treatment of lumbar facet joint syndrome, with autologous PRP demonstrating superior long-term efficacy.

McCormick et al. (827) conducted a prospective randomized trial comparing medial branch CRFA versus corticosteroid facet joint injections for treatment of lumbar facet syndrome, with outcomes reported through 12 months. Patients with dual MBB-confirmed facet joint pain were randomized to receive either lumbar medial branch CRFA or intraarticular facet steroid injections. Thirty-two patients met eligibility criteria, with 20 patients receiving lumbar CRFA and 12 receiving intraarticular steroid injections. In the CRFA group, 70% (95% CI 48-85), 55% (95% CI 34-74), and 45% (95% CI 26-66) of participants met NPRS responder criteria at 3, 6, and 12 months, respectively, compared with 25% (95% CI 9-53), 25% (95% CI 9-53), and 17% (95% CI 5-45) in the intraarticular steroid group. Differences were significant at 3 months ($P = .014$). PGIC responder proportions were also higher in the CRFA group at 3 and 6 months ($P < .05$). They concluded that CRFA demonstrated superior success rates compared with intraarticular steroid injections across both pain and functional outcome domains.

Table 25 shows study characteristics of RCTs assessing lumbar spinal facet joint intraarticular injections.

8.3.3 Therapeutic Facet Joint Nerve Blocks

Facet joint nerve blocks are extensively utilized and represent the preferred modality for diagnosis of facet joint pain. However, they have also been employed therapeutically because of their safety, ease of administration, clinical effectiveness, and lack of significant side effects.

8.3.3.1 Systematic Reviews

The literature search identified 5 updated systematic reviews and multiple observational studies.

Manchikanti et al. (2) evaluated the effectiveness of facet joint nerve blocks as a therapeutic modality in managing chronic facet joint axial spinal pain. Twenty-one studies were identified. Quality assessment criteria utilized included the Cochrane review criteria, IPM-QRB for randomized therapeutic trials, and the Interventional Pain Management Techniques – Quality Appraisal of Reliability and Risk of Bias Assessment for Nonrandomized Studies (IPM-QRBNR). Evidence was graded utilizing GRADE assessment. Data collection extended through July 2023. The results identified 9 studies utilizing controlled dual diagnostic blocks (49,50,693-696,700,701,859). In one study, diagnostic blocks were performed using a single block with a standard of > 75% pain relief (860). Unfortunately, in one study, technical descriptions were unclear (861). Consequently, only 10 of 21 studies utilized either single or dual diagnostic blocks. The authors performed both qualitative and quantitative analyses. Quantitative analysis included both conventional dual-arm analysis and single-arm analysis.

Using conventional dual-arm analysis, 3 trials (693,695,700) involving 320 patients were included, comparing a local anesthetic control group with a local anesthetic plus steroid group in a dual-arm meta-analysis over 3 months. Results did not demonstrate a statistically significant difference in pain levels between the 2 groups [SMD 0.03 (-0.19, 0.25), $P = 0.78$] (Fig. 34A). The same 3 trials also evaluated outcomes at 6 months. Results again failed to demonstrate a statistically significant difference in pain levels between the 2 groups [SMD 0.13 (-0.21, 0.46), $P = 0.45$] (Fig. 34B). The 2 groups were also evaluated at 12 months, where

Table 25. *Study characteristics of randomized controlled trials assessing lumbar spinal facet joint intraarticular injections.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Facet Joint Intraarticular Injections**	**Comparator**	**Outcome Measures and Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
Carette et al, 1991 (725) RA, DB, impure placebo or AC Quality Scores: Cochrane = 11/13 IPM-QRB = 40/48	n = 97 Patients with chronic low back pain who reported immediate relief of their pain after injection of local anesthetic into the facet joints Patients were randomly assigned into 2 groups Selection Criteria: Single diagnostic blocks with 50% relief were randomly assigned to receive injections under fluoroscopic guidance	n =49 One injection of methylprednisolone into the facet joints Only one injection was provided	n =48 One intraarticular injection of isotonic saline	VAS, MPQ, mean SIP One, 3, and 6 months	After one month, 42% of the patients in the methylprednisolone group and 33% in the sodium chloride group reported marked or very marked improvement At the 6-month evaluation, 46% in the methylprednisolone group and 15% in the placebo group showed sustained relief Revised statistics showed 22% improvement in active group and 10% in control group	Well-performed randomized, double-blind controlled trial	Only single block was applied and patients were treated with steroids without local anesthetic with only one treatment and expected 6 months of relief	Negative trial The authors concluded that results were negative with injection of either sodium chloride solution or steroid into the facet joints after diagnosis with a single block
Annaswamy et al, 2018 (746) DB, RA, AC Quality Scores: Cochrane = 12/13 IPM-QRB = 33/48	n = 30 Patients were randomly assigned to receive bilateral L3 to S1 lumbar facet joint injections with triamcinolone or Synvisc 1 Selection Criteria: • Clinical diagnosis • No diagnostic blocks performed	Intraarticular injection of Synvisc 1, 8 mg of hyaluronidase into each joint for a total volume of 6 mL injected per patient	Intraarticular injection of triamcinolone, 10 mg per mL into each joint with a total volume of 6 mL	VAS and functional status PDQ were collected at 1, 3, and 6 months after the procedure 1 month, 3 months, and 6 months	• Statistically significant changes in pain relief were noted in the hyaluronidase group only at 1 month • Functional disability scores significant improvement in steroid group at one month • Patients in hyaluronidase group showed significant improvement from baseline to 1 month, 3 months, and 6 months. Overall, hyaluronidase group appears to be superior to intraarticular steroid injection without local anesthetic	Randomized, double-blind, active-controlled trial	Active control trial in a small number of patients No diagnostic blocks utilized Outcomes of intraarticular triamcinolone injection showed lack of response due to triamcinolone group may be due to lack of local anesthetic	Negative trial The study shows lack of effectiveness of intraarticular steroid alone The response with hyaluronidase was only a month in reference to the pain relief

Table 25 cont. *Study characteristics of randomized controlled trials assessing lumbar spinal facet joint intraarticular injections.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Facet Joint Intraarticular Injections**	**Comparator**	**Outcome Measures and Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
Fuchs et al, 2005 (726) RA, DB, AC Quality Scores: Cochrane = 8/13 IPM-QRB = 26/48	n = 60 60 patients with chronic low back pain were included with patients randomly assigned into 2 groups Selection Criteria: • Clinical trial group • No diagnostic block performed	Intraarticular glucocorticoid injection	Intraarticular injection of hyaluronic acid	VAS, RMDQ, ODI, LBOS, SF-36 3 months and 6 months	Patients reported lasting pain relief, better function, and improved quality of life with both treatments	Randomized, active-control, double-blind study	Relatively small sample of patients with 6-month follow-up without a placebo group, without diagnostic blocks	Indeterminate Undetermined (clinically inapplicable) results with high number of injections during a 6-month period
Do et al, 2017 (733) RA, DB, AC Quality Scores: Cochrane = 10/13 IPM-QRB = 33/48	n = 60 Patients with lumbar facet joint pain were randomly assigned to 1 of 2 groups Selection Criteria: • Clinical diagnosis • No diagnostic block performed	Group 2 Intraarticular injection of corticosteroid with 0.3 mL of contrast, 10 mg (0.25 mL of dexamethasone mixed with 0.25 mL of 0.125% bupivacaine) using a 26-gauge, 90 mm spinal needle. Intraarticular injection was successful in all 30 patients in the intraarticular injection group	Intraarticular pulsed RFA Pulsed radiofrequency was performed after placing a 23-gauge cannula with a 10 mm active tip inside the joint, followed by injection of 0.3 mL of contrast with pulsed radiofrequency for 360 seconds at 55 volts at temperature no exceeding 42°F	Blinded outcome measures were performed utilizing Pain intensity & NRS Successful outcome was defined as 50% reduction in the NRS scores at 6 months compared with pre-treatment scores Outcomes were measured before treatment, 2 weeks, 1, 3, and 6 months after treatment 3 months and 6 months	Analysis of improvement between the 2 groups showed a significant decrease in NRS scores at 2 weeks, and 1, 3, and 6 months after each treatment PRF was superior at 2 weeks At 3 and 6 months after the procedure, the decrements of NRS scores were not significantly different between the groups Six months after treatment, 50% of the patients in both groups reported successful pain relief of 50% or greater	Randomized, double-blind, active control trial	Active control trial with small number of patients No diagnostic blocks utilized Intraarticular pulsed radiofrequency is not an approved technique at the present time to treat facet joint pain	Positive trial This study shows that a single intraarticular injection may be effective for 6 months in 50% of the patients

Table 25 cont. *Study characteristics of randomized controlled trials assessing lumbar spinal facet joint intraarticular injections.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Facet Joint Intraarticular Injections**	**Comparator**	**Outcome Measures and Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
Lakemeier et al, 2013 (731) RA, DB, AC Quality Scores: Cochrane = 9/13 IPM-QRB = 37/48	n = 56 Patients were randomized into 2 groups receiving intraarticular steroid injections or radiofrequency denervation after the diagnosis was made with intraarticular injection of local anesthetic (0.5 mL of bupivacaine) with a single block	n = 29 Intraarticular injection of local anesthetic 0.5 mL of 0.5% bupivacaine and 1 mL of betamethasone 3 mg was injected into the target joint after placing the radiofrequency needle with confirmation with contrast.	n = 27 Radiofrequency denervation was performed after placing the 20-gauge curved RF needle with 10 mm active tip after confirmation of correct placement using electrostimulation, followed by injection of 1 mL of 0.5% bupivacaine through the cannula	RMDQ, VAS, ODI, analgesic intake 6 months	Pain relief and functional improvement were observed in both groups There were no significant differences between the 2 groups for pain relief and functional status improvement RFA had a lower VAS than patients after steroid injection after 6 months The decrease in VAS appears to be less than 2 in steroid group and approximately 2.5 or 3 points in radiofrequency group. Consequently, it is not known the clinical significance of the results as they have not provided clear results.	Lack of placebo group. Relatively short-term follow-up	Single diagnostic block with intraarticular injection Presentation of the results was unclear with relief which is indeterminate of positive response	Indeterminate Even though both groups showed improvement, which was equivalent, it is difficult to determine how much clinical improvement was there.

Table 25 cont. *Study characteristics of randomized controlled trials assessing lumbar spinal facet joint intraarticular injections.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Facet Joint Intraarticular Injections**	**Comparator**	**Outcome Measures and Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
Ribeiro et al, 2013 (846) RA, DB, AC Quality Scores: Cochrane = 10/13 IPM-QRB = 32/48	n = 60 Patients with a clinical diagnosis of facet joint syndrome were randomized into experimental and control groups. Selection Criteria: • Clinical diagnosis • No diagnostic block performed	n = 31 Intraarticular injection of 6 lumbar facet joints with a total of 120 mg of triamcinolone hexacetonide All procedures were performed under fluoroscopic guidance	n = 29 All patients received intramuscular injections of 1 mL (20 mg) of triamcinolone acetonide, 1 mL of lidocaine with a 30 x 8 needle on 6 surface points of the lumbar paravertebral musculature bilaterally with a total of 120 mg All procedures were performed under fluoroscopic guidance	Pain, VAS during extension of the spine, Likert scale, improvement percentage scale, RMDQ, SF-36, and accountability of medications taken One, 4, 12, & 24 weeks	Improvement "percentage" analysis at each time point, showed significant differences between the groups at week 7 and week 12. Improvement percentage was > 50% at all times in the experimental group with intraarticular steroids; however, significant difference was noted at 24 weeks only Clinically, in the experimental group at 12-week follow-up, VAS pain decreased from 7.0 to 4.7, whereas in the control group, it decreased from 6.8 to 6.1 With evaluation of VAS pain on extension, at 12-week follow-up, pain decreased from 6.8 to 5.1 in the experimental group, whereas it decreased from 6.5 to 6.4 in the control group	Randomized, double-blind controlled trial	Diagnostic blocks were not employed, thus, many patients without facet joint pain may have been included in this trial Excessive amount of steroids with 120 mg in each patient With the high dose steroids, it was difficult to assess the value of intraarticular injections VAS with pain on extension, also reduction in VAS pain and VAS pain on extension appear to be clinically insignificant	Indeterminate Even though overall intraarticular steroids showed better relief at 12-week follow-up, which was still clinically indeterminate, as VAS pain decreased from 7.0 to 4.7 in experimental group, and 6.8 to 6.1 in control group

Table 25 cont. *Study characteristics of randomized controlled trials assessing lumbar spinal facet joint intraarticular injections.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Facet Joint Intraarticular Injections**	**Comparator**	**Outcome Measures and Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
Kotb et al, 2022 (851) P, RA, single-blind Quality Scores: Cochrane = 11/13 IPM-QRB = 32/48	n = 30 Patients with lumbar facet joint synovitis were randomly allocated into 2 groups Selection Criteria: • Imaging and clinical assessment • No diagnostic block performed	n = 15 Intraarticular injection of a mixture of 0.5% lidocaine and 5 mg/mL of betamethasone)	n = 15 Intraarticular injection of 0.5 mL of autologous PRP	VAS, RMDQ, ODI, functional disability questionnaires 3 months	Both groups showed a significant improvement in all mentioned parameters at follow-up after 3 months PRP injections promoted better performance in terms of MRI synovitis grade in all lumbar FJ levels compared withcompared with CS injection Significant decrease in the number of tender lumbar facet joints on palpation and percentage of tender facet joints was higher in PRP group Maximum active lumbar extension range of motion was higher in PRP group	RCT The study evaluated corticosteroids and autologous PRP in the treatment of synovitis and lumbar facet joint disease	Small sample size Active control Single blind Authors utilized 10% change in ODI as significant	Indeterminate Corticosteroid injections reduced pain and increased the function, along with PRP injections; however, the clinical significance may not be highly relevant as VAS decreased from 8.07 to 5.73 in corticosteroid group and 8.0 to 5.73 in PRP group Even though statistically significant and facet joint tenderness decreased with increased range of motion, the clinical relevance of decrease in pain and function remains questionable

Table 25 cont. *Study characteristics of randomized controlled trials assessing lumbar spinal facet joint intraarticular injections.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Facet Joint Intraarticular Injections**	**Comparator**	**Outcome Measures and Time of Measurement**	**Results**	**Strengths**	**Weaknesses**	**Conclusions**
Anshul et al, 2023 (849) P, single-blind, RA Quality Scores: Cochrane = 11/13 IPM-QRB = 33/48	n = 60 Patients with a medical evaluation and pain pattern consistent with lumbar facet joint pain were randomly allocated to two groups Selection Criteria: • Clinical evaluation • No diagnostic block performed	n = 30 Lumbar facet joint intraarticular injection utilizing 2 mL drug solution comprising 0.25% bupivacaine plus 10 mg of triamcinolone was injected into each facet joint under fluoroscopic guidance	n = 30 Lumbar facet joint nerve block utilizing a 2 ml drug solution comprising 0.25% bupivacaine plus 10 mg of triamcinolone was administered under fluoroscopic guidance For each affected lumbar facet joint, two facet joint nerve blocks were done - first at the affected level and second at the immediate higher level	NRS, ODI, RMDQ 1, 3 & 6 months	There was a statistically significant improvement in pain score after injection in both groups ($p > 0.05$) The mean pain score in both groups remained less than two at all time intervals throughout the study period ($p > 0.05$) Excellent patient satisfaction was reported by the majority of the patients at different time intervals in both groups	RCT	Single-blinded Small sample size No diagnostic blocks were performed.	Positive trial Both lumbar facet joint injection and lumbar facet joint nerve block are safe and effective techniques for managing lower back pain patients. Both techniques provide adequate pain relief and disability improvement
Wu et al, 2017 (850) RA, AC Quality Scores: Cochrane = 13/13 IPM-QRB = 36/48	n = 46 Lumbar facet joint syndrome Biologic Used: PRP Group A = PRP Group B = LA with steroids Selection Criteria: • Clinical assessment • Single intraarticular injections • Radiographic evidence	n = 23 Intraarticular injection of corticosteroids	n = 23 Intraarticular injection of autologous PRP	Low back pain, VAS, RMDQ, ODI 1 week, 1, 2, 3, & 6 months	Both groups showed a significant improvement in all parameters at follow-up after 3 months PRP injections promoted better performance in terms of MRI synovitis grade in all lumbar facet joint levels compared withcompared with corticosteroid injections	RCT The first of its nature to study the role of PRP versus corticosteroids in the treatment of synovitis Multiple outcome parameters were utilized	A single blind study, with no placebo group There were no controlled diagnostic blocks performed to accurately predict the diagnosis of facet joint pain Short-term follow-up	Positive trial The results show improvement in both groups Compared withCompared with corticosteroids, PRP intraarticular injections showed better results

Table 25 cont. *Study characteristics of randomized controlled trials assessing lumbar spinal facet joint intraarticular injections.*

Study Study Characteristic Methodological Quality Scoring	Number of Patients & Selection Criteria	Facet Joint Intraarticular Injections	Comparator	Outcome Measures and Time of Measurement	Results	Strengths	Weaknesses	Conclusions
McCormick et al, 2023 (827) P, RA, comparative Quality Scores: Cochrane = 11/13 IPM-QRB = 30/48	n = 32 Patients with chronic low back pain and confirmed facet joint pain with dual medial branch blocks 32 patients met eligible criteria out of 1,128 patients 32 patients were randomized into 2 groups with 12 patients undergoing intraarticular facet steroid injection, 12 patients undergoing facet intraarticular injection, and 20 patients undergoing cooled lumbar medial branch RFA	n = 12 Intraarticular facet steroid injection utilizing 0.5 mL of 40 mg/mL Kenalog and 0.5 mL of 2% preservative-free lidocaine per facet joint A maximum of 4 facet joints (two on each side) were injected for bilateral low back pain For unilateral low back pain, up to 3 facet joints were injected	n = 20 Cooled lumbar medial branch RFA performed for 165 seconds, with the RFA generator temperature set to 60C For bilateral low back pain, a maximum of four facet joints (two on each side) were denervated by cooled lumbar medial branch RFA For unilateral low back pain, a maximum of three facet joints were denervated by cooled lumbar medial branch RFA	NRS, ODI, PGIC 1, 3, 6, & 12 months	In the cooled lumbar medial branch RFA group, 70% (95% CI 48-85), 55% (95% CI 34-74), and 45% (95% CI 26-66) of participants met the NRS responder definition, compared withcompared with 25% (95% CI 9-53), 25% (95% CI 9-53), and 17% (95% CI 5-45) in the intraarticular facet steroid injection group at 3, 6, and 12 months, respectively (p = .014 at 3 months) The PGIC responder proportion was higher in the cooled lumbar medial branch RFA compared withcompared with intraarticular facet steroid injection group at 3 and 6 months (p < .05)	RCT with selection criteria of dual diagnostic blocks and 12-month follow-up	Small sample size Active control trial	Negative trial Of the 12 patients receiving intraarticular injections, only 25% of the patients reported significant improvement at 3 months. Intraarticular facet joint steroid injections were inferior to CRFA

AC = active control; CI = confidence interval; DB = double-blind; IPM-QRB = Interventional Pain Management techniques–Quality Appraisal of reliability and Risk of Bias Assessment; LA = local anesthetic; LBOS = low-back outcomes score; MPQ = McGill Pain Questionnaire; NRS = Numeric Rating Scale; NDI = Neck Disability Index; ODI = Oswestry Disability Index; P= prospective; PDQ = Pain Disability Questionnaire; PRF = platelet-rich fibrin; PGIC = Patient Global Impression of Change ; PRP = platelet-rich plasma; RA = randomized; RCT – randomized controlled trial; RMDQ = Roland-Morris Disability Questionnaire; SCL = Symptom Checklist; SF-36 = Short Form-36; SIP = Sickness Impact Profile; VAS = Visual Analog Scale

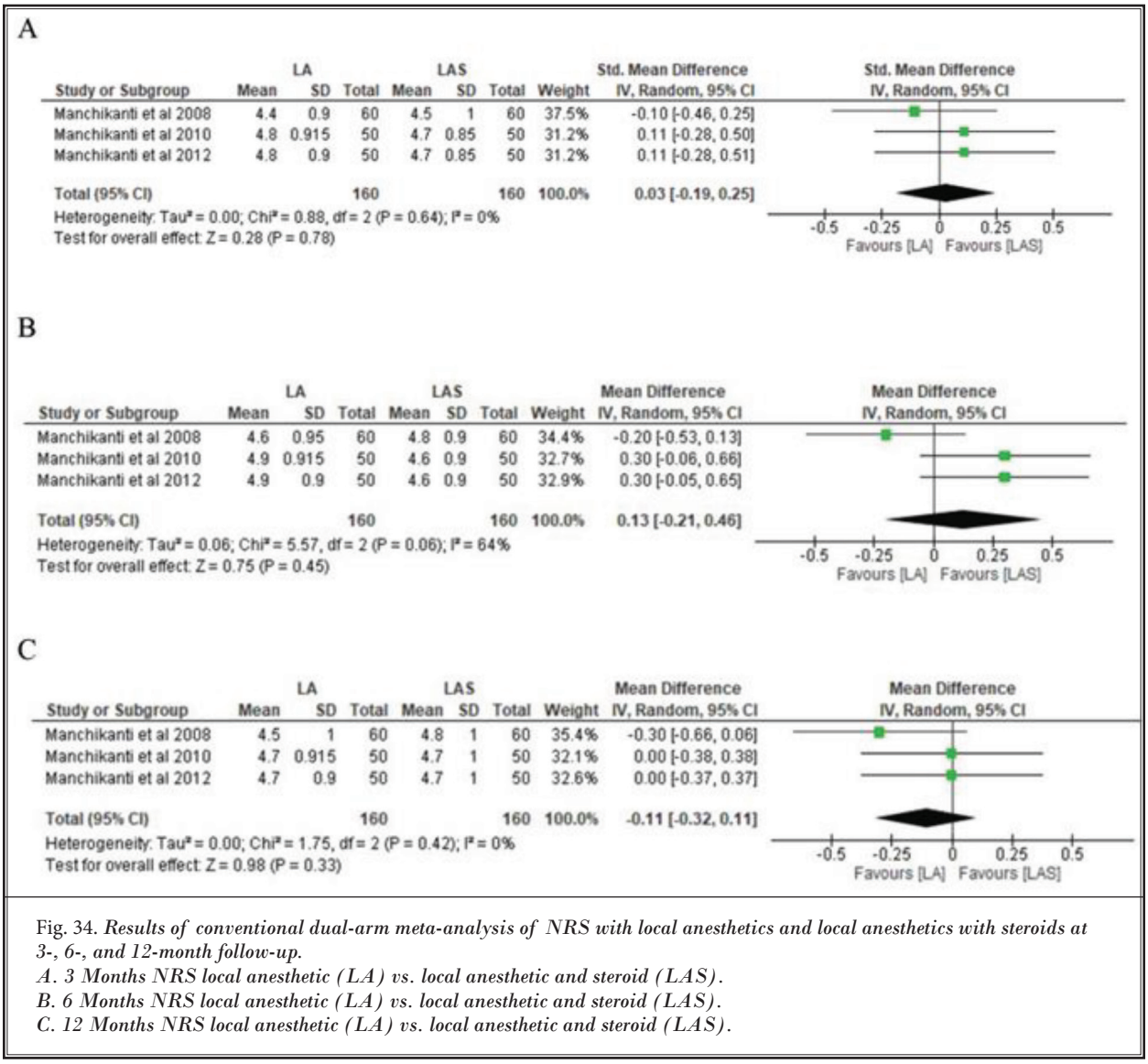


Fig. 34. *Results of conventional dual-arm meta-analysis of NRS with local anesthetics and local anesthetics with steroids at 3-, 6-, and 12-month follow-up.*
A. 3 Months NRS local anesthetic (LA) vs. local anesthetic and steroid (LAS).
B. 6 Months NRS local anesthetic (LA) vs. local anesthetic and steroid (LAS).
C. 12 Months NRS local anesthetic (LA) vs. local anesthetic and steroid (LAS).

results similarly demonstrated no statistically significant difference in pain levels between the groups [SMD -0.11 (-0.32, 0.11), *P* = 0.33] (Fig. 34C).

Functionality was also assessed utilizing conventional dual-arm analysis. Three trials (693,695,700) involving 320 patients were included, comparing functionality outcomes between the control and steroid groups in a dual-arm meta-analysis at 3 months. Results did not demonstrate a statistically significant difference in functionality levels between the 2 groups [SMD -0.18 (-0.48, 0.11), *P* = 0.22] (Fig. 35A).

The same 3 trials (693,695,700) also compared functionality outcomes between the control and steroid groups in a dual-arm meta-analysis at 6 months. Results again did not demonstrate a statistically significant difference in functionality levels between the local anesthetic and local anesthetic plus steroid groups [SMD -0.98 (-2.10, 0.14), *P* = 0.09] (Fig. 35B).

The 3 trials (693,695,700) also compared functionality outcomes between the control and steroid groups in a dual-arm meta-analysis at 12 months. Results did not demonstrate a statistically significant difference in functionality levels between the 2 groups [SMD -0.28 (-1.36, 0.79), *P* = 0.61] (Fig. 35C).

Single-arm meta-analysis showed significant differences.

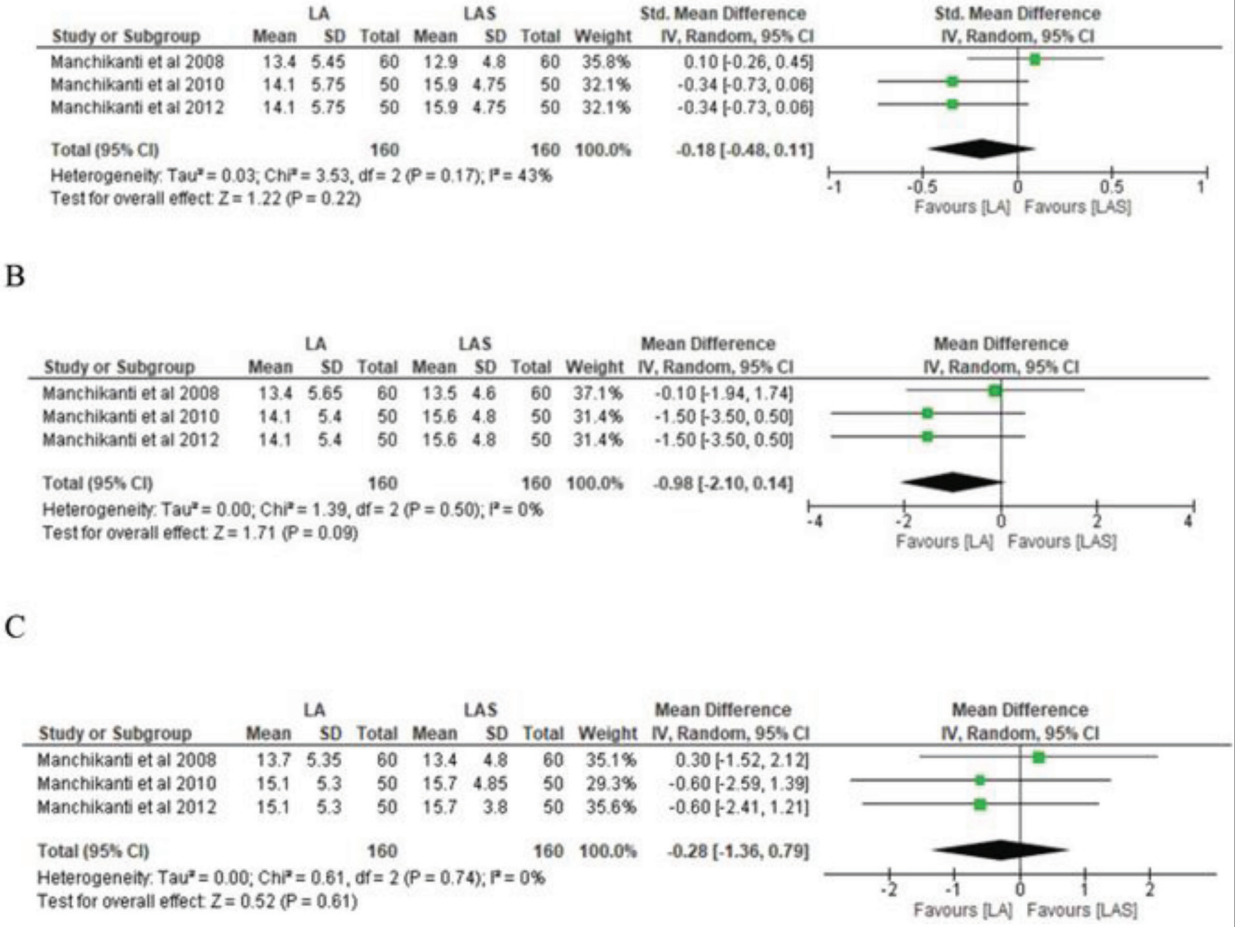


Fig. 35. *Results of conventional dual-arm meta-analysis assessing disability with ODI with local anesthetic alone compared with local anesthetic and steroids.*
A. 3 Months ODI local anesthetic (LA) vs. local anesthetic and steroid (LAS).
B. 6 Months ODI local anesthetic (LA) vs. local anesthetic and steroid (LAS).
C. 12 Months ODI local anesthetic (LA) vs. local anesthetic and steroid (LAS).

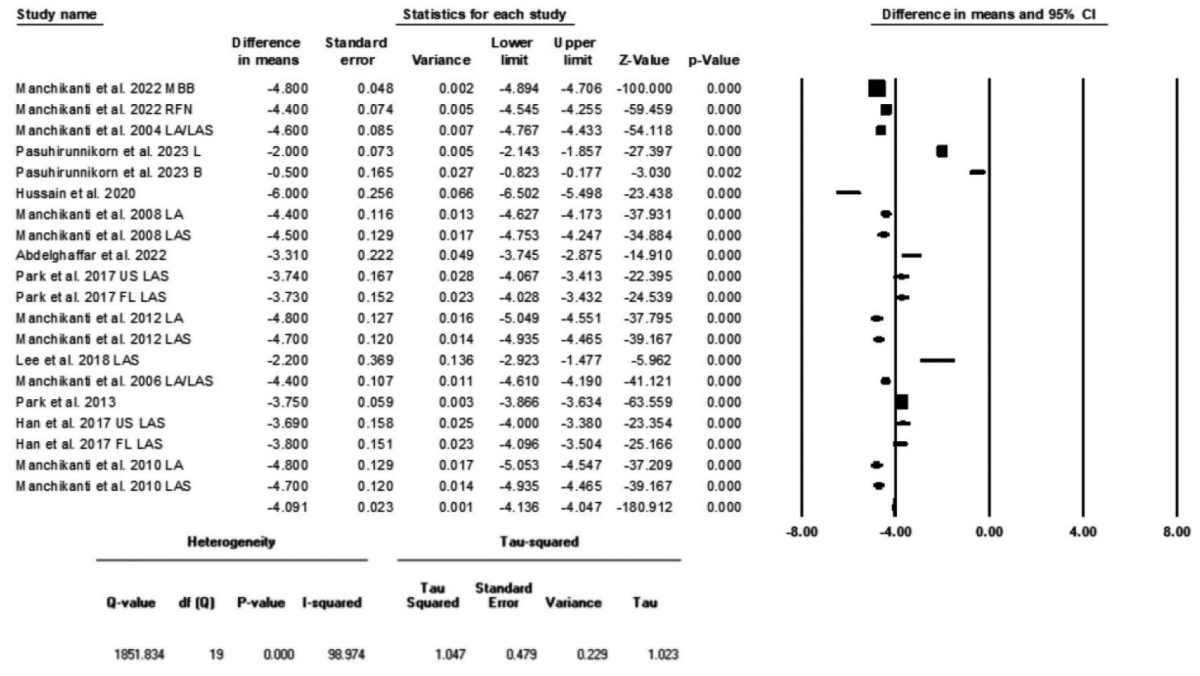
Figure 36A shows the results of a single-arm meta-analysis utilizing MBBs. Twelve studies (50,695,696,701,842,847,861-866) assessed pain scores at 3 months using NRS. As shown in Fig. 36A, the pooled mean difference in pain scores from baseline to the 3-month follow-up was a 4.091-point decrease (95% CI: -4.136 to -4.047, $P < 0.0001$).

Figure 36B shows the results of a single-arm meta-analysis utilizing MBBs. Ten studies (50,695,696,700,701 ,842,847,861,865,866) assessed pain scores at 6 months using NRS. As shown in Fig. 36B, the pooled mean difference in pain scores from baseline to the 6-month follow-up was a 4.666-point decrease (95% CI: -4.715 to -4.617, $P < 0.0001$).

Figure 36C shows the results of a single-arm meta-analysis utilizing MBBs. Eight studies (50,695,696,700,7 01,842,864,866) assessed pain scores at 12 months using NRS. As shown in Fig. 36C, the pooled mean difference in pain scores from baseline to the 12-month follow-up was a 4.604-point decrease (95% CI: -4.658 to -4.551, $P < 0.0001$).

Figure 36D shows the results of a single-arm meta-analysis utilizing MBBs. Two studies (695,700) assessed pain scores at 18 months using NRS. As shown in Fig.

A



B

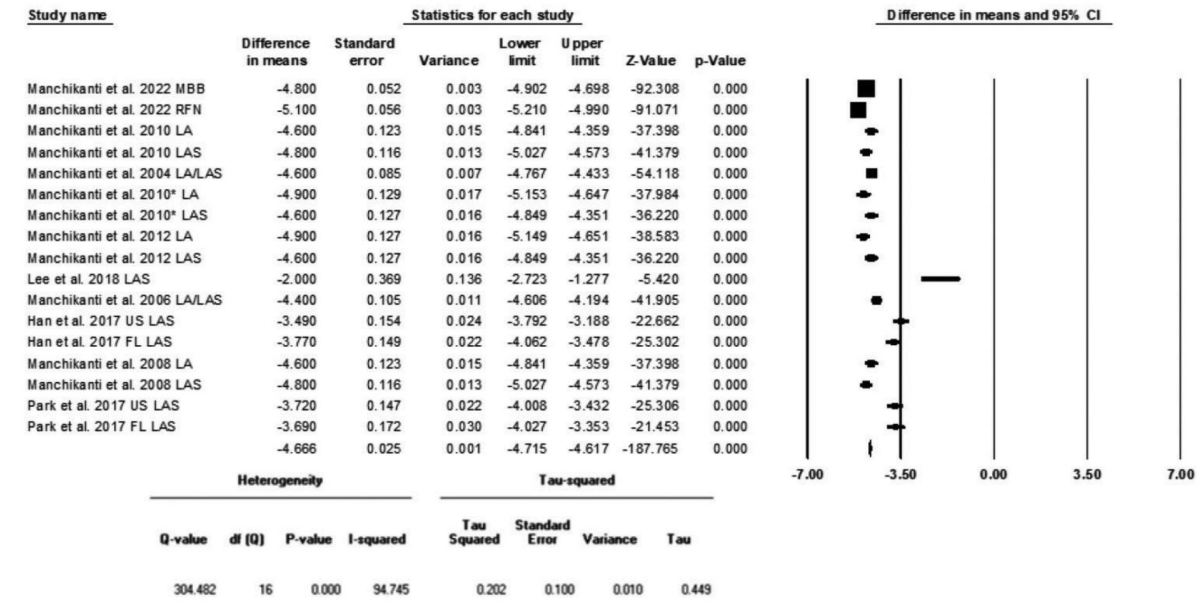


Fig. 36. *Results of single-arm meta-analysis of NRS at 3 months, 6 months, and 12 months with local anesthetic alone and local anesthetic and steroid.*
A. Single-arm meta-analysis on NRS at 3 months. (US = ultrasound, FL = fluoroscopic, L = lidocaine, B = bupivacaine, MBB = medial branch block, RFA = radiofrequency ablation, LA = local anesthetic, LAS = local anesthetic and steroid)
B. Single-arm meta-analysis on NRS at 6 months. (US = ultrasound, FL = fluoroscopic, MBB = medial branch block, RFN = radiofrequency neurotomy, LA = local anesthetic, LAS = local anesthetic and steroid)

36D, the pooled mean difference in pain scores from baseline to the 18-month follow-up was a 4.777-point decrease (95% CI: -4.904 to -4.651, $P < 0.0001$).

Figure 36E shows the results of a single-arm meta-analysis utilizing MBBs. Three studies (695,696,700) assessed pain scores at 24 months using NRS. As shown in Fig. 36E, the pooled mean difference in pain scores from baseline to the 24-month follow-up was a 4.698-point decrease (95% CI: -4.817 to -4.578, $P < 0.0001$).

A 3-month functionality assessment with single-arm meta-analysis is shown in Fig. 37A, with inclusion of 5 studies (695,861,864-866) utilizing NRS. As shown in Fig. 37A, the pooled mean difference in functionality scores from baseline to the 3-month follow-up was a 14.880-point decrease (95% CI: -15.324 to -14.436, $P < 0.0001$).

Figure 37B shows the results of a single-arm meta-analysis utilizing MBBs. Four studies (695,861,865,866) assessed functionality scores at 6 months using NRS. As shown in Fig. 37B, the pooled mean difference in functionality scores from baseline to the 6-month follow-up was a 13.752-point decrease (95% CI: -14.197 to -13.307, $P < 0.0001$).

Figure 37C shows the results of a single-arm meta-analysis utilizing MBBs. Three studies (695,861,866) assessed functionality scores at 12 months using NRS. As shown in Fig. 37C, the pooled mean difference in functionality scores from baseline to the 12-month follow-up was a 16.072-point decrease (95% CI: -16.670 to -15.474, $P < 0.0001$).

The authors concluded that the systematic review and meta-analysis of therapeutic facet joint nerve blocks in managing chronic axial spinal pain demonstrated **Level II** evidence with **moderate to strong strength of recommendation**. This conclusion was based on 9 relevant high-quality RCTs and 12 relevant moderate- to high-quality observational studies, with 3 of 21 studies demonstrating high levels of evidence and clinical applicability, and 11 studies demonstrating moderate levels of GRADE evidence and clinical applicability.

Based on the GRADE assessment of randomized and observational studies evaluating the effectiveness of facet joint nerve blocks, as shown in Table 26, 3 of the 21 studies demonstrated high levels of evidence and clinical applicability (693,695,700,842,866,867), while 11 studies (49,50,694,696,701,828,829,847,858,862,868) demonstrated moderate levels, and 6 studies showed low GRADE evidence and clinical applicability (859,861,863-865,869). Overall, the evidence is **Level II** with **moderate to strong strength of recommendation** for therapeutic facet joint nerve blocks in managing spinal facet joint pain.

In 2021, Baroncini et al. (853) published a systematic review on the management of facet joint osteoarthritis associated with chronic low back pain. In their assessment, they utilized data from 8 publications involving a total of 487 patients with a mean follow-up of 12.4 ± 10.5 months. Incorporating Cochrane methodological quality assessment criteria and demonstrating an overall low risk of bias, the results obtained with MBBs were more consistent than those observed with facet joint injections. Overall, the findings showed that local anesthetics, steroids, and Sarapin, either alone or in combination, resulted in improvement in pain and disability scores.

Mazmudar et al. (840) addressed the economic value perspective of therapeutic facet joint interventions in the lumbar spine. They evaluated intraarticular injections, MBBs, and RFA. This 2020 publication demonstrated limited evidence for therapeutic intraarticular facet joint injections and moderate evidence supporting the use of therapeutic MBBs and RFA.

Additional publications include studies by da Rocha et al. (870), Liu et al. (871), Manchikanti et al. (49,50), van Eerd et al. (829), and Pasuhirunnikorn et al. (860). Da Rocha et al. (870) evaluated MBBs for the diagnosis of chronic lumbar facet joint pain. They demonstrated that after controlled diagnostic blocks, 52% of patients reported greater than 50% improvement over 3 months. These findings indicate, at a minimum, the short-term effectiveness of diagnostic facet joint nerve blocks functioning as therapeutic facet joint blocks. Liu et al. (871) published a similar study demonstrating the therapeutic benefits of diagnostic MBBs. Other important studies in recent years include 2 studies by Manchikanti et al. (49,50) demonstrating the comparative effectiveness of RFA and therapeutic facet joint nerve blocks, along with the added cost utility of these interventions in the cervical and lumbar spine. Van Eerd et al. (829) demonstrated the comparative value of local anesthetic blocks versus RFA. Pasuhirunnikorn et al. (860), in a recent publication, demonstrated that lidocaine medial branch injections provided significant pain reduction for up to 16 weeks and significant improvement in neck functional outcomes for up to 8 weeks compared with baseline. They also showed that bupivacaine yielded significant pain relief for up to 8 weeks only for pain associated with neck mobilization. Their study also demonstrated notable improvement in neck function for up to 4 weeks compared with baseline.

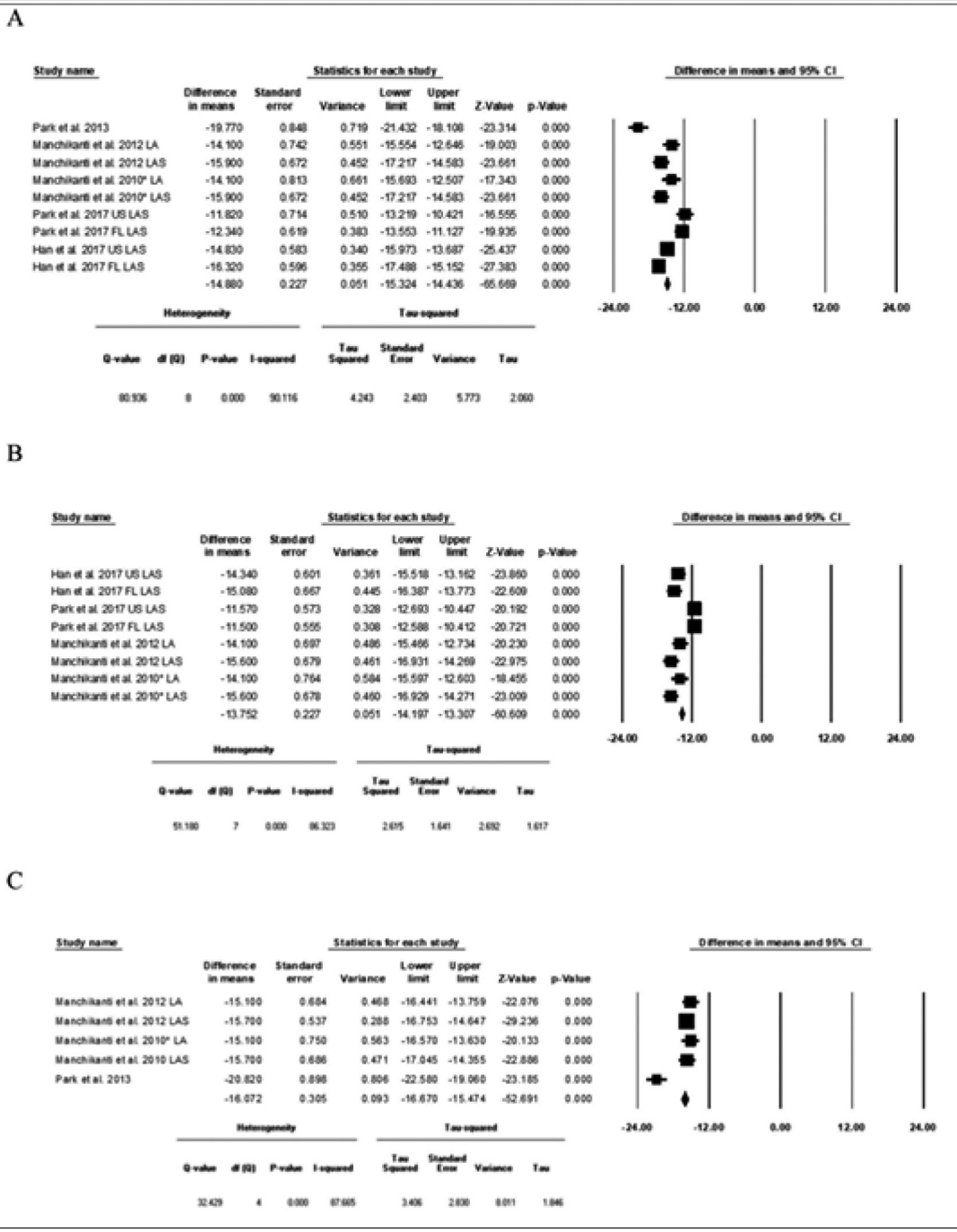


Fig. 37. *Results of single-arm meta-analysis of functionality at 3-, 6-, and 12-month follow-up.*

A. Single-arm meta-analysis on functionality at 3 months. (LA = local anesthetic, LAS = local anesthetic and steroid, US = ultrasound, FL = fluoroscopic)
B. Single-arm meta-analysis on functionality at 6 months. (LA = local anesthetic, LAS = local anesthetic and steroid, US = ultrasound, FL = fluoroscopic)
C. Single-arm meta-analysis on functionality at 12 months. (LA = local anesthetic, LAS = local anesthetic and steroid, US = ultrasound, FL = fluoroscopic)

Table 26. *GRADE assessment of randomized and observational studies evaluating effectiveness of facet joint nerve blocks.*

Article	Methodologic Limitation	Consistency	Indirectness	Imprecision	Publication Bias	Total
Civelek et al (828)	High	Moderate	Moderate	Moderate	Very low	Moderate
Manchikanti et al (693,867)	Very low	High	High	Low	Very low	High
Anshul et al (849)	Moderate	Moderate	High	Low	Very low	Moderate
Manchikanti et al (700,842)	Very low	High	High	Low	Very low	High
van Eerd et al (829)	High	High	High	Moderate	Very low	Moderate
Pasuhirunnikorn et al (860)	Low	High	High	Low	Very low	Moderate
Hussain et al (862)	High	Moderate	High	Moderate	Very low	Moderate
Abdelghaffar & Awad (863)	High	Moderate	High	Moderate	Very low	Low
Manchikanti et al (695,866)	Very low	High	High	Low	Very low	High
Lee et al (847)	High	Moderate	Moderate	Moderate	Very low	Moderate
Manchikanti et al (49)	Moderate	High	Moderate	Moderate	Very low	Moderate
Manchikanti et al (50)	Moderate	High	Low	Low	Very low	Moderate
Manchikanti et al (694)	Moderate	High	Low	Low	Very low	Moderate
Manchikanti et al (701)	Moderate	High	Low	Low	Very low	Moderate
Hahn et al (868)	High	Low	Low	High	Very low	Moderate
Lee & Huston (859)	High	Low	Low	High	Very low	Low
Han et al (861)	High	Low	Low	Moderate	Very low	Low
Park et al (865)	High	Low	Low	Moderate	Very low	Low
Klessinger (869)	High	Low	Low	High	Very low	Low
Manchikanti et al (696)	Low	High	High	Low	Very low	Moderate
Park et al (864)	High	Low	Low	High	Very low	Low

A noticeable bias remains in favor of intraarticular injections over facet joint nerve blocks, even though intraarticular injections lack comparable evidence. Intraarticular injections are technically more challenging and more painful than nerve blocks. Notably, intraarticular injections have been associated with a high technical failure rate ranging from 29% to 38% per joint and 46% to 64% per procedure (644,872). Excessive procedural pain may also lead to false-negative results, whereas less painful procedures such as MBBs may reduce the false-negative rate (13,873). Moreover, the technical failure rate is highest at the L5/S1 level for intraarticular injections. In contrast, lumbar MBBs reliably target the intended nerve despite a 4% to 9% intravascular uptake rate, which can result in false negatives but is fortunately mitigated with appropriate fluoroscopic guidance (837,874).

8.3.3.2 Clinical Studies– Cervical Spine

Several studies have evaluated therapeutic cervical facet joint nerve blocks for the management of neck pain. There were 5 RCTs and additional observational studies. Table 27 shows the study characteristics of therapeutic facet joint nerve blocks.

Machikanti et al. (842), in a double-blind RCT, evaluated the clinical effectiveness of therapeutic local anesthetic cervical MBBs with or without steroids in managing chronic facet joint neck pain diagnosed with controlled diagnostic blocks resulting in 80% relief. A total of 120 patients were included. There were 60 patients in the local anesthetic group (group I - bupivacaine) and 60 patients in the steroid group (group II - bupivacaine with steroid). Significant pain relief (≥ 50%) and functional status improvement were observed at 3 months, 6 months, and 12 months in over 83% of patients. The average number of treatments over one year was 3.5 ± 1.0 in the nonsteroid group and 3.4 ± 0.9 in the steroid group. The average duration of pain relief with each procedure was 14 ± 6.9 weeks in the nonsteroid group and 16 ± 7.9 weeks in the steroid group. Significant relief and functional improvement were reported for 46 to 48 weeks per year.

Pasuhirunnikorn et al. (860) evaluated prolonged concordant response and functional clinical improvement between lidocaine and bupivacaine for cervical MBBs in chronic cervical facet syndrome. They concluded that cervical medial branch blocks using lidocaine

Table 27. *Study characteristics of randomized controlled trials and observational studies of cervical spinal facet joint nerve blocks.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Interventions**	**Pain Relief and Function**			**Results**			**GRADE Criteria Assessment**	**Clinical Applicability**	**Comments/ Conclusions**
			3 months	**6 months**	**1-year**	**Short-Term ≤ 6 mos.**	**Long-Term**				
							6 months	**1 year**			
RANDOMIZED CONTROLLED TRIALS											
Manchikanti et al, 2008, 2010 (700,842) RA, DB, AC, F Quality Scores: Cochrane = 12/13 IPM-QRB = 45/48	120 patients Selection criteria: Positive diagnostic blocks of 80% pain relief as the criterion standard Diagnostic criteria: Dual controlled diagnostic blocks with 80% pain relief as the criterion standard	Local anesthetic = 60 Local anesthetic with steroid = 60	83% versus 85%	87% versus 95%	85% versus 92%	P	P	P	High	High	Short- and long-term effectiveness High level of evidence and clinical applicability
Pasuhirunnikorn et al, 2023 (860) RA, DB, AC, US-guided Quality Scores: Cochrane = 13/13 IPM-QRB = 42/48	62 patients diagnosed with a single diagnostic block were randomized into 2 groups of 31 each and were treated with either 2% lidocaine or 0.5% bupivacaine Diagnostic blocks were performed utilizing 2% lidocaine with criterion standard of 75% pain relief with a single block	Lidocaine group: Facet joint nerve blocks were performed with injection of 2% lidocaine with a volume of 0.5 to 1 mL per level according to the patients' pain symptoms Comparator group received injection of 0.5% bupivacaine with a volume of 0.5 to 1 mL per level based on the patients' pain symptoms	• Lidocaine provided significant pain reduction up to 16 weeks and significant improvement in neck functional outcomes up to 8 weeks compared with the baseline • Bupivacaine provided significant pain relief for up to 8 weeks for pain and demonstrated notable improvement in neck function up to 4 weeks compared with the baseline	NA	NA	P	NA	NA	Moderate	High	Positive trial with short term effectiveness High level of evidence and clinical applicability

Table 27 cont. *Study characteristics of randomized controlled trials and observational studies of cervical spinal facet joint nerve blocks.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Interventions**	**Pain Relief and Function**			**Results**			**GRADE Criteria Assessment**	**Clinical Applicability**	**Comments/ Conclusions**
			3 months	**6 months**	**1-year**	**Short-Term ≤ 6 mos.**	**Long-Term**				
							6 months	**1 year**			
van Eerd et al, 2021 (829) RA, AC Quality Scores: Cochrane = 13/13 IPM-QRB = 39/48	76 patients were included on the basis of the diagnosis with clinical criteria. No diagnostic blocks were performed	Facet joint nerve block group followed by sham RFA vs. facet joint nerve blocks, followed by conventional RFA Comparator group received radiofrequency denervation following bupivacaine injection as in control group	61.1% facet joint nerve block vs. 61.1% denervation group	51.3% facet joint nerve block vs. 55.6% denervation group	NA	P	P	NA	Moderate	Moderate	Positive study with short and long-term effectiveness Moderate level of evidence and clinical applicability Noninferior to RFA
Hussain et al, 2020 (862) RA, DB, AC, F Quality Scores: Cochrane = 10/13 IPM-QRB = 35/48	55 patients Diagnosis by clinical signs and symptoms No diagnostic blocks were performed	Facet joint nerve blocks vs. trigger point injections	NRS scores 8 ± 1 in facet joint group vs. 7.57 ± 1.47 in trigger point group with reductions significantly at 12-weeek follow-up to 2.2 ± 1.8 in medial branch group and 6.96 ± 2.37 in trigger point group with significant difference. NDI also showed similar improvements	NA	NA	P	NA	NA	Moderate	Moderate	Positive study with short-term effectiveness Moderate level of evidence and clinical applicability
Abdelghaffar & Awad (863) RA, AC Quality Scores: Cochrane = 10/13 IPM-QRB = 33/48	60 patients Diagnosis by clinical criteria No diagnostic blocks were performed	Medial branch blocks vs. retrolaminar blocks	Significant improvement in both groups with no significant differences among the groups with reductions in pain and disability scores	NA	NA	P	NA	NA	Low	Low	Positive study with short-term effectiveness Low level of evidence and clinical applicability

Table 27 cont. *Study characteristics of randomized controlled trials and observational studies of cervical spinal facet joint nerve blocks.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Interventions**	**Pain Relief and Function**			**Results**			**GRADE Criteria Assessment**	**Clinical Applicability**	**Comments/ Conclusions**
			3 months	**6 months**	**1-year**	**Short-Term ≤ 6 mos.**	**Long-Term**				
							6 months	**1 year**			
OBSERVATIONAL STUDIES											
Klessinger, 2010 (869) Retrospective study IPM-QRBNR = 24/48	87 patients A single diagnostic block with 80% pain relief as the criterion standard	Diagnostic blocks Therapeutic medial branch blocks were performed with a combination of bupivacaine 0.25% and triamcinolone 5 mg with a total volume of approximately 1 mL at each level	NA	Success rate was 56.7%	Success rate was 52.9%	NA	P	P	Low	Low	Positive study with diagnostic blocks providing long term relief Low level of evidence and clinical applicability
Manchikanti et al, 2022 (50) Observational study Quality Scores: IPM-QRBNR = 38/48	132 patients Selection by positive with controlled dual diagnostic blocks with 80% pain relief as the criterion standard	Therapeutic medical branch blocks Repeated based on outcomes with return of pain	100%	94%	81%	P	P	P	Moderate	Moderate	Long-term effectiveness Moderate level of evidence and clinical applicability
Manchikanti et al, 2004 (701) Prospective Quality Score: IPM-QRBNR = 37/48	100 patients Selection by positive with controlled diagnostic blocks with 80% pain relief as the criterion standard	Therapeutic medical branch blocks	92%	82%	56%	P	P	P	Moderate	Moderate	Long-term effectiveness Moderate level of evidence and clinical applicability
Lee & Huston, 2018 (859) Observational study Quality Score: IPM-QRBNR = 34/48	51 patients were positive for controlled diagnostic blocks	Therapeutic medical branch blocks	86%	86%	86%	P	P	P	Low	Low	Long-term effectiveness Low level of evidence and clinical applicability

Table 27 cont. *Study characteristics of randomized controlled trials and observational studies of cervical spinal facet joint nerve blocks.*

Study Study Characteristic Methodological Quality Scoring	Number of Patients & Selection Criteria	Interventions	Pain Relief and Function			Results			GRADE Criteria Assessment	Clinical Applicability	Comments/ Conclusions
			3 months	6 months	1-year	Short-Term ≤ 6 mos.	Long-Term				
							6 months	1 year			
Park et al, 2017 (865) Retrospective comparative study Quality Scores: IPM-QRBNR = 36/48	Patients with chronic cervical facet joint pain who received medial branch blocks were included in this retrospective study. The number of patients were 68 in the ultrasound group and 58 in the fluoroscopy group Inclusion criteria was pain of at least 3 months and positive response to cervical facet joint nerve blocks with comparative local anesthetic blocks The criterion standard was not described	Cervical medial branch blocks were performed with injection of 1 mL mixture of 1% lidocaine, 0.5 mL, and dexamethasone 5 mg Patients received 2 consecutive injections at 2 week intervals The second injection was omitted if initial injection resulted in significant improvement	62.1% fluoroscopy 64.7% ultrasound	51.7% fluoroscopy 55.9% ultrasound	NA	P	P	NA	Low	Low	Low level of effective results with low level of clinical applicability

RA = randomized; AC = active controlled; DB = double-blind; F = Fluoroscopy; US = Ultrasound; IPM-QRB = Interventional Pain Management techniques–Quality Appraisal of reliability and Risk of Bias Assessment; IPM-QRBNR = Interventional Pain Management Techniques – Quality Appraisal of Reliability and Risk of Bias Assessment for Nonrandomized Studies; LA = local anesthetic; NA = not applicable; P = positive; NRS = Numeric Rating Scale; NDI = Neck Disability Index

or bupivacaine provided clinical benefits due to prolonged analgesic effects and improved neck function in chronic cervical facet syndrome for up to 8 weeks. Lidocaine demonstrated superior performance and could be considered the local anesthetic of choice with regard to prolonged concordant response.

Van Eerd et al. (829) assessed the efficacy of RF denervation of the cervical facet joints in chronic cervical facet joint pain diagnosed by clinical criteria. Patients were randomized to receive RF denervation combined with bupivacaine (intervention group) or bupivacaine alone (control group). In the intervention group, an RF thermal lesion was created at the cervical medial branches following injection of bupivacaine. They did not observe significant differences between RF denervation combined with bupivacaine and bupivacaine alone at 6-month follow-up. However, they identified a favorable long-term effect after 6 months in the RF treatment group.

Hussain et al. (862), in a randomized, double-blind, prospective study, compared cervical MBBs versus trigger point injections in patients with chronic neck pain diagnosed by clinical criteria. They included 60 patients, with 30 patients in each group. Results showed significant improvement in the MBB group, with NRS scores decreasing from 8.8 ± 1 to 2.2 ± 1.8. In contrast, NRS scores decreased from 7.57 ± 1.47 to 6.96 ± 2.37 in the trigger point group. Significant differences were also observed in NDI scores. Overall, differences were significant at the 12-week follow-up. They concluded that cervical MBBs with local anesthetic and steroid may provide longer-term relief in patients with chronic neck pain compared with trigger point injections. No major complications were reported in either group.

Abdelghaffar and Awad (863) compared retrolaminar blocks and MBBs in cervical facet joint arthropathy diagnosed by clinical criteria. They concluded that cervical retrolaminar block is a reasonable alternative to cervical MBB in the management of cervical facet joint pain, producing similar pain relief, better NDI improvement, shorter procedure time, and no serious complications.

Klessinger (869), in a retrospective practice audit, evaluated whether therapeutic MBBs represent a rational treatment for patients with persistent postoperative neck pain following cervical spine operations, given the limited therapeutic recommendations available for these patients. The study suggested utilizing therapeutic MBBs as an initial treatment for pain recurrence. The success rate was 52.9%.

Manchikanti et al. (50) evaluated the clinical outcomes and cost utility of therapeutic MBBs versus RFA in managing chronic facet joint neck pain. Overall, 295 patients met inclusion criteria, with 132 patients receiving cervical MBBs and 163 receiving cervical RFA. One hundred and seven patients in the cervical medial branch group and 105 patients in the RFA group completed one-year follow-up. Significant improvement was observed in both groups from baseline to 12 months, with a proportionate number of patients achieving ≥ 50% pain relief. The average duration to achieve 50% relief for cervical MBBs was 13 to 14 weeks, whereas for RFA it was 20 to 25 weeks. Significant pain relief was recorded in 100%, 94%, and 81% of patients in the MBB group, compared with 100%, 69%, and 64% in the RFA group at 3-, 6-, and 12-month follow-up, respectively. Differences were significant at 6 and 12 months. Cost utility analysis demonstrated an average cost per QALY of $4,994 for cervical MBBs compared with $5,364 for cervical RFA. Six of 132 patients (5%) in the cervical medial branch group and 53 of 163 patients (33%) in the cervical RFA group were converted to other treatments due either to side effects (6 patients or 4%) or inadequate relief (47 patients or 29%).

Manchikanti et al. (701) conducted a prospective evaluation of 100 patients diagnosed with cervical facet joint pain using controlled diagnostic blocks with an 80% pain relief criterion standard. The authors reported effectiveness of therapeutic MBBs with greater than 50% relief in 92% of patients at 3 months, 82% at 6 months, and 56% at one year. Multiple blocks were provided throughout the year as pain recurred, totaling 3 to 4 treatments annually.

Lee and Huston (859) investigated injection response in an atraumatic neck pain population to determine treatment viability and whether injections could reduce the need for RF in neck pain patients. Patients were diagnosed using controlled diagnostic blocks. Thirty-four of 59 patients demonstrated ≥ 2-point VNS reductions or ≥ 50% overall symptom improvement after one year, and 24 of 44 patients discontinued narcotic use, leading the authors to conclude that cervical facet joint injections may reduce the need for RF.

Park et al. (865) compared the mid-term effects and advantages of ultrasound-guided versus fluoroscopy-guided cervical MBBs for chronic cervical facet joint pain diagnosed with controlled diagnostic blocks. Outcomes including pain relief, functional improvement, and procedural efficiency demonstrated effectiveness in both groups. Therapeutic injections consisted of a 1

mL mixture of 1% lidocaine with 0.5 mL dexamethasone 5 mg. Patients received 2 consecutive injections at 2-week intervals, although the second injection was omitted if significant improvement occurred after the initial injection. At 3 months, 62.1% of patients in the fluoroscopy group and 64.7% in the US group demonstrated improvement in pain and function. At 6 months, 51.7% of patients in the fluoroscopy group and 55.9% in the US group demonstrated significant improvement. The authors also observed that ultrasound-guided MBBs required shorter procedural time and fewer needle passes, recommending ultrasound-guided blocks. However, this may not reflect real-world practice settings, as the authors may have had greater expertise in ultrasound-guided procedures than fluoroscopy-guided procedures.

Although US guidance allows visualization of critical soft tissue structures such as the vertebral artery, ultrasound-guided spinal procedures are operator dependent and require extensive training to develop expertise. Etheridge et al. evaluated the safety of ultrasound-guided cervical medial branch blocks in a prospective study involving 500 patients and 2,308 individual block levels. Only rare minor immediate complications such as hematomas were reported, with no adverse events observed during the following 2 weeks. The authors concluded that ultrasound-guided cervical medial branch blocks, when performed using an in-plane technique by experienced operators, were safe.

8.3.3.3 Clinical Studies– Thoracic Spine

As has been observed with RFA and intraarticular injections, studies evaluating thoracic facet joint blocks are sparse. In fact, only 2 RCTs (847,866) are available, both of which were active-control studies. Three observational studies were also included in this evaluation (696,864).

Manchikanti et al. (695,866), in a randomized, double-blind trial, assessed the role of thoracic MBBs in managing chronic mid and upper back pain. Their results were published with 2-year follow-up. One hundred patients were included, with 50 patients in the group receiving MBBs with local anesthetic alone (Group I) and 50 patients in the group receiving local anesthetic plus steroid (Group II). Diagnosis was established using controlled diagnostic blocks. Results demonstrated significant improvement in pain relief and functional status, with 50% or greater improvement observed in 80% of Group I patients and 84% of Group II patients at 2-year follow-up. They concluded that therapeutic thoracic MBBs with or without steroids may provide a management option for chronic function-limiting facet joint thoracic pain. In this evaluation, patients underwent repeated nerve blocks as required based on pain relief and functional status, generally ranging from every 3 to 6 months, with 3 to 4 therapeutic MBBs per year and 5 to 6 procedures over 2 years.

Lee et al. (847), in a prospective observational study, compared intraarticular thoracic facet joint steroid injections and thoracic MBBs for management of thoracic facet joint pain. Forty patients with thoracic facet joint pain were recruited and randomly assigned to one of 2 groups. Twenty patients were assigned to the intraarticular steroid injection group and 20 patients to the MBB group. Diagnosis was established by a positive response to a single thoracic medial branch block utilizing 0.5 mL of 1% lidocaine. For both intraarticular thoracic facet joint steroid injection and therapeutic MBB, 0.5 mL of 0.5% bupivacaine mixed with 10 mg (0.25 mL) dexamethasone was injected. The authors assessed thoracic facet joint pain severity using NRS before treatment and at 1, 3, and 6 months following treatment. Results demonstrated that compared with pretreatment NRS scores, pain scores at 1, 3, and 6 months showed significant decreases in both groups. Intergroup changes in NRS scores were not significantly different over time. Six months after treatment, 65% of patients in the intraarticular steroid injection group reported continued successful pain relief (≥ 50% pain relief), while 40% of patients in the MBB group reported continued successful pain relief. They concluded that both intraarticular thoracic facet joint steroid injections and therapeutic MBBs significantly relieved thoracic facet joint pain, with effects persisting for at least 6 months after the procedure.

Manchikanti et al. (696) evaluated therapeutic thoracic MBBs in the management of chronic facet joint upper and mid back pain in a prospective outcome study. Fifty-five patients meeting diagnostic criteria for thoracic facet joint pain based on comparative controlled diagnostic blocks were included. Therapeutic thoracic MBBs were repeated according to response to previous blocks upon recurrence of pain and/or deterioration in functional status. Results demonstrated significant reductions in numeric pain scores and significant pain relief (≥ 50%) in 71% of patients at 3 and 6 months, 76% at 12 months, 71% at 24 months, and 69% at 36 months compared with baseline measurements. Functional improvement was demonstrated at 1-, 2-, and 3-year follow-up. Significant improvement was also observed in

employment status among eligible patients (employed and unemployed), increasing from 61% at baseline to 96% to 100% at 1, 2, and 3 years, respectively, along with improved psychological functioning. Overall, patients received 4 to 5 procedures during the first year and a total of 8 to 9 procedures over 2 years. However, some patients required only a single procedure over 2 years. The authors concluded that therapeutic thoracic MBBs were an effective treatment modality in managing chronic facet joint thoracic pain confirmed by controlled comparative local anesthetic blocks.

Park et al. (864) evaluated the effect of MBBs in chronic facet joint pain associated with osteoporotic compression fractures. Fifty-three patients with axial back pain related to osteoporotic compression fractures were included. Results demonstrated improvement in VNS and ODI scores 2 weeks after injection, with continued improvement through 12 months. Overall, 78.9% of patients reported significant improvement in pain relief (> 40%) and functional improvement (> 20%), rating their satisfaction as "excellent" or "good" at 12 months after the first injection. Radiographic and clinical parameters were not significantly correlated with treatment outcomes. The authors concluded that MBBs provided significant pain relief and functional recovery for patients with osteoporotic vertebral compression fractures who experienced persistent facet joint pain after vertebroplasty or conservative treatment.

Characteristics of clinical studies involving the thoracic spine, including RCTs and observational studies, are shown in Table 28.

8.3.3.4 Clinical Studies– Lumbar Spine

Therapeutic lumbar facet joint nerve blocks were evaluated in 2 RCTs (828,867) and 3 observational studies meeting the inclusion criteria (49,694,861).

Therapeutic lumbar facet joint nerve blocks were assessed in 3 high-quality RCTs (693,828,849). All 3 studies demonstrated positive effectiveness for both short- and long-term relief. Civelek et al. (828) reported improvement in 69% of patients treated with local anesthetic and steroids, whereas 75% and 85% of patients reported improvement in the RCT and other studies by Manchikanti et al. (693,694). Anshul et al (849) reported significant pain reported significant pain relief and improvement in function at 6 month follow up.

Manchikanti et al. (693), in a randomized, double-blind controlled trial, evaluated the clinical effectiveness of therapeutic lumbar facet joint nerve blocks with or without steroids in managing chronic facet joint low back pain. A total of 120 patients were included, with 60 patients in the group treated with local anesthetic alone (Group I) and 60 patients in the group treated with local anesthetic and steroids (Group II). Inclusion criteria were based on a positive response to controlled comparative diagnostic lumbar facet joint nerve blocks. Results demonstrated significant pain relief (≥ 50%) and functional improvement (≥ 40%) in 85% of Group I patients and 90% of Group II patients at 2-year follow-up. Patients experienced significant pain relief for 82 to 84 weeks out of 104 weeks, requiring approximately 5 to 6 treatments, with an average duration of relief of 19 weeks per treatment. The authors concluded that therapeutic lumbar facet joint nerve blocks, with or without steroids, may provide a management option for chronic function-limiting facet joint low back pain.

Civelek et al. (828) compared the clinical effectiveness of facet joint injections versus facet joint RFA in patients with chronic low back pain diagnosed solely on clinical criteria. They included 100 patients, with 50 patients in the facet joint injection group and 50 patients in the facet joint RFA group. Results of this randomized trial demonstrated improved pain relief and function in 75% of patients treated with MBBs and 92% of patients treated with RFA at 6 months. At 1-year follow-up, improvement rates were 69% and 90%, respectively. In the short term, facet joint injections were more effective than facet joint RFA; however, during midterm follow-up, facet joint RFA produced more satisfactory results than facet joint injections. They concluded that the first treatment choice should be facet joint injections, but if pain recurs after a period of time or if injections are ineffective, RFA should be utilized for treatment of chronic lumbar facet joint pain.

Anshul et al. (849) conducted a comparative evaluation of intraarticular facet joint injections compared to medial branch blocks in a randomized controlled trial in patients with low back pain. Thirty patients received fluoroscopic-guided lumbar facet joint intraarticular injections. (Group I), whereas 30 patients received fluoroscopic-guided lumbar facet joint nerve blocks (Group II). The results showed significant improvement in pain scores following injection in both groups ($P > 0.05$). Mean pain scores in both groups remained below 2 throughout the study period. Further, they reported excellent patient satisfaction in most patients in both groups at multiple time intervals. The authors concluded that both lumbar facet joint injections and facet joint nerve blocks are safe and effective for management of low

Table 28. *Study characteristics of randomized controlled trials and observational studies of thoracic spinal facet joint nerve blocks.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Interventions**	**Pain Relief and Function**			**Results**			**GRADE Criteria Assessment**	**Clinical Applicability**	**Comments/ Conclusions**
Manchikanti et al 2010, 2012 (695,866) RA, DB, AC Quality Scores: Cochrane = 11/13 IPM-QRB = 45/48	100 patients Selection by positive with controlled dual diagnostic blocks with 80% pain relief as the criterion standard	Local anesthetic = 50 Local anesthetic with steroid = 50	79% vs 83%	79% vs 81%	80% vs 83%	P	P	P	High	High	Short- and long-term effectiveness High level of evidence and clinical applicability
Lee et al, 2018 (847) RA, AC Quality Scores: Cochrane = 12/13 IPM-QRB = 34/48	40 patients • Intraarticular steroid injection = 20 patients • Medial branch blocks = 20 patients.	Thoracic facet joint nerve blocks	NA	40%	NA	P	NA	NA	Moderate	Moderate	Short- and long-term effectiveness Moderate level of evidence and clinical applicability
Manchikanti et al, 2006 (696) Prospective observational study Quality Scores: IPM-QRBNR = 37/48	55 consecutive patients, all meeting diagnostic criteria for thoracic facet joint pain Selection by positive with controlled dual diagnostic blocks with 80% pain relief as the criterion standard	Thoracic facet joint nerve blocks	71%	71%	76%	P	P	P	Moderate	Moderate	Short- and long-term effectiveness High level of evidence and clinical applicability
Park et al, 2013 (864) Observational study Quality Score: IPM-QRBNR = 29/48	53 patients with axial back pain with chronic facet joint pain for osteoporotic compression fractures in thoracolumbar region. Majority of the patients included osteoporotic fractures at T12 and L1.	Facet blocks of the T11 and T12 medial branches and L1 and L2 medial branches	78.9%	78.9%	78.9%	P	P	P	Low	Low	Positive study Low level of evidence and clinical applicability

RA = randomized; AC = active controlled; DB = double-blind; F = Fluoroscopy; US = Ultrasound; IPM-QRB = Interventional Pain Management techniques–Quality Appraisal of reliability and Risk of Bias Assessment; IPM-QRBNR = Interventional Pain Management Techniques – Quality Appraisal of Reliability and Risk of Bias Assessment for Nonrandomized Studies; LA = local anesthetic; NA = not applicable; P = positive; NRS = Numeric Rating Scale; NDI = Neck Disability Index

back pain, providing adequate pain relief and disability improvement. The disadvantages include that diagnosis was made by clinical assessment, radiographic evidence, and single intraarticular injection. Further, there was no placebo group and it was single-blind design. However, they have shown that facet joint nerve blocks to provide long-term relief equivalent to intraarticular injections.

Manchikanti et al. (49) assessed clinical outcomes and cost utility of therapeutic lumbar facet joint nerve blocks (lumbar facet joint nerve blocks with L5 dorsal ramus block) compared with RFA in managing chronic facet joint low back pain. The primary outcome was pain relief measured by NRS at 3, 6, and 12 months. Significant improvement was defined as at least 50% pain relief. Cost utility was calculated using direct payment procedure data combined with estimated indirect costs over one year based on surgical and previously published interventional pain management literature. A total of 326 patients met inclusion criteria, with 99 patients receiving lumbar facet joint nerve blocks and 227 patients receiving lumbar RFA. Forty-eight patients in the facet joint nerve block group and 148 patients in the radiofrequency group completed 1-year follow-up. Significant improvement was observed in both groups from baseline through 12 months, with significant pain relief (≥ 50%) reported in both groups. Significant pain relief was recorded in 100%, 99%, and 79% of patients in the facet joint nerve block group at 3, 6, and 12 months, respectively, whereas the RFA group demonstrated relief in 100%, 74%, and 65% of patients, respectively. The difference was significant at 6 months. Cost utility analysis demonstrated average costs per QALY of $4,664 for lumbar facet joint nerve blocks and $5,446 for lumbar RFA. Twelve patients (12%) in the lumbar facet joint nerve block group and 79 patients (35%) in the lumbar RFA group were converted to alternative treatments because of side effects or inadequate relief. The authors concluded that therapeutic lumbar facet joint nerve blocks produced outcomes similar to RFA with respect to pain relief and cost utility.

Manchikanti et al. (694), in a randomized clinical trial, assessed the effectiveness of therapeutic lumbar facet joint nerve blocks. Two hundred patients underwent controlled diagnostic blocks for evaluation of facet joint pain. Eighty-four patients (42%) were determined to have lumbar facet joint pain. Patients were randomized into 2 groups: Group I received therapeutic injections with local anesthetic and Sarapin, whereas Group II received therapeutic injections with local anesthetic, Sarapin, and methylprednisolone. A total of 73 patients underwent medial branch blocks under fluoroscopic guidance. Results demonstrated that patients underwent multiple procedures over 2.5 years. The mean number of procedures was 2.5 ± 0.09 during months one to 3, 4 ± 0.13 during months 4 to 6, 6.1 ± 0.21 during months 7 to 12, and 8.4 ± 0.31 during months 13 to 32. Cumulative significant relief with one to 3 injections was 100% at one to 3 months, 82% at 4 to 6 months, 21% at 7 to 12 months, and 10% after 12 months, with mean relief lasting 6.5 ± 0.76 months. Significant improvement was observed in overall health status, including pain relief, physical and functional status, psychological status, and return-to-work outcomes. The authors concluded that medial branch blocks with local anesthetic and Sarapin, with or without steroids, are a cost-effective treatment modality that improves pain, physical, psychological, and functional status as well as return-to-work outcomes.

Han et al. (861) compared the midterm effects and benefits of ultrasound-guided versus fluoroscopy-guided MBBs for chronic lower lumbar facet joint pain diagnosed with controlled diagnostic blocks. They assessed pain relief, functional improvement, and injection efficiency. Patients with chronic lumbar facet joint pain who underwent ultrasound-guided (n = 68) or fluoroscopy-guided (n = 78) MBBs were included. All procedures were performed under either US or fluoroscopic guidance. Both ODI and VNS scores improved at 1, 3, and 6 months after the last injections in both groups, with similar outcomes. No statistically significant differences in ODI or VNS scores were observed between groups ($P > 0.05$). The proportion of patients reporting successful treatment outcomes also showed no significant differences between groups at various time points. In the US group, VNS improved from 6.57 ± 0.84 at baseline to 2.77 ± 1.82 at 3 months and 2.80 ± 1.79 at 6 months. Similar results were observed in the fluoroscopy group, with VNS improving from 6.35 ± 0.94 at baseline to 2.66 ± 1.66 at 3 months and 2.86 ± 1.60 at 6 months. ODI scores also improved significantly from baseline. In the US group, ODI improved from 30.25 ± 3.87 at baseline to 15.42 ± 5.74 at 3 months and 15.91 ± 6.04 at 6 months. In the fluoroscopy group, ODI improved from 31.08 ± 4.88 at baseline to 14.76 ± 5.65 at 3 months and 16.00 ± 6.91 at 6 months. The authors appeared to have substantial expertise in ultrasound-guided procedures and therefore concluded that ultrasound-guided procedures were easier to perform and produced better pain relief than fluoroscopy-guided procedures; however, both groups demonstrated appropriate improvement.

Characteristics of clinical studies involving lumbar spine RCTs and observational studies are shown in Table 29.

Table 29. *Study characteristics of randomized controlled trials and observational studies of lumbar spinal facet joint nerve blocks.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Interventions**	**Pain Relief and Function**			**Results**			**GRADE Criteria Assessment**	**Clinical Applicability**	**Comments/ Conclusions**
			3 months	**6 months**	**1 year**	**Short-Term ≤ 6 mos.**	**Long-Term**				
							6 months	**1 year**			
RANDOMIZED CONTROLLED TRIALS											
Civelek et al, 2012 (828) RA, AC Quality Scores: Cochrane = 9/13 IPM-QRB = 28/48	100 patients Selection Criteria: Failed conservative therapy Clinical Criteria: No diagnostic blocks	LA with steroid = 50 Conventional radiofrequency = 50	NA	75% vs. 92%	69% vs. 90%	NA	P	P	Moderate	Moderate	Long-term effectiveness Moderate level of evidence and clinical applicability
Manchikanti et al, 2008, 2010 (693,867) RA, DB, AC Quality Scores: Cochrane = 12/13 IPM-QRB = 45/48	120 patients 120 chronic axial low back pain patients were positive for facet joint pain diagnosed with controlled dual diagnostic blocks with 80% pain relief as the criterion standard were included	LA with steroid = 60 LA = 60	82% vs. 83%	93% vs. 83%	85% vs. 84%	P	P	P	High	High	Short- and long-term effectiveness High level of evidence and clinical applicability

Table 29 cont. *Study characteristics of randomized controlled trials and observational studies of lumbar spinal facet joint nerve blocks.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Interventions**	**Pain Relief and Function**			**Results**			**GRADE Criteria Assessment**	**Clinical Applicability**	**Comments/ Conclusions**
			3 months	**6 months**	**1 year**	**Short-Term ≤ 6 mos.**	**Long-Term**				
							6 months	**1 year**			
Anshul et al, 2023 (849) P, single-blind, RA Quality Scores: Cochrane = 11/13 IPM-QRB = 33/48	n = 60 Patients with a medical evaluation and pain pattern consistent with lumbar facet joint pain were randomly allocated to two groups Selection Criteria: • Clinical evaluation • No diagnostic block performed	n = 60 30 patients in each group (Group I and Group II) received either lumbar facet joint intraarticular injections or lumbar facet joint nerve blocks utilizing 2 mL drug solution comprising 0.25% bupivacaine plus 10 mg of triamcinolone was injected into each facet joint under fluoroscopic guidance	There was a statistically significant improvement in pain score after injection in both groups ($p > 0.05$) The mean pain score in both groups remained less than two at all time intervals throughout the study period ($p > 0.05$) Excellent patient satisfaction was reported by the majority of the patients at different time intervals in both groups	There was a statistically significant improvement in pain score after injection in both groups ($p > 0.05$) The mean pain score in both groups remained less than two at all time intervals throughout the study period ($p > 0.05$) Excellent patient satisfaction was reported by the majority of the patients at different time intervals in both groups	NA	P	P	NA	Moderate	Moderate	Positive trial Both lumbar facet joint injection and lumbar facet joint nerve block are safe and effective techniques for managing lower back pain patients. Both techniques provide adequate pain relief and disability improvement
OBSERVATIONAL STUDIES											
Manchikanti et al, 2022 (49) Observational study Quality Scores: IPM-QRBNR = 38/48	326 patients Selection by positive controlled comparative local anesthetic blocks with 80% pain relief as the criterion standard	Facet joint nerve blocks with bupivacaine 1.5 mL, 0.25% per level vs. bupivacaine injection, followed by conventional RFA for 120 seconds at 90°	100% vs. 100%	96% facet joint nerve block group vs. 74% radiofrequency group	79% facet joint nerve blocks group vs. 65% radiofrequency group	P	P	P	Moderate	Moderate	Short and long-term effectiveness Moderate level of evidence and clinical applicability

Table 29 cont. *Study characteristics of randomized controlled trials and observational studies of lumbar spinal facet joint nerve blocks.*

Study **Study Characteristic** **Methodological Quality Scoring**	**Number of Patients & Selection Criteria**	**Interventions**	**Pain Relief and Function**			**Results**			**GRADE Criteria Assessment**	**Clinical Applicability**	**Comments/ Conclusions**
			3 months	**6 months**	**1 year**	**Short-Term ≤ 6 mos.**	**Long-Term**				
							6 months	**1 year**			
Manchikanti et al, 2001 (694) Prospective observational study Quality Scores: IPM-QRBNR = 38/48	73 patients Selection by positive dual controlled comparative diagnostic blocks of 80% pain relief as the criterion standard	LA with steroid = 41 LA = 32	100% vs 100%	75% vs 80%	75% vs 80%	P	P	P	Moderate	Moderate	Positive short and long-term results Moderate level of evidence and moderate clinical applicability
Han et al, 2017 (861) Retrospective comparative study Quality Scores: IPM-QRBNR = 34/48	The study included treatment with facet joint nerve blocks either performed with ultrasound guidance (n= 68) or fluoroscopy (n=78) All patients had pain of at least 3 months Diagnostic blocks were performed, presumably with criterion standard of 80% pain relief	Facet joint nerve blocks were performed utilizing a volume of 1 mL mixture of 1% lidocaine 0.5 mL and dexamethasone 5 mg per mL at 0.5 mL at each level with all patients receiving blocks of 3 nerves Patients also received 2 consecutive therapeutic injections at a 2-week interval	VNS fluoroscopy 6.57 ± 0.84 to 2.77 ± 1.82 VNS Ultrasound 6.35 ± 0.94 to 2.66 ± 1.66 ODI fluoroscopy 31.08 ± 4.88 to 14.76 ± 5.66 ODI Ultrasound 30.25 ± 3.87 to 15.42 ± 5.74	VNS fluoroscopy 6.57 ± 0.84 to 2.80 ± 1.79 VNS Ultrasound 6.35 ± 0.94 to 2.86 ± 1.60 ODI fluoroscopy 31.08 ± 4.88 to 16.00 ± 6.91 ODI Ultrasound 30.25 ± 3.87 to 15.91 ± 6.04	NA	P	P	NA	Low	Low	A positive study Low level of evidence and clinical applicability Noninferior to RFA

RA = randomized; AC = active controlled; DB = double-blind; F = Fluoroscopy; US = Ultrasound; IPM-QRB = Interventional Pain Management techniques–Quality Appraisal of reliability and Risk of Bias Assessment; IPM-QRBNR = Interventional Pain Management Techniques – Quality Appraisal of Reliability and Risk of Bias Assessment for Nonrandomized Studies; LA = local anesthetic; NA = not applicable; P = positive; NRS = Numeric Rating Scale; NDI = Neck Disability Index

8.4 Evidence Synthesis

Recent systematic reviews and RCTs were utilized in the evidence synthesis. When essential, observational studies were also described. Evidence synthesis was carried out based on the treatment modality for each spinal region.

8.4.1 Radiofrequency Ablation

8.4.1.1 Cervical Spine

The evidence is **Level II** for long-term effectiveness with **moderate strength of recommendation** for cervical RFA.

8.4.1.2 Thoracic Spine

The evidence is **Level III** with **weak to moderate strength of recommendation** for thoracic RFA.

8.4.1.3 Lumbar Spine

The evidence is **Level II** for long-term effectiveness with **moderate strength of recommendation** for lumbar RFA.

8.4.2 Therapeutic Intraarticular Injections

8.4.2.1 Cervical Spine

Thus, evidence is **Level III** for short-term improvement and **Level V** for long-term improvement with **weak strength of recommendation** for cervical facet joint intraarticular injections.

8.4.2.2 Thoracic Spine

The evidence is **Level III**, with **weak to moderate strength of recommendation** for thoracic facet joint intraarticular injections.

8.4.2.3 Lumbar Spine

The evidence is **Level IV** with **weak strength of recommendation** for lumbar facet joint intraarticular injections.

8.4.3 Therapeutic Facet Joint Nerve Blocks

8.4.3.1 Cervical Spine

The evidence is **Level II** with **moderate strength recommendation** for therapeutic cervical facet joint nerve blocks.

8.4.3.2 Thoracic Spine

The evidence is **Level II** for therapeutic thoracic facet joint nerve blocks with **moderate strength recommendation**

8.4.3.3 Lumbar Spine

The evidence is **Level II** for therapeutic lumbar facet joint nerve blocks with **moderate strength recommendation**

8.4.3.4 Summary of Evidence of Spinal Facet Joint Interventions

Table 30, shows summary of evidence of spinal facet joint interventions including radiofrequency ablation of the facet joint nerves, facet joint intraarticular injections, and facet joint nerve blocks. This table shows the evidence derived from systematic reviews, RCT's, GRADE analysis, along with Level of Evidence for cervical, thoracic, and lumbar spinal facet joints.

Table 30. *Summary of Evidence of Spinal Facet Joint Interventions*

		RFA	Intraarticular Injections	Facet Joint Nerve Blocks
Systematic Reviews		13	11	5
RCT's	Total = High Quality- Moderate Quality- Low Quality-	17 10/17 7/17 0/17	14 12/14 2/14 0/14	10 9/10 1/10 0/10
GRADE Analysis	Total = High Quality- Moderate Quality- Low Quality-	17 2/17 6/17 9/17	14 0/14 4/14 10/14	10 3/10 6/10 1/10
Level of Evidence/ Recommendations		Cervical- II/ moderate Thoracic- III/weak Lumbar- II/ moderate	Cervical- III/weak Thoracic- III/weak Lumbar- IV/weak	Cervical- II/moderate Thoracic- II/moderate Lumbar- II/moderate
Number of Treatments per Year		Moderate	Moderate	moderate
QOL/Year		$5,364-$5,446	$5,446	$3,572-$4,994

9.0 Special Considerations

9.1 Repeat Facet Joint Interventions: Safety and Effectiveness

Key Question 7: Are repeat facet joint interventions, specifically RFAs, safe and effective in managing spinal facet joint pain?

Repeated facet joint interventions have been evaluated for both safety and effectiveness (49,50,693,694,751-755).

Repeat therapeutic facet joint nerve blocks have been described by Manchikanti et al. in multiple publications over the years without adverse consequences (1-4,35,47,49,50,71,72). In contrast, RFA has been considered problematic by some investigators because of the incidence of nerve damage or neuritis, along with the potential for multifidus denervation altering spinal biomechanics (875,876).

The recurrence of facet joint pain following facet joint interventions depends on the type of treatment provided. The mechanisms of recurrence differ between nerve blocks and RFA. Recurrence after RFA depends on peripheral nerve regeneration, which is related to the extent of injury. Regeneration of peripheral nerves depends on the degree of tissue damage, including injury to the myelin, axon, endoneurium, perineurium, and epineurium, in that order.

In addition, complications associated with RFA are related to neural plasticity. Functional deficits caused by nerve injuries can be compensated through reinnervation of denervated targets by regeneration of injured axons or collateral branching of undamaged axons, with subsequent remodeling of nervous system circuitry related to the lost function (793).

When axonal continuity with surrounding myelin is lost but the endoneurium remains preserved or only partially injured, complete recovery remains possible because the intact mesenchymal latticework provides a pathway for subsequent axonal sprouting and reinnervation of the target organ (792). Results of this study (792) indicated that the frequency of success and duration of relief from repeated RF medial branch ablation for lumbar facet syndrome were similar to the initial results, providing relatively prolonged pain relief without major side effects. Each procedure appeared to provide successful pain relief for approximately 10 months in more than 85% of carefully selected patients when RFA was appropriately performed (792).

Schmidt et al. (875) described the incidence, diagnosis, and management of neuromas following RFA. Their literature review identified one case report describing neuroma formation following lumbar medial branch RFA.

One of the more common concerns and disadvantages associated with RFA remains multifidus denervation and its potential effect on spinal biomechanics (876). Almalki and Cortes (876) hypothesized that multifidus denervation following RFA affects spinal mechanics. Such changes may be associated with abnormal tissue deformation and stress, potentially altering mechanobiology and homeostasis, thereby affecting spinal health. In addition, Garcia et al. (877), in a narrative literature review, described evidence of multifidus changes following lumbar RFA. Multifidus dysfunction has been extensively documented as a major contributor to chronic low back pain through muscle inhibition, dysfunction, and progressive loss of neuromuscular feedback and spinal stability, factors that collectively exacerbate pain and further impair function (877-881). In this review, the authors identified 5 cohort studies and one case series. Two studies demonstrated confirmed decreases in multifidus function following lumbar RFA. Four studies analyzed structural changes after lumbar RFA, with 2 reporting reduced cross-sectional area or fatty infiltration, one demonstrating no measurable difference, and another showing apparent muscle enlargement. They concluded that current evidence suggests lumbar RFA may lead to structural and functional changes in the multifidus muscle, although findings remain inconsistent because of significant study heterogeneity. Further high-quality prospective studies with standardized imaging and functional assessments are required to clarify long-term clinical impact.

Dreyfuss et al. (882) demonstrated diffuse atrophy of the multifidus muscle in 5 patients 17 to 26 months after unilateral RFA. However, 3 blinded radiologists correctly identified the side and level of the lesion in only one patient. Clinical consequences of the atrophy were not established. Smuck et al. (883) found no significant difference in multifidus muscle area or adverse facet joint changes in 27 patients following RFA, although they did identify increased intervertebral disc degeneration. Another study (884) examined the proportion of fat tissue in the multifidus muscle before and at least 6 months after RFA. No significant difference in fatty degeneration was identified.

In a systematic review (885), repeated RFA was successful in 88% of patients in the cervical spine and 59% of patients in the lumbar spine. Success was de-

fined as a minimum of 50% pain reduction for at least 3 months. The duration of success was comparable to the initial RFA. Additional studies confirmed these findings (751,754,755). No significant differences in pain reduction were observed between first, second, or third RFAs. Duration of benefit also did not differ significantly among the first, second, and third procedures (754,755,792,886). Similar findings were also described for repeated CRFA of the SI joint (887).

One review examined outcomes of a second RFA after an unsuccessful first denervation and found a success rate of only 38% (885). Lord et al. (888) found a success rate of only 33% for repeated application after short-term success lasting less than 90 days following the initial ablation. The authors suggested that if the first RF denervation was unsuccessful, the repeat success rate was essentially zero.

None of the evaluated retesting studies performed a medial branch block prior to repeated RFA (Table 30).

The NICE Guidelines (803) advise caution in recommending repeat RFA until additional long-term data become available. Consensus guidelines (13) recommend repeat lumbar RFA for patients who have experienced at least 3 months, and preferably 6 months, of successful pain relief following the initial RFA. Consensus guidelines for the cervical spine (12) similarly recommend repetition after at least 3 months of positive response, but no more frequently than twice yearly.

Manchikanti et al. (49) assessed the clinical outcomes and cost utility of therapeutic lumbar facet joint nerve blocks (lumbar facet joint nerve blocks with L5 dorsal ramus block) compared with RFA in managing chronic facet joint low back pain. A total of 326 patients met inclusion criteria, with 99 patients receiving lumbar facet joint nerve blocks and 227 patients receiving lumbar RFA. No adverse effects were reported.

Manchikanti et al. (50) evaluated the clinical outcomes and cost utility of therapeutic MBBs compared with RFA in managing chronic facet joint neck pain. Overall, 295 patients met inclusion criteria, with 132 patients receiving cervical MBBs and 163 patients receiving cervical RFA. One hundred and seven patients in the cervical medial branch group and 105 patients in the radiofrequency group completed 1-year follow-up. No adverse effects were reported.

Rambaransingh et al. (751) prospectively assessed 104 patients who underwent repeat RFA for chronic neck or back pain using the Pain Disability Questionnaire-Spine (PDQ-S). Data were gathered from 596 patients undergoing RFA over 5 years. Among these, 104 patients (20 cervical and 84 lumbar) underwent repeat RFA of the same facet joints. Results demonstrated significant improvement in pain intensity, pain frequency, and patient-specific disability measures following initial, second, and third RFAs. Furthermore, there was no statistically significant difference in duration of relief between the initial and repeat procedures. They concluded that repeated cervical and lumbar RFA reduced pain and disability with equivalent effectiveness for approximately 10 months in patients with chronic facet joint neck and back pain.

Multiple investigators have reported the safety and effectiveness of repeat RFA (752-755). Schofferman and Kine (754), in evaluating repeated lumbar RFA, demonstrated a mean duration of relief of 10.5 months, with repeat procedures successful in 85% of patients in whom the initial lumbar RFA had been successful. No significant difference was observed between the initial and subsequent procedures regarding duration of relief or other factors.

Burnham and Holitski (752), in a prospective outcome study evaluating the effects of lumbar facet joint RFA, assessed 44 consecutive patients involving 101 facet joints diagnosed by dual diagnostic blocks producing greater than 50% pain relief. Patients reported significant improvement in pain, analgesic requirements, satisfaction, disability, and direct costs. However, benefits peaked between 3 and 6 months and gradually diminished thereafter.

Gofeld et al. (753) published a 10-year prospective clinical audit. Of 209 patients undergoing RFA, 174 completed the study, whereas 35 were lost to follow-up or failed to provide complete data. Among the 174 patients with complete data, 55 patients (31.6%) experienced no benefit, whereas 119 patients (68.4%) experienced good (≥ 50%) to excellent (≥ 80%) pain relief lasting 6 to 24 months. These findings suggest that slightly less than 50% of all patients initially treated responded successfully, with approximately 15% lost to follow-up. Approximately 90 of 209 patients (32%) with follow-up experienced no benefit from RFA.

These findings are similar to those reported in other publications (49,50), where approximately 30% of patients receiving RFA preferred not to undergo repeat procedures or transitioned to alternative treatments such as therapeutic facet joint nerve blocks.

Finally, Joo et al. (748) considered repeat RFA a standard process for providing prolonged pain relief lasting at least 6 months. However, they raised the clinical dilemma regarding how frequently and how many times patients should undergo repeated interventions

over their lifetime. Accordingly, they compared alcohol ablation with repeat thermal RFA to determine which procedure produced superior long-term pain relief. Their results demonstrated that alcohol ablation provided longer-lasting relief than RFA.

Overall, repeat RFAs provide similar efficacy in appropriately selected patients. Results may be summarized by stating that patients who experience at least 50% pain relief for a minimum of 5 to 6 months following RFA and subsequently develop recurrent pain may undergo repeat RFA up to twice yearly without limitation on the total number of procedures throughout their lifetime.

Table 31 shows the literature review of studies evaluating repeat RFA.

9.1.1 Strength of Evidence and Recommendations

The **level of evidence is II**, with **moderate to strong strength of recommendation** for the safety and effectiveness of repeat facet joint interventions, including repeat RFA providing results similar to the initial treatment.

9.2 Impact of Temperature, Duration of Lesioning, and Size of the Lesion

Key Question 8: What is the impact of temperature, duration of lesioning, and size of the lesion on outcomes?

The size of the lesion has been a subject of debate. CRF lesioning, continuous RFA, as well as CRFA (cooled RFA), are affected by probe size, temperature, and duration of current application, all of which can be modified to control lesion size (808,809). Consequently, it has traditionally been believed that larger needles, higher temperatures, and longer lesioning durations increase lesion size. Injection of fluids may also influence lesion size. CRFA is based on producing a larger lesion size; however, outcomes based on lesion size remain inconclusive. Side effects may occur more frequently with larger needles, higher temperatures, and longer lesioning durations, producing burning sensations and neuritis.

A limited number of clinical studies have compared different RFA parameters (889,890). The likelihood of patient-reported improvement of at least 75% was 2.8 times greater in the 90°C group (P = 0.002). In a randomized trial, Ertilav et al. (890) assigned patients undergoing RFA into one of 3 groups: 90°C for 50 seconds, 85°C for 60 seconds, or 70°C for 90 seconds. No significant difference in pain reduction was observed after 6 months among the 3 groups. This finding was attributed to delivery of a similar amount of energy across all groups, achieved through combinations of higher temperatures with shorter duration or lower temperatures with longer duration.

In a 2025 randomized double-blind study, Mekhail et al. (891) assessed the impact of temperature on the

Table 31. *Literature review of studies about repeat RF-ablation.*

STUDY	DESIGN	POPULATION	RESULTS
Schoffermann et al, 2004 (754)	Retrospective observational study	20 lumbar	The duration of success was comparable to the first RF denervation. Duration of effect was not significantly different between the first, second and third RF denervation
Smuck et al, 2012 (885)	Systematic review	115 cervical 29 lumbar	Success of repeat RF denervation: 88% cervical, 59% lumbar
Rambaransingh et al, 2010 (751)	Prospective observational study	15 cervical 58 lumbar	The duration of success was comparable to the first RF denervation
Son et al, 2010 (792)	Retrospective observational study	60 lumbar	Duration of effect was not significantly different between the first, second and third RF denervation
Kim et al, 2014 (886)	Retrospective observational study	56 lumbar	Duration of effect was not significantly different between the first, second and third RF denervation
Manchikanti et al, 2022 (49)	Comparative evaluation	227 lumbar	Patients received RFA or facet joint nerve blocks over a period of longer than 2 years with repeat RFA or nerve blocks with no side effects with variable success.
Manchikanti et al, 2022 (50)	Comparative evaluation	295 cervical	Patients received RFA or facet joint nerve blocks over a period of longer than 2 years with repeat RFAs or nerve blocks with no side effects with variable success.

Adapted and modified from: Klessinger S, Casser HR, Gillner S, et al. Radiofrequency denervation of the spine and the sacroiliac joint: A systematic review based on the Grades of Recommendations, Assessment, Development, and Evaluation Approach Resulting in a German National guideline. *Global Spine J* 2024; 14:2124-2154 (14).

magnitude and duration of pain relief following lumbar facet medial branch RFA. Ablations were performed in 2 cohorts at 80°C and 90°C. The authors utilized a 20-gauge, 10 mm active tip straight radiofrequency needle. Duration of lesioning was not described. Results demonstrated significant pain reduction in both groups; however, median time to repeat RFA in the 80°C group was 112 days (49-252 days), whereas median time in the 90°C group was 217 days (198-348 days) ($P < 0.04$). They concluded that temperature was a statistically significant factor for achieving pain improvement greater than 50% based on univariate analysis. One limitation of the study was incomplete follow-up. In the 80°C group, only 53 of 71 patients completed the 12-month follow-up, whereas in the 90°C group, only 46 of 73 patients completed follow-up.

Costandi et al. (889), in a retrospective evaluation, published comparative results of RFA performed at 80°C and 90°C. Patients treated with RFA at 90°C had a 3.1 times greater likelihood of significant improvement than those treated at 80°C, defined as at least 50% pain relief ($P = 0.0004$).

Medicare LCDs recommend a temperature of 80°C without a specific recommendation regarding lesion duration (98).

Among multiple recommendations, the consensus guidelines for cervical and lumbar spine RFA (12-14) suggest that larger lesions increase both the probability of successful medial branch ablation and the duration of pain relief. The SIS Practice Guidelines (892) recommend temperatures of 80°C to 85°C and lesion durations of 60 to 90 seconds. Multiple lesions (2 to 3) are also recommended depending on cannula diameter and active tip length. The British Pain Society technical guideline (893) recommends use of an 18-gauge cannula with a 10 mm curved active tip at 80°C for 120 seconds with 2 lesions per nerve. The American Society of Pain and Neuroscience (ASPN) guidelines (813) recommend temperatures of 60°C to 80°C for 60 to 90 seconds in both the cervical and lumbar spine. German National Guidelines (4), based on evidence synthesis, recommend a large diameter cannula (at least 18-gauge) when using conventional electrodes with a 10 mm active tip length, producing multiple lesions per medial branch.

Table 32 shows the literature review of studies comparing different radiofrequency parameters.

9.2.1. Strength of Evidence and Recommendations

The evidence is **Level II** with a **strong strength of recommendation** for the impact of temperature, duration of lesioning, and lesion size when RFA is performed using an 18-gauge cannula with a 10 mm active tip in the lumbar spine and a 20-gauge cannula with a 5 mm or 10 mm active tip in the cervical and thoracic spine.

Table 32. *Literature review of studies comparing different radiofrequency parameters.*

STUDY	DESIGN	POPULATION PARAMETER 1/2/3	RESULTS
Mekhail et al, 2025 (891)	RCT	Received 80°C intervention – RFA (n=71) Received 90°C intervention – RFA (n=73)	Among the 2 groups, both reported pain improvement in a follow-up time point. Overall, both groups achieved statistically significant pain reduction (p=<0.05). The median time to repeat RFA 80°C group was 112 (49-252 days) days. The median time to repeat RFA in the 90°C group was 217 (198–348) days (p<0.04). Univariate analysis emphasized that the RFA temperature is a statistically significant factor for pain improvement of more than 50%. A significantly large drop-out rate at 12-month follow-up.
Ertilav et al, 2022 (890)	RCT	31/32/33	Three groups: 90°C, 50 s or 85°C, 60 s or 70°, 90 s. No significant difference in pain reduction was found after 6 months. Similar amount of energy in all 3 groups
Costandi et al, 2015 (889)	Retrospective observational study	100/99	At 90°C 3.1 times greater chance of at least 50% improvement (p = .0004). Chance of a patient-reported improvement of at least 75% was 2.8 times better in the 90°C group (p = .002)

Adapted and modified from: Klessinger S, Casser HR, Gillner S, et al. Radiofrequency denervation of the spine and the sacroiliac joint: A systematic review based on the Grades of Recommendations, Assessment, Development, and Evaluation Approach Resulting in a German National guideline. *Global Spine J* 2024; 14:2124-2154 (14).

9.3 Type of Electrodes and Needles

Key Question 9: Is there difference in outcomes and preference for certain types of electrodes and needles?

In performing RFA, both monopolar and bipolar electrodes are available. Traditionally, and in most practices, a conventional monopolar electrode has been utilized. This has been the case in almost all RCTs and observational studies evaluating the management of spinal facet joint pain. However, with the development of CRFA and the performance of RFA in patients with metallic implants, spinal cord stimulators, and cardiac implants, the bipolar technique has gained support. The literature clearly describes the production of larger lesions with CRFA.

Two observational studies (830,894) evaluated the outcomes associated with different electrode types in the lumbar spine. A conventional electrode was compared with cooled-RF or with an electrode containing 3 active components at the tip. No significant differences were observed in pain scores or ODI outcomes. Similarly, a systematic review with meta-analysis (895) found no significant differences in pain reduction between conventional RFA and CRFA.

More recently, various electrode designs have been developed to increase lesion size and potentially improve outcomes (819,896,897). Künzle et al (819), in a small single-center observational study, evaluated the effectiveness of a multitined cannula designed to produce three lesions. Due to the limited number of patients, no definitive conclusions could be drawn from this study.

Two publications (896,897) reported the effectiveness of cervical medial branch RFA using a perpendicular approach with a three-tined electrode. Both studies demonstrated significant improvement following RFA. In the first study, Civitarese et al (896) reported a successful outcome in 65.4% of patients at 3 months. Among the responders, 15 of 34 patients experienced recurrence of symptoms after an average of 8.8 ± 2.5 months. However, successful RFA outcomes are generally defined as lasting at least 6 months. Based on these findings, the results do not appear superior to those achieved with conventional RFA. In the second study by Sen et al (897), which included 66 patients with a mean follow-up of 16.3 ± 7 months, 77.3% of patients experienced a > 2-point reduction in NRS scores and 63.6% reported a Patient Global Impression of Change (PGIC) score > 6. Opioid use decreased significantly by 15.2%. Overall, 51.5% of participants achieved a > 50% reduction in NRS scores from baseline at an average follow-up of approximately 16 months after treatment with the three-tined electrode. However, the proportion of responders was not superior to that reported with conventional RFA, although the duration of relief appeared to be longer with the three-tined electrode.

9.3.1 Strength of Evidence and Recommendations

The **level of evidence is Level IV** with **no specific recommendation** for the use of a specific type of electrode or needle for RFA.

9.4 Position of the Electrode

Key Question 10: Is the position of the electrode to the nerve parallel or perpendicular relevant and important?

Traditionally, a perpendicular technique has been utilized in performing RFA. However, Bogduk et al (898) and others have described the disadvantages of the perpendicular technique and recommended the use of a parallel technique. Consequently, 2 dominant techniques have emerged in the literature regarding needle guidance during RFA, differing primarily in the angle of electrode insertion. In the parallel technique, curved electrodes are positioned tangentially to the medial branch so that contact with the nerve occurs along the long axis of the noninsulated electrode tip. Compared with a medial branch block, RF denervation requires a much flatter puncture angle (899,900). In contrast, the perpendicular technique utilizes a needle trajectory similar to that used for a medial branch block, with the needle tip contacting the nerve at a 90° angle. The literature provides mixed results regarding the superiority of either approach.

A systematic review by Schneider et al (706), supporting the positions of the Spine Intervention Society and Bogduk, evaluated the effectiveness of lumbar medial branch thermal ablation stratified by diagnostic methods and procedural techniques. Based on this review, the parallel technique appeared to produce superior results when combined with rigorous patient selection. In contrast, the studies utilizing the perpendicular technique did not employ similarly rigorous patient selection criteria. Consequently, there appears to be significant bias favoring the parallel technique.

In the lumbar spine, multiple authors specified

the needle placement technique utilized during RFA. Among randomized trials, Nath et al (727), Tekin et al (730), and van Wijk et al (728) described the use of parallel needle placement. Positive outcomes were reported by Nath et al (727) and Tekin et al (730), whereas van Wijk et al (728) demonstrated a lack of efficacy, even at 3-month follow-up. In contrast, the randomized trial by van Kleef et al (729), which utilized perpendicular needle placement, demonstrated positive efficacy. Moon et al (740) directly compared perpendicular and parallel needle placement in a randomized active-controlled trial including 41 patients in each group. Positive outcomes were observed in both groups at 6-month follow-up; however, perpendicular placement demonstrated somewhat superior results compared with parallel placement.

Loh et al (901) performed a comparative evaluation of perpendicular versus parallel needle placement and found no significant difference in pain reduction. However, longer duration of pain relief was observed with the parallel technique.

In the cervical spine, Engel et al (836) conducted a systematic review without specifically describing needle placement technique. As summarized in the literature review (Table 32), Lord et al (772) are well recognized for utilizing parallel needle placement, whereas van Eerd et al (829) utilized a perpendicular approach. Significant differences in outcomes were observed between the studies. Although the study by Lord et al suggested superior outcomes, the van Eerd study demonstrated inferior outcomes. Unfortunately, the van Eerd study was limited by multiple methodological deficiencies, including inadequate diagnostic criteria and poor outcome parameters. Among other authors, Civitarese et al (896), Sen et al (897), and Manchikanti et al (50) primarily utilized a perpendicular approach and reported outcomes similar to those achieved with parallel needle placement.

Table 33 shows the literature review of studies comparing perpendicular versus parallel electrode placement in the lumbar and cervical spine.

The consensus guidelines for the cervical and lumbar spine (12,13) recommend a parallel needle position using a posterior or oblique posterior approach for conventional electrodes. The Consensus Guidelines for LWS (14) also recommend a parallel electrode position. The guidelines of the American Society of Pain and Neuroscience (ASPN) (813) recommend utilizing a sagittal and oblique approach in the cervical spine to achieve denervation along a portion of the nerve, while a parallel needle position is recommended in the lumbar spine.

The issue of multiple lesions versus a single lesion remains controversial. The majority of studies in both the cervical and lumbar spine have utilized multiple lesions, often as many as six lesions per nerve. Although several authors reported positive outcomes with multilesion techniques, these results were not directly compared with outcomes achieved using a single lesion. In contrast to the multilesion studies, 2 observational studies in the cervical (50) and lumbar spine (49) utilized a perpendicular approach with a single lesion and demonstrated positive outcomes. In the cervical spine, significant pain relief of 50% or greater was observed in 69% of patients at 6 months and 64% at 12 months. In the lumbar spine, the study demonstrated 74% pain relief at 6 months and 65% pain relief at 12 months.

9.4.1 Strength of Evidence and Recommendations

The **level of evidence is Level IV** with **weak strength of recommendation** for placement of the electrode, either parallel or perpendicular to nerve.

9.5 Stimulation Parameters

Key Question 11: Is sensory or motor test stimulation necessary and is there a preference for sensory, motor, or both?

In a prospective study by Dreyfuss et al (902), RFA was performed with prior motor stimulation and impedance measurement in 15 patients. No correlation was identified between RFA success and impedance values, nor between RFA success and the observation of muscle twitches. Cohen et al (903) specifically investigated the influence of sensory testing on RFA outcomes and found no significant difference between RFA results and the mean sensory stimulation threshold. A retrospective study (904) evaluated the duration of successful outcomes following RFA as a function of muscle twitching observed during motor stimulation. Although a longer duration of benefit was observed in patients with muscle twitches, the difference was not statistically significant. A statistically significant difference (P = .03) was identified only when paravertebral muscle twitching occurred within 1.6 times the voltage level at which sensory provocation was achieved (Table 34).

The SIS Practice Guidelines (892) do not recommend sensory or motor testing, but instead recommend localization of the electrode according to anatomical landmarks

Table 33. *Literature review of studies comparing a perpendicular or a parallel electrode position for the lumbar and cervical spine.*

STUDY	DESIGN	POPULATION /CONTROL	RESULTS
LUMBAR SPINE			
Loh et al, 2015 (901)	Retrospective observational study	82/241	"Early Australian" (parallel) vs "advanced Australian" (perpendicular) technique. Exact needle position not described. No significant difference regarding pain reduction. Significant better results for pain duration with parallel placement
Moon et al, 2013 (740)	Randomized, active control	41/41	This study specifically compared the results of parallel placement of the needle versus perpendicular placement. The results were statistically insignificant in both groups and the study was judged to be positive with positive outcomes in both groups. Further, perpendicular approach was slightly superior to parallel approach.
Tekin et al, 2007 (730)	RCT	20/20	Parallel needle placement. Significant differences in pain reduction and ODI reduction at 6 and 12 months
Nath et al, 2008 (727)	RCT	20/20	A rigorous diagnostic technique with parallel technique showed significantly better results.
van Kleef et al, 1999 (729)	RCT	15/16	Perpendicular needle placement. Improvement in pain and ODI after 2 months, successful therapy after 3, 6, or 12 months
van Wijk et al, 2005 (728)	RCT	40/41	Perpendicular needle placement. No significant difference for the endpoints pain after 3, 6 or 12 months and global impression after 6 months
Juch et al, 2017 (58)	RCT	125/126	A perpendicular technique with 50% single block showed poor results.
Manchikanti et al, 2022 (49)	Comparative evaluation	227	Analysis of lumbar RFA in 227 patients compared with lumbar facet joint nerve blocks in 99 patients with perpendicular needle placement showed > 50% improvement in pain relief in 74% of the patients at 6-months and 65% of the patients at 12-month follow-up. The results are similar to multiple publications including utilizing parallel technique.
CERVICAL SPINE			
Lord et al, 1996 (772)	RCT	12/12	Parallel needle placement. Clear advantage after cervical RF denervation in terms of pain reduction (success rate of 59.5%)
van Eerd et al, 2021 (829)	Randomized study	37/39	"Alternative approach" (perpendicular). No effect in terms of 30% pain reduction, global impression, neck disability index or medication consumption
Civitarese et al, 2025 (896)	Retrospective cohort study	52	Perpendicular approach was utilized with a 3-tined probe at 3 months post-procedure, > 50% of NRS pain reduction and MCID were both reported in 65.4% of the patients at 3-month follow-up. Of the 34 patients with successful response, only 15 had return of symptoms after an average of 8.8 ± 2.5 months. This study shows no significant difference with improved with outcomes with perpendicular technique with a 3-tined probe.
Sen et al, 2025 (897)	Cross sectional cohort study	66	This study with inclusion of 66 patients showing > 50% NRS reduction in 51.5% of participants, at an average of approximately 16 months, showing significantly better results compared with the other publications, even though this is not a direct comparison.
Manchikanti et al, 2022 (50)	Clinical outcomes and cost utility	295	Analysis of cervical RFA in 163 patients compared with cervical medial branch blocks in 132 patients showed > 50% improvement in pain relief in 69% of the patients at 6-months and 64% of the patients at 12-month follow-up. The results are similar to multiple publications including utilizing parallel technique.

Adapted and modified from: Klessinger S, Casser HR, Gillner S, et al. Radiofrequency denervation of the spine and the sacroiliac joint: A systematic review based on the Grades of Recommendations, Assessment, Development, and Evaluation Approach Resulting in a German National guideline. *Global Spine J* 2024; 14:2124-2154 (14).

utilizing multiplanar fluoroscopy. A warning is provided against performing motor stimulation without adequate imaging guidance. The Consensus Guidelines (12,13) recommend both sensory and motor testing for the cervical and lumbar spine. The British Pain Society technical guidelines (893) recommend sensory testing, but not motor testing. The guidelines of the American Society of Pain and Neuroscience (ASPN) (813) recommend both sensory and motor testing in the lumbar spine.

9.5.1 Strength of Evidence and Recommendations

The **level of evidence is II, or moderate, with strong strength of recommendation** to perform either motor or sensory testing prior to RFA.

9.6 Radiofrequency Ablation in Patients with Metallic Implants

Key Question 12: Is it safe and effective to perform radiofrequency ablation in patients with metallic implants?

Multiple authors have evaluated lumbar RFA in patients with spinal hardware. Abd-Elsayed et al (805) described a case series and concluded that RFA can be performed safely and effectively in close proximity to hardware. Although heating of the hardware may occur, which theoretically could result in tissue injury or reduced heat delivery to the target nerve, this did not appear to have clinical significance. Ellwood et al (804), in a retrospective review of spinal RFA procedures in patients with metallic posterior spinal instrumentation, reported that among 507 patients undergoing RFA, 36 patients had metallic hardware. A total of 56 ablations were performed at levels containing metallic spinal hardware, of which 44 were lumbar procedures. No complications were observed.

Lamer et al (747) also evaluated the safety of lumbar spine radiofrequency procedures in patients with posterior spinal hardware. Ten lumbar medial branch RFAs were performed in 6 patients, with placement of a probe on the fusion hardware to continuously monitor hardware temperature throughout the procedure. The temperature of the fusion hardware increased during 6 of the 10 RFAs. In 2 procedures, the temperature increased rapidly to 42°C, prompting discontinuation of the procedure at that level. The authors concluded that this case series demonstrated that radiofrequency lesioning for symptomatic facet joint pain in patients with adjacent posterior lumbar fusion hardware may result in heat transfer to the hardware. Consequently, they hypothesized that this phenomenon may increase the risk of patient injury.

Several observational studies demonstrated significant warming of metallic implants during RFA procedures; however, no complications were reported (Table 35) (804,805,905).

In a FactFinder addressing patient safety (906), the SIS recommends avoiding direct electrode contact with metallic hardware. Existing axial imaging should be carefully reviewed prior to the procedure. The consensus guidelines for lumbar spine procedures (13) recommend the use of multiplanar fluoroscopic imaging in the lumbar spine and emphasize avoiding direct electrode contact with metal. Similarly, the consensus guidelines for the cervical spine (12) recommend multiplanar fluoroscopic imaging and a more posterior approach to avoid direct hardware contact.

For safety, it is essential to determine the needle trajectory carefully to ensure that the electrode does not contact metallic hardware. Multiple guideline restrictions have been described. Medicare guidelines

Table 34. *Literature review of studies about test stimulation.*

STUDY	DESIGN	POPULATION	RESULTS
Dreyfuss et al, 2000 (902)	Prospective observational study	15	RF denervation with motor stimulation and impedance measurement. No correlation between success and impedance or muscle twitches
Cohen et al, 2011 (903)	Prospective observational study	61	Influence of sensory testing on the result of RF denervation. No significant relationship between the mean sensory stimulation threshold and the result
Koh et al, 2017 (904)	Prospective observational study	68	Duration of success after RF denervation as a function of muscle twitching after motor stimulation. Significant difference (p= .03) only when paravertebral muscle twitching was observed within 1.6 times the voltage level of sensory provocation

Adapted and modified from: Klessinger S, Casser HR, Gillner S, et al. Radiofrequency denervation of the spine and the sacroiliac joint: A systematic review based on the Grades of Recommendations, Assessment, Development, and Evaluation Approach Resulting in a German National guideline. *Global Spine J* 2024; 14:2124-2154 (14).

Table 35. *Literature review of studies with an RF denervation in patients with metal implant.*

STUDY	DESIGN	POPULATION	RESULTS
Elwood et al, 2018 (804)	Retrospective observational study	36	No complications
Abd-Elsayed et al, 2019 (805)	Case Series	5	No complications
Klessinger, 2016 (905)	Retrospective observational study	40	No complications

Adapted and modified from: Klessinger S, Casser HR, Gillner S, et al. Radiofrequency denervation of the spine and the sacroiliac joint: A systematic review based on the Grades of Recommendations, Assessment, Development, and Evaluation Approach Resulting in a German National guideline. *Global Spine J* 2024; 14:2124-2154 (14).

state that RFA should not be performed in patients with anterior lumbar interbody fusion (ALIF). No specific comments are provided regarding cervical fusion. Other policies specify that ablation should not be performed at the level of fusion. Because of the technical challenges associated with performing RFA in patients with hardware, facet joint nerve blocks may be considered when permitted by medical policies. However, there are no studies evaluating their comparative effectiveness relative to RFA in this population.

9.6.1 Strength of Evidence and Recommendations

The **level of evidence is IV** with **weak strength of recommendation** to perform RFA in patients with metallic implants.

9.7 Radiofrequency Ablation in Patients with Cardiac Implantable Devices

Key Question 13: What are the safety precautions to be observed in patients with cardiac pacemakers and defibrillators during radiofrequency ablation?

Cardiac implantable electronic devices (CIEDs) include pacemakers, implantable cardioverter-defibrillators (ICDs), and cardiac resynchronization therapy devices (CRTDs). Each device serves specific functions, and during the perioperative period while performing RFA, these functions must be clearly identified and appropriately managed. Pacemakers are the most commonly utilized electronic devices for the management of cardiac arrhythmias and conduction abnormalities. ICDs provide immediate shock therapy when non-perfusing tachyarrhythmias are detected, whereas CRTDs provide pacing for dyssynchronous ventricular activation to optimize cardiac output. These devices consist of a pulse generator attached to electrodes or leads. The pulse generator is typically implanted in the infraclavicular region of the anterior chest wall and connected to transvenously placed leads anchored within the myocardium. Electrodes detect both intrinsic and extrinsic electrical currents and function in sensing, pacing, defibrillation, or a combination of these functions depending on the device type. Output is delivered in the form of pacing or defibrillation based on signals received from the sensing electrode (907).

Electromagnetic interference may result in malfunction of implanted devices such as CIEDs and brain or spinal cord stimulators (SCS) (908-910). RFA treatments may be sensed by these devices and trigger unintended responses. In pacemakers, sensed electrical current may inhibit the device from delivering additional current in order to avoid cardiac dyssynchrony and the "R on T" phenomenon. In pacemaker-dependent patients, such inhibition may result in asystole. In ICDs, sensed electrical current may be misinterpreted as a non-perfusing tachyarrhythmia, thereby triggering cardioversion therapy. Less common complications include electromagnetic interference or device reset, pulse generator damage, and lead-tissue interface damage. Consequently, manufacturers recommend maintaining a minimum distance of 15 centimeters between sources of electromagnetic interference and CIEDs. However, these recommendations may vary depending on the specific device. Anatomically, electromagnetic interference occurring below the L3/4 or umbilical level is unlikely to produce significant interference. Therefore, procedures performed above the umbilicus, including those in the thoracic or cervical spine, are considered high-risk.

Sowder et al (911) published guidelines for RFA procedures in patients with implanted devices on behalf of the American Society of Pain and Neuroscience (ASPN). They provided a management algorithm as illustrated in Fig. 38. Table 36 also summarizes updated manufacturer recommendations for CIEDs (912-915).

Friedrich et al (916) published a physician survey and guideline review regarding the management of CIEDs in patients undergoing RFA for spinal pain. In a survey involving approximately 200 participating clinicians, respondents demonstrated substantial variability in the management of CIEDs before, during, and after RFA for facet joint pain. They emphasized the absence of specific guidelines for percutaneous spinal RFA procedures, despite the existence of multiple guidelines for other spinal interventions. Subsequently, Sowder et al published specific CIED guidelines for these procedures (911).

Friedrich et al (916) reviewed the literature extensively and provided detailed recommendations regarding preprocedural planning, procedural management, and magnet utilization. They also discussed device reprogramming and risk mitigation strategies. The authors noted that only a minority of patients with CIEDs undergoing percutaneous spinal RFA procedures should require magnet use. Table 37 summarizes decision aids for spinal RFA procedures in patients with CIEDs. They cautioned that indiscriminate magnet application is not recommended because application of a

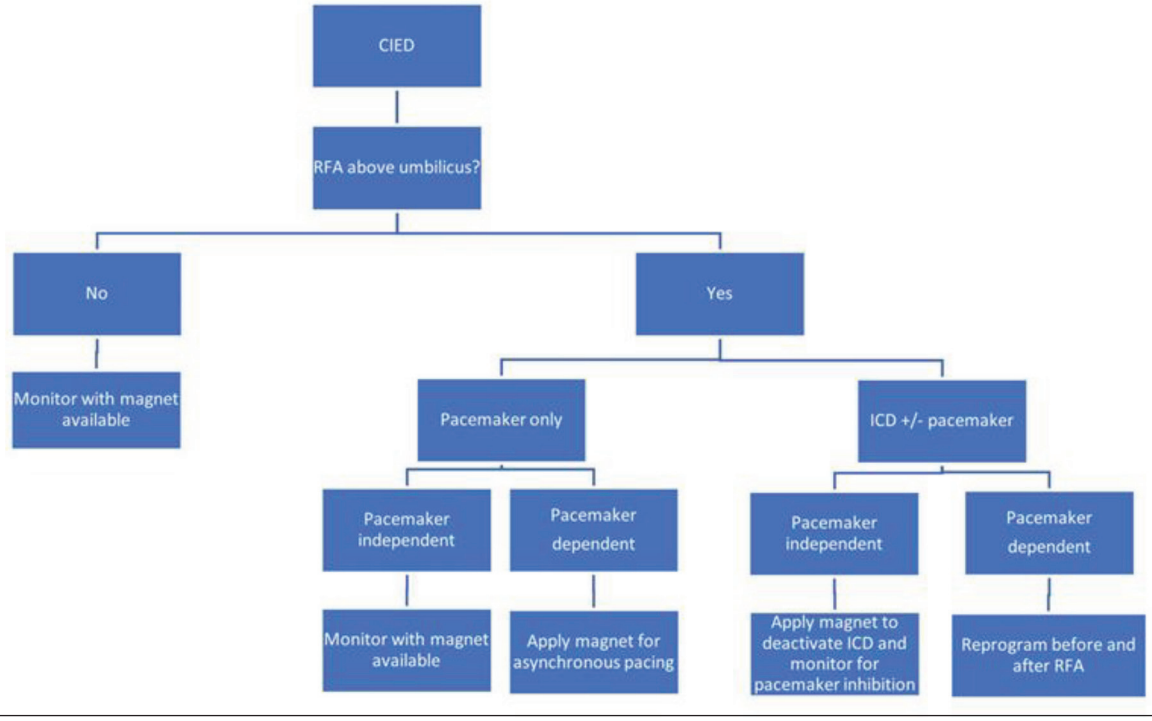


Fig. 38. ***CIED management algorithm.***
Adapted from: Sowder T, Sayed D, Concannon T, et al. The American Society of Pain and Neuroscience (ASPN) guidelines for radiofrequency ablative procedures in patients with implanted devices. *J Pain Res* 2023; 16:3693-3706 (911).

magnet in a patient with a strong competing intrinsic rhythm, particularly one who is not permanent pacemaker (PPM) dependent, could potentially precipitate an arrhythmia (907). In addition, prone positioning during RFA procedures may necessitate additional personnel to maintain appropriate magnet placement.

Magnet application has variable effects depending on the type of implanted device. In patients with ICDs, magnet application disables tachytherapy and shock functions. These effects vary by device type, as summarized in Table 37. Normal ICD function is restored upon magnet removal. In patients with PPMs without ICDs, magnet application activates an asynchronous pacing mode at a manufacturer-specific predetermined rate (Table 38), with return to normal patient-specific settings following magnet removal. In patients with combined ICD and PPM systems, magnet application has no effect on pacemaker function and only suspends ICD function.

The interventional pain physician should consider magnet utilization in patients with ICDs, recognizing that the risk of inappropriate shock is lower when procedures are performed below the umbilicus or when bipolar RFA is utilized. An important exception includes patients with ICDs who are also PPM-dependent and undergoing RFA procedures above the umbilicus, in whom device preprogramming should be considered. In such situations, an electrophysiologist should participate in procedural care to reprogram the device both before and immediately after the procedure (917).

Friedrich et al (916) described multiple risk mitigation strategies. They recommended obtaining a device prescription prior to the procedure to determine in advance what interventions may be required, including monitoring, magnet application, or device reprogramming. The risk of electromagnetic interference is considered low when the entire RF circuit, from the needle to the grounding pad, is maintained at least 15 centimeters away from the CIED components (907-920). The most effective method to reduce RF circuit size is the use of bipolar RFA rather than the more traditional monopolar RFA. If monopolar RFA is utilized, the RF circuit should be minimized, positioned as far from the CIED as possible, and arranged so that the current path does not cross the CIED or its leads.

Table 36. *Cardiac implantable electronic devices manufacturer recommendations.*

Medtronic (912)	Ablation is a surgical technique in which radio frequency (RF) or microwave energy is used to destroy cells by creating heat. Ablation used in cardiac device patients may result in, but is not limited to, induced ventricular tachyarrhythmias, oversensing, unintended tissue damage, device damage, or device malfunction. Pulse-modulated ablation systems may pose higher risk for induced ventricular tachyarrhythmias. Medtronic cardiac devices are designed to withstand exposure to ablation energy. To mitigate risks, observe the following precautions: • Ensure that temporary pacing and defibrillation equipment is available. • Avoid direct contact between the ablation catheter and the implanted system. • Position the return electrode patch so that the electrical current pathway does not pass through or near the device and lead system. • Always monitor the patient during ablation with at least two separate methods, such as arterial pressure display, ECG, manual monitoring of the patient's rhythm (taking pulse) or monitor by some other means such as ear or finger pulse oximetry, or Doppler pulse detection. To avoid or mitigate the effects of oversensing, if appropriate for the patient, initiate asynchronous pacing by implementing one of the following precautions: • Initiate the magnet mode (asynchronous pacing) by placing a magnet over the device. • Program the device to an asynchronous pacing mode (for example, DOO). After the ablation procedure, remove the magnet or restore device parameters.
Boston Scientific (913)	Electrocautery and RFA may induce ventricular arrhythmias and/or fibrillation, and may cause asynchronous pacing, inhibition of pacing, and/or a reduction in pulse generator pacing output possibly leading to loss of capture. RFA may also cause ventricular pacing up to the MTR and/or changes in pacing thresholds. Additionally, exercise caution when performing any other type of cardiac ablation procedure in patients with implanted devices. If electrocautery or RFA is medically necessary, observe the following to minimize risk to the patient and device: • Depending on the pacing needs of the patient, enable the Electrocautery Protection Mode, program to an asynchronous pacing mode, or use a magnet to switch to asynchronous pacing. An option for patients with intrinsic rhythm is to program the Brady Mode to VVI to the rate below the intrinsic rate to avoid competitive pacing. • Have temporary pacing and external defibrillation equipment available. • Avoid direct contact between the electrocautery equipment or ablation catheters and the pulse generator and leads. RFA close to the lead electrode may damage the lead-tissue interface. • Keep the path of the electrical current as far away as possible from the pulse generator and leads. • If RFA and/or electrocautery is performed on tissue near the device or leads, monitor pre- and post-measurements for sensing and pacing thresholds and impedances to determine the integrity and stability of the system. • For electrocautery, use a bipolar electrocautery system where possible and use short, intermittent, and irregular bursts at the lowest feasible energy levels. • RFA equipment may cause telemetry interference between the pulse generator and PRM. If device programming changes are necessary during an RFA procedure, turn off the RFA equipment before interrogation. When the procedure is finished, cancel the Electrocautery Protection Mode in order to reactivate the previously programmed therapy modes.
Abbott (914,915)	Radiofrequency ablation (RFA) in patients with a device may cause any of the following: asynchronous pacing above or below the programmed rate; reversion to an asynchronous operation; device electrical reset; premature triggering of the elective replacement indicator; or device malfunction or damage. Minimize RFA risks by doing the following: • Programming all tachyarrhythmia therapies off • Program a non-rate-responsive, asynchronous pacing mode prior to the RFA procedure. • Avoid direct contact between the ablation catheter and the implanted lead or pulse generator. • Position the ground plate so that the current pathway does not pass near the pulse generator system; in other words, place the ground plate under the patient's buttocks or legs. • Always have a separate standby external defibrillator immediately available. • Have a programmer available
Biotronik Website	In the event that a patient with a BIOTRONIK pacemaker undergoes a surgical procedure that requires the use of electrosurgical cautery or radiofrequency ablation, BIOTRONIK recommends the following: For electrocautery and radiofrequency ablation procedures: • Continuously monitor the patient's cardiac rhythm during the procedure (i.e., via ECG). • Do not apply a magnet to the pacemaker. • Use only short bursts of electrocautery (one second or less). • Program the electrocautery unit to a bipolar mode. If the electrocautery unit is programmed to a unipolar mode, place the grounding pad away from the pacemaker, such as under the buttocks or around the thigh. If possible, the grounding pad should be placed so that the pacemaker and leads are not between the electrocautery wand and the grounding pad. • Electrocautery and radiofrequency ablation should not be performed within 15 cm (6 inches) of the implanted pacemaker. When the pacemaker interprets the electrocautery or radiofrequency ablation as "noise", the device will pace asynchronously at the programmed basic rate, providing pacing therapy regardless of the patient's intrinsic rhythm. In the event that electrocautery or radiofrequency ablation is used within 15 cm (6 inches) of the implanted pacemaker or leads, the device may revert to Back-up mode. If the device goes into the Back-up mode, contact the local BIOTRONIK representative to evaluate and reset the device.

Notes: *Manufacturer guidelines included for reference, but list is not comprehensive and confirmation of device specific recommendations is recommended.

Source: Sowder T, Sayed D, Concannon T, et al. The American Society of Pain and Neuroscience (ASPN) guidelines for radiofrequency ablative procedures in patients with implanted devices. *J Pain Res* 2023; 16:3693-3706 (911).

Table 37. *Decision-aid for spine radiofrequency ablation procedures in patients with cardiac implantable electrical devices (CIEDs)*.*

DEVICE/DEPENDENCY STATUS	PROCEDURE CAUDAL TO UMBILICUS (L3 VERTEBRAE)	PROCEDURE CEPHALAD TO UMBILICUS (L3 VERTEBRAE)
PPM (no ICD)/ Non-dependent	Monitor	Monitor
PPM (no ICD)/Dependent	Monitor	Monitor or apply magnet Consider risk mitigation (i.e. bipolar RFA)
ICD (no PPM)	Apply magnet Monitor	Apply magnet Monitor
ICD and PPM/Non-dependent	Apply magnet to deactivate ICD (no effect on PPM) Monitor	Apply magnet to deactivate ICD (no effect on PPM) Monitor
ICD and PPM/Dependent	Apply magnet to deactivate ICD (no effect on PPM) Monitor	Reprograming needed by cardiology before AND after procedure Monitor

*Decision-aid still requires clinical discretion as exceptions can occur based on individual clinical scenarios.
Source: Friedrich J, Itano EM, Lynn RR. Management of cardiac implantable electrical devices in patients undergoing radiofrequency ablation for spine pain: Physician survey and review of guidelines. *Pain Physician* 2020; 23:E335-E342 (916).

Table 38. *Magnet information for common devices*.*

DEVICE	MAGNET PLACEMENT	MAGNET REMOVAL
PPM (no ICD)	Asynchronous pacing Medtronic: 85 bpm Boston Scientific: 100 bpm St. Jude: 96-100 bpm Biotronik: 90 bpm	Reactivation of previously programed PPM function
ICD (no PPM)	Suspends tachytherapy Audible tone: Medtronic and Boston Scientific No tone: St. Jude and Biotronik	Tachytherapy re-activated Audible tone: Medtronic and Boston Scientific No tone: St. Jude and Biotronik
PPM and ICD	Suspends tachytherapy No effect on PPM	Tachytherapy re-activated No effect of PPM

*Some exceptions possible in older devices
Source: Friedrich J, Itano EM, Lynn RR. Management of cardiac implantable electrical devices in patients undergoing radiofrequency ablation for spine pain: Physician survey and review of guidelines. *Pain Physician* 2020; 23:E335-E342 (916).

During the procedure, use of pacemaker detection and careful telemetry monitoring for bradycardia during stimulation and RFA may help identify PPM dependency, detect electromagnetic interference, and determine the need for magnet utilization. Furthermore, if significant arrhythmia, hypoxia, chest pain, palpitations, or shortness of breath occur, the RFA procedure should be immediately discontinued and appropriate medical management initiated.

When any of these concerns arise, or if procedural difficulties are suspected, or if either the physician or patient is uncomfortable proceeding, patients should instead be treated with therapeutic facet joint nerve blocks rather than RFA, as there is appropriate evidence supporting their effectiveness (35,47), and exemptions from mandatory RFA utilization have been recognized.

Hanna and Abd-Elsayed (921) reviewed the safety of bipolar RFA in patients with chronic pain and implantable cardiac rhythm management devices. Their review included 4 studies (795,922-924), summarized in Table 39. Overall, the available data regarding RFA interactions with ICDs were limited, with only 4 studies identified. These studies included 33 patients undergoing a total of 71 bipolar RFA treatments. No adverse events or interactions between the RF device and ICDs were reported in any patient.

Several observational studies evaluating cardiac RFA in patients with pacemakers or defibrillators provide indirect evidence regarding safety (910,925-927). In these studies, pacemaker malfunctions were observed during RF application, and in some cases, device reprogramming was required following ablation. However, a retrospective evaluation (928) found no significant differences in generator parameters before and after cardiac ablation. Similar findings have also been reported in case reports involving RFA procedures for malignancies (929,930).

The American Society of Anesthesiologists (ASA) guidelines (931) recommend maintaining the high-frequency electric field as far away from the pacemaker electrode as possible. The consensus guidelines (12,13) also recommend maintaining a distance of at least 15

Table 39. *Radiofrequency used for pain and its interaction with CIEDs.*

STUDY	METHOD	PATIENT POPULATION	INTERVENTIONS	OUTCOMES	RESULTS	CONCLUSIONS
Bautista et al, 2016 (795)	Case study	2 patients with complex cardiac histories and AICD devices	Treated with bipolar RFA of the facet joints	Pain score and functionality	No evident complications related to AICD devices. Both patients reported more than 50% sustained pain relief and improvement in their functionality	2 cases of patients with AICD who found relief from their facetogenic pain through bipolar RF lesioning of the medial branch nerves without any complications in relation to AICD"
Barbieri & Bellini, 2014 (922)	Retrospective study	30 patients with implanted medical devices (5 ICD, 5 PM)	Underwent 68 treatments consisting of RFA of the lumbar facet joints, intervertebral discs, sacroiliac joint, and peripheral nerves	The patients' ECGs were monitored before, during, and after the procedure. Also stimulus frequency, pulse duration, intensity of stimulus, interelectrode impedances, and electrode configuration were recorded	No adverse reactions were recorded due to electrical interaction or due to clinical events. Implantable cardioverter defibrillator and pacemaker activity did not suffer any interference. No differences in neurological or cardiac examination after the treatment were reported.	Results suggest that the RF intervention can be safely applied to patients carrying electrical devices
Sun et al, 2004 (924)	Case study	1 patient who presented with a cardiac pacemaker and a 30-yr history of right-sided trigeminal neuralgia not responding to medical therapy	Percutaneous radiofrequency trigeminal rhizotomy	Interaction between RFA and implanted cardiac pacemaker	During the stimulation and the RFA, the usual radiofrequency artifact in the ECG was noted, but the pacemaker output remained continuous, as evidenced by the peripheral pulse waveform on the pulse oximeter plethysmograph; the procedure was completed uneventfully. The patient remained stable throughout. Postoperatively, the pacemaker was interrogated, showing no change in its variables	First reported case of percutaneous radiofrequency of the trigeminal nerve in patient with an implanted cardiac pulse generator with no complications"
Smith et al, 2019 (923)	Expert review	NA	NA	NA	NA	There are no known reports of RFA procedures for spine or other joint pain causing ICD/ pacemaker dysfunction that led to serious injury or death. However, caution is advised in patients who have cardiac pacemakers and defibrillators. If a decision is made to proceed with RFN in these patients, physicians should consider precautions

ECG = electrocardiogram, N/A = not available, PM = pacemaker, RFA = radiofrequency ablation, AICD = automatic implantable cardioverter-defibrillator, ICD = implantable cardioverter defibrillator, RFN = radiofrequency neurotomy

Source: Hanna R, Abd-Elsayed A. Review of the safety of bipolar radiofrequency ablation in patients with chronic pain with implantable cardiac rhythm management devices. *Pain Physician* 2021; 24:E169-E176 (921).

centimeters between the neutral electrode and pacemaker electrodes. The Spinal Interventional Society recommends close collaboration with an experienced cardiologist prior to RF denervation procedures (923).

9.7.1 Strength of Evidence and Recommendations

The **level of evidence is III** with **moderate strength of recommendation** for safety and effectiveness of RFA in patients with cardiac pacemakers with appropriate preparation and precautions, including bipolar RFA and maintenance of distance of 15 cm or 6 inches.

The **level of evidence is II**, **moderate, with moderate to strong strength of recommendation** to treat spinal facet joint pain in patients with cardiac pacemakers with therapeutic facet joint nerve blocks instead of RFA.

9.8 Stimulators and Intrathecal Infusion Systems: Deep Brain, Spinal Cord Stimulators, Peripheral Nerve Stimulators, and Other Implants

Key Question 14: What are the safety precautions to be observed in patients with deep brain stimulators (DBS), spinal cord stimulators (SCS), intrathecal implantables, and other implants?

RFA for chronic pain has been performed in multiple settings for patients with deep brain stimulators, spinal cord stimulators at various spinal levels, intrathecal implantable devices, and other implanted devices including peripheral nerve stimulators, bladder stimulators, Inspire hypoglossal nerve stimulators, and vagus nerve stimulators.

9.8.1 Deep Brain Stimulators

While DBS devices are implanted by neurosurgeons, these patients often present with spinal pain requiring RFA. DBS is approved for various conditions including Parkinson's disease, dystonia, essential tremor, chronic pain, intractable focal epilepsy, and certain neuropsychiatric conditions such as Tourette's syndrome, depression, and obsessive-compulsive disorder (932). The electrodes are typically placed within the basal ganglia, specifically within the subthalamic nucleus, with connecting leads attached to an insulated extension wire tunneled to an implanted pulse generator (IPG), commonly placed in the infraclavicular region. However, the location may vary based on surgeon and patient preference.

Intraoperatively, there is a risk to the DBS system during RFA. The risk occurs during activation of the radio waves, which generate current to heat and ablate the target nerve. In this scenario, the primary concern is inappropriate activation of the stimulator as well as electromagnetic interference that may damage the IPG, rendering the entire system nonfunctional.

Before performing RFA, the system should be turned off or programmed to surgery mode. In addition, the grounding pad should be placed as close as possible to the RFA needle to minimize dispersion of the electrical current. Further, bipolar RFA is the preferred treatment option (932). With shared decision-making, therapeutic facet joint nerve blocks should be considered instead of assuming unnecessary risks (35,47).

9.8.2 Spinal Cord Stimulators

Spinal cord stimulators are widely used in interventional pain management. Traditional SCS devices utilize an array of electrodes implanted in the epidural space, targeting the dorsal columns and specifically stimulating the A-delta fibers. The electrodes at their distal portion are positioned over the dorsal columns. The proximal segment is connected to an internal pulse generator (IPG), which delivers energy to the electrodes. These systems may be implanted percutaneously or through laminectomy using paddle leads. The majority of stimulator leads are placed within the thoracic spine. However, in patients with both thoracic and cervical pain, leads may be placed within the cervical and upper thoracic spine. The IPG is tunneled subcutaneously and positioned either in the low back or abdominal wall.

During the use of a monopolar RFA needle, current travels through the patient and reaches the grounding electrode or pad, which is typically placed on the contralateral side of the body. Increased risk of damage or injury may occur if the RFA needle is positioned too close to the IPG, SCS lead, or surrounding tissue near the leads (933). Using a bipolar RFA needle, which employs one active electrode and one grounding electrode with a shorter inter-electrode distance (5 mm), reduces these risks because it allows more precise and predictable ablation of the target tissue (934).

During intraoperative management of RFA, the primary objective is to minimize electromagnetic interference between the RF cannula and the IPG or stimulator leads. This may be accomplished by reducing the distance between the RF cannula and the grounding pad, ensuring that it is shorter than the distance between the needle and the IPG and/or leads whenever possible.

The IPG may be placed in surgery mode. Bipolar RFA, as described above, is considered the safest technique for performing the intervention. The stimulator should be turned off. Keeping the grounding pad as close to the ablation site as possible minimizes electromagnetic interference. During RFA lesioning, patients should be instructed to report any abnormal sensations. Although concerns exist regarding activation of the stimulator during the procedure, the principal concern is permanent loss of therapy secondary to electromagnetic interference. There have been reported cases of RFA causing interference in patients with implanted neuromodulation devices (935). These events are extremely rare. Precautions include the following:

1. The stimulator should be placed in surgery mode or turned off prior to initiating the procedure.
2. Patients should be monitored for motor activation and pain during lumbar RF procedures, and for pain or paresthesia in the hands during monopolar RF procedures.
3. Patients should remain minimally sedated to preserve adequate communication during the procedure.
4. Sensory and motor testing should begin at 0.1 volts with gradual increases while maintaining continuous communication with the patient.
5. A bipolar technique is considered safer.
6. Additional caution should be exercised, and thoracic RFA should generally be avoided in patients with thoracic leads, while cervical RFA should generally be avoided in patients with cervical leads.
7. LCDs and medical policies also permit the use of therapeutic facet joint nerve blocks.

9.8.3 Other Stimulators

Multiple other stimulators, including PNS, bladder stimulators, vagus nerve stimulators, and hypoglossal nerve stimulators, may be associated with complications similar to those observed with spinal cord stimulators. Consequently, the recommendations remain the same. It is particularly important to follow the manufacturer's recommendations and avoid cervical radiofrequency procedures in patients with cervical leads and hypoglossal nerve stimulators.

9.8.4 Intrathecal Pumps

Intrathecal pumps consist of 2 components: a reservoir pump and a catheter. The pump is anchored within the pump pocket using a suture loop located on the exterior of the device, and the medication to be infused is stored within the pump reservoir. The intrathecal catheter connects to the pump catheter port. The reservoir is typically placed either in the low back or within the abdominal wall.

At present, safety has not been established for RF or microwave ablation in patients with intrathecal implantable systems (ITPs) (936). Strong sources of electromagnetic interference (EMI) may interact adversely with the pump. This interaction may include heating of the implanted pump, resulting in system damage or alterations in pump operation or flow rate. Pump heating may cause tissue injury, recurrence of underlying symptoms, or potentially significant or fatal drug underdose or overdose (936). For intraoperative management, it is recommended that the manufacturer's guidelines for the specific device be reviewed carefully.

When RFA is performed in patients with intrathecal infusion systems, it is essential to identify the location of both the catheter and pump in relation to the planned ablation site. The primary objective is to maintain the greatest possible distance between the RF cannula and all components of the intrathecal pump system.

There is no available literature regarding the safety of bipolar RFA in patients with intrathecal infusion systems. As with other implanted devices, therapeutic facet joint nerve blocks may be considered instead of RFA.

9.8.5 Strength of Evidence and Recommendations

The **level of evidence is III to V with weak strength of recommendation** for performing RFA in patients with implantable stimulators and intrathecal infusion systems in the thoracic and lumbar spine when appropriate safety precautions are utilized, including bipolar RFA and maintenance of distance of 15 cm or 6 inches.

The **level of evidence is V with weak strength of recommendation** for performing RFA in patients with stimulators and pumps implanted in the cervical spine, including hypoglossal nerve stimulators, vagus nerve stimulators, and cervical leads, while utilizing appropriate safety precautions including bipolar RFA and maintenance of a 15 cm distance, which may not always be feasible.

The **level of evidence is II with moderate to strong strength of recommendation** for performing therapeutic facet joint nerve blocks to manage spinal facet joint pain as a substitute for RFA including bipolar and maintenance of distance of 15 cm or 6 inches, particularly in the cervical and thoracic spine, and potentially in the lumbar spine.

10.0 Cost Utility Analysis

Key Question 15: What is the evidence for cost-effectiveness of interventional techniques in managing spinal facet joint pain?

Cost utility analysis has emerged over the years as an important tool in the provision of value-based health care by integrating patient-centered outcomes with the utilization of health care resources (71,72,937-946). Cost utility analysis or cost effectiveness analysis enables policy makers and providers to compare treatment strategies across multiple disciplines and identify relative priorities for optimal resource allocation among various interventions (75-78,937,943-962). In cost analysis, direct costs are relatively simple to calculate; however, indirect costs are considerably more difficult to determine. In interventional pain management, cost utility analysis was calculated based on approximately 60% direct expenses and 40% indirect expenses (71,72,937-941,958,963). This proportion is actually higher than that reported in most analyses, suggesting that cost utility analysis may overestimate rather than underestimate costs. According to the ACA, cost effectiveness is not utilized as a basis for coverage or other analyses in the United States (75-78). However, cost effectiveness and cost utility analyses are frequently utilized as the basis for coverage decisions in other countries, including the United Kingdom (803). These analyses are based on health technology assessment guidance in the United Kingdom. Even though the United States does not openly incorporate cost utility analysis into coverage decisions, the importance of delivering high-quality care at lower cost has been emphasized through numerous public policy initiatives, including the ACA, physician quality reporting systems, value-based payment systems, merit-based incentive payment systems, and accountable interventional pain management (75-78,952).

In the management of low back pain classified as "nonspecific low back pain," incremental cost effectiveness of $4,594 per QALY was demonstrated with physical therapy (964). A favorable cost utility of $2,216 per QALY was reported for spinal stabilization physiotherapy using individual physiotherapy (965). Physiotherapy was also shown to be more cost effective than advice alone in patients with low back pain of 6-week duration, with a cost utility of $6,379 per QALY (966). Furthermore, a study evaluating the cost effectiveness of primary care management, with or without early physical therapy for acute low back pain (947), demonstrated that early physical therapy resulted in higher total one-year costs but improved quality of life after one year. The incremental cost effectiveness ratio in this analysis was $32,058 per QALY. Despite the higher costs associated with early physical therapy, the authors concluded that early physical therapy was a cost-effective modality compared with usual primary care after one year in patients with acute nonspecific low back pain. In addition, the authors of the same study (947) cited observational research demonstrating that delayed referral to physical therapy was associated with increased overall health care costs and a greater likelihood of advanced imaging or invasive procedures for low back pain (961,962,967). Overall analyses of complementary and alternative medical treatments, compared with no treatment, placebo, physical therapy, or usual care for immediate or short-term pain reduction after treatment initiation, demonstrated significantly greater effectiveness with complementary and alternative medicine treatments (949).

With respect to spinal cord stimulators, another study evaluating the management of chronic pain associated with FBSS, complex regional pain syndrome, peripheral arterial disease, and refractory angina pectoris demonstrated costs of CAD $9,293, CAD $11,216, CAD $93,050, and CAD $99,084 per QALY gained for failed back surgery syndrome, complex regional pain syndrome, peripheral arterial disease, and refractory angina pectoris, respectively (956).

Among earlier publications, Kepler et al (953) demonstrated that the one-year cost per QALY gained was less than $100,000 in only 45% of the studies evaluated. In another study, Indrakanti et al (954) reported that greater value was assigned to studies evaluating nonoperative treatments compared with surgical interventions. In a systematic review, highly variable QALY costs were reported, ranging from $304,000 to $579,527, with a median cost of $13,000. In general, surgical interventions represent the highest costs in the management of spinal pain. The most common intervention, surgical lumbar discectomy, demonstrated that operative care provided significant incremental benefit and superior outcomes compared with nonoperative care. Multiple analyses were performed using SPORT trial data. Tosteson et al (963) demonstrated cost effectiveness of surgical treatment for lumbar disc herniation at $69,403 per QALY for the general population and $34,355 per QALY for the Medicare population. They also reported that the cost effectiveness of spinal stenosis surgery (958) was $77,600 per QALY gained, whereas degenerative spondylolisthesis surgery demonstrated a cost of $115,600

per QALY gained. In the cervical spine, cost effectiveness analysis of posterior cervical fusion demonstrated $20,547 per QALY in one study (943), whereas anterior cervical discectomy and fusion in obese patients demonstrated $52,816 per QALY in another study.

Multiple cost utility and cost effectiveness analyses and reviews have been published over the years evaluating treatments for spinal pain ranging from physical therapy to complex surgical fusions (71,72,937-941,943,947-949,953-960,968). However, only a limited number of studies have assessed the cost utility of nonsurgical techniques in the management of neck pain (949-959,963,968).

Among interventional techniques, several clinically relevant and methodologically sound cost utility studies have been performed (71,72,937-941). Figure 39 illustrates the ranges of cost utility analyses for various commonly performed procedures in the United States.

Multiple studies have also analyzed the cost utility of spinal cord stimulation, which has been shown to be effective compared with conventional medical management at a cost of €5,624 per QALY (960). Caudal epidural injections (940) were demonstrated to be effective at a cost of $3,628 per QALY in the management of disc herniation, spinal stenosis, discogenic pain, and post-surgery syndrome, including both direct procedural costs and indirect expenses. Percutaneous adhesiolysis (941) was shown to be effective at a cost of $4,426 per QALY in recalcitrant post-surgery syndrome and spinal stenosis. Lumbar interlaminar epidural injections in the treatment of disc herniation, central spinal stenosis, and axial or discogenic low back pain demonstrated clinical effectiveness with a cost utility of $1,976.58 for direct costs and a total cost of $3,301 per QALY. Cervical interlaminar epidural injections in the treatment of disc herniation, post-surgery syndrome, and axial or discogenic neck pain demonstrated direct costs of $2,267.57 with a total cost of $3,785.89 per QALY. Thoracic interlaminar epidural injections demonstrated direct procedural costs of $1,943.19, whereas the total estimated costs per QALY were $3,245.12.

Utilizing the same methodology employed in the SPORT studies (338,958,963), Manchikanti et al (71,72) performed cost utility analyses of cervical and lumbar therapeutic facet joint nerve blocks and RFA procedures in the management of chronic spinal pain (47,50,645,969-971). The cervical MBB cost utility analysis for managing chronic neck pain (72) was based on direct payment procedural data from a total of 120 patients over a period of 2 years and utilized actual 2016 reimbursement data. The payment data reflected direct procedural costs without inclusion of medication expenses. An additional 40% was added to procedural costs by applying a multiplication factor of 1.67 to estimate total direct and indirect costs based on highly regarded surgical literature (958,963). Outcome measures included significant improvement defined as at least 50% reduction in pain and disability status, as well as a combined 50% or greater reduction in pain and improvement in the NDI. This cost utility analysis demonstrated overall costs of $4,261 per QALY (71). Similarly, therapeutic lumbar facet joint nerve blocks were shown to be cost effective at $4,432 per QALY using estimated overall costs.

Manchikanti et al (71,72) also performed 2 additional cost utility analyses involving lumbar and cervical facet joint nerve blocks together with lumbar and cervical RFAs. In 2022, they published equivalent outcomes (49) comparing lumbar therapeutic facet joint nerve blocks and RFAs through evaluation of clinical outcomes and cost utility. In this STROBE-compliant study, only patients meeting diagnostic criteria for facet joint pain by means of comparative controlled diagnostic local anesthetic blocks with 80% pain relief as the criterion standard were included. The primary outcome measure was pain relief assessed by NRS at 3, 6, and 12 months. Significant improvement was defined as at least 50% improvement in pain relief. Cost utility was calculated utilizing direct procedural payment data with the addition of estimated indirect costs over a one-year period based on highly regarded surgical literature and previously published interventional pain management literature (338,958,963). Cost utility analysis demonstrated an average cost per QALY of $4,664 for lumbar facet joint nerve blocks and $5,446 for lumbar RFA. Similarly, Manchikanti et al (50) published another study in 2022 demonstrating significant improvement in pain relief (≥ 50%) for both groups from baseline to 12 months. The average duration of relief for each cervical medial branch block was 13 to 14 weeks, whereas the relief duration for RFA was 20 to 25 weeks. Significant pain relief was observed in 100%, 94%, and 81% of patients in the MBB group and in 100%, 69%, and 64% of patients in the RFA group at 3-, 6-, and 12-month follow-up, respectively. A significant difference was observed at 6 and 12 months. Cost utility analysis demonstrated an average cost per QALY of $4,994 for cervical MBBs compared with $5,364 for cervical RFA. The authors concluded that cervical therapeutic MBBs demonstrated significantly better outcomes with significant pain relief and comparable costs when compared with cervical RFAs over a one-year period.

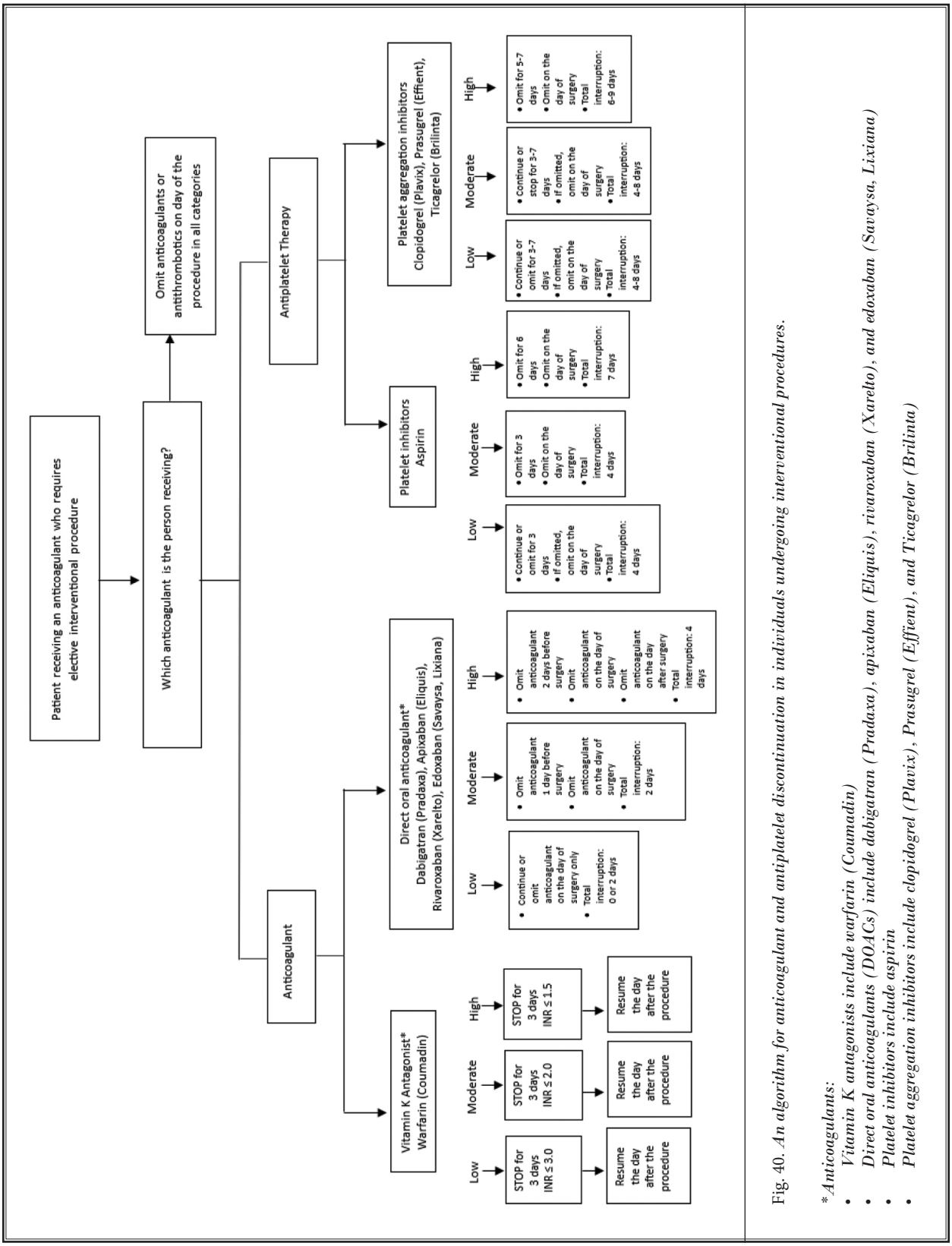


Fig. 40. *An algorithm for anticoagulant and antiplatelet discontinuation in individuals undergoing interventional procedures.*

**Anticoagulants:*

- *Vitamin K antagonists include warfarin (Coumadin)*
- *Direct oral anticoagulants (DOACs) include dabigatran (Pradaxa), apixaban (Eliquis), rivaroxaban (Xarelto), and edoxaban (Savaysa, Lixiana)*
- *Platelet inhibitors include aspirin*
- *Platelet aggregation inhibitors include clopidogrel (Plavix), Prasugrel (Effient), and Ticagrelor (Brilinta)*

Sittimart et al (970) published a cost utility analysis of RFA among patients with facet joint-related chronic low back pain in Thailand. However, this study concluded that RFA was not cost effective compared with conservative treatment in Thailand. Nevertheless, the authors recognized that RFA therapy resulted in improved health outcomes compared with standard treatment and helped reduce the economic burden associated with pain and potentially unnecessary back surgeries. They recommended that RFA should be considered for incorporation into the Thailand health benefit package. The lack of cost utility may have been related to the public health system in Thailand and the high service costs hospitals incur in managing these patients in various settings.

In 2021, Hambraeus et al (969) published a cost effectiveness analysis of RFA for facet joint pain. The study was conducted in an interventional pain management clinic in Sweden. A total of 331 patients underwent RFA and were followed for one year. Data were collected from national registers, allowing the authors to determine healthcare costs, medication costs, patient time and travel costs, and patient work capacity. The effects of RFA on QALY and cost per QALY gained were calculated. The results demonstrated significant improvement in health-related quality of life (HRQOL). An EQ-5D index result of 0.530 with a *P* value of 0.0001 indicated highly significant improvement in health-related quality of life. Drug consumption and specialized healthcare utilization were reduced by 54% and 81%, respectively, and the cost per QALY gained from a societal perspective was 221,324 Swedish Krona, equivalent to $26,008 U.S. dollars. Sensitivity analysis demonstrated that the treatment was cost effective in all evaluated scenarios using patients as their own controls. The cost per QALY gained from a healthcare perspective was 72,749 Swedish Krona (USD $8,548). The authors concluded that RFA is a cost-effective treatment meeting Swedish National Board of Health and Welfare criteria for a high-priority treatment. Compared with the United States, these costs are substantially higher. As demonstrated in the United States, lumbar RFA cost analysis demonstrated a QALY of $5,446.

In contrast, Cohen et al (645) evaluated the cost utility of RFA using no diagnostic blocks versus a single diagnostic block versus 2 diagnostic blocks. The primary purpose of this study was to evaluate the effectiveness of diagnostic MBBs. The study included 151 patients with suspected lumbar facet joint pain. Group 0 underwent radiofrequency denervation based solely on clinical findings; Group 1 underwent denervation contingent upon a positive response to a single diagnostic block; and Group 2 proceeded to denervation only after a positive response to comparative blocks performed with lidocaine and bupivacaine. A positive outcome was predefined as ≥ 50% pain relief combined with a positive global perceived effect persisting for 3 months. Denervation success rates were 33% in the group without diagnostic blocks, 39% in the group with a single block, and 64% in the group with comparative blocks. They demonstrated that the cost for successful treatment without diagnostic blocks ranged from $60 to $86, whereas the cost with a single diagnostic block was $17,142 and with comparative blocks was $15,241. Unfortunately, this study evaluated only costs without adequately considering outcomes. Furthermore, the reported costs appear extremely high compared with average costs in the United States. Consequently, the overall value of this analysis is limited.

In 2020, Maas et al (971) published an economic evaluation conducted alongside 3 pragmatic multicenter, nonblinded randomized clinical trials (RCTs) in The Netherlands with 52-week follow-up. Participants had chronic low back pain, a positive diagnostic block at the facet joints (n = 251), sacroiliac (SI) joints (n = 228), or a combination of facet joints, SI joints, and intervertebral discs (n = 202), and were unresponsive to initial conservative care. Quality-adjusted life-years (QALYs) and societal costs were measured using self-reported questionnaires. Missing data were imputed using multiple imputation, and bootstrapping was utilized to estimate statistical uncertainty. Their results demonstrated that after 52 weeks, there was no difference in costs between groups in the facet joint or combination RCTs. Total costs were significantly higher for the intervention group in the SI joint RCT. The maximum probability of RFA being cost effective when added to a standardized exercise program ranged from 0.10 in the facet joint RCT to 0.17 in the SI joint RCT irrespective of the ceiling ratio, and 0.65 at a ceiling ratio of €30,000 per QALY in the combination RCT. The authors concluded that although the findings were equivocal among patients with symptoms involving a combination of facet joints, SI joints, and intervertebral discs, the evidence suggested that radiofrequency denervation combined with a standardized exercise program could not be considered cost effective from a societal perspective for patients with chronic low back pain originating from either facet or SI joints in a Dutch healthcare setting.

11.0 Side Effects and Adverse Consequences

11.1. General Side Effects

Key Question 16. What are the side effects and adverse consequences of facet joint interventions?

The literature addressing safety, adverse consequences, complications, harms, and appropriate precautions for facet joint interventions is sparse. Facet joint interventions include intraarticular injections, facet joint nerve blocks, and facet joint ablation. Although complications are rare, the most common and concerning complications are related to needle placement and drug administration. These complications include bleeding with or without intravascular entry, infection, dural puncture and spinal anesthesia, neural trauma, spinal cord trauma or infarction, pneumothorax, radiation exposure, hematoma formation, neuropathic pain following RFA, steroid-related side effects, and sedation (45,66,720,972-993). In one report evaluating adverse events related to intraarticular facet joint steroid injections, Kim et al (973) reviewed procedures performed from January 2007 to December 2017 and reported that approximately 12,000 facet joint steroid injections were performed in a radiology department. There were 6,066 patients with a mean age of 66.8 years, ranging from 15 to 97 years. All procedures were performed by a radiologist and involved the administration of steroids and local anesthetic. They reported 101 facet joint injection-related adverse events in 99 patients, with an overall incidence of adverse events of 0.84% per case and 1.63% per patient. The incidence of procedure-related complications and drug-related systemic adverse events was 0.07% in 8 patients and 0.15% in 18 patients, respectively. Events of uncertain etiology occurred in 0.63% or 75 of 11,980 procedures. All 8 procedure-related events involved major complications, including 7 cases of infectious spondylitis, one of which progressed to systemic aspergillosis of the spine. One patient died from uncontrolled infection secondary to infective endocarditis, and 2 patients experienced partial recovery with neurological sequelae. The authors concluded that the overall incidence of facet joint injection-related adverse events is low and that procedure-related major complications are rare in the absence of dural puncture or epidural hematoma. Nevertheless, they emphasized that infection can occur and may result in serious outcomes.

The majority of reported complications have been presented as case reports in which intravascular injections, bleeding, and infection were evaluated (973-978). In a review evaluating the incidence of intravascular penetration during cervical, thoracic, and lumbar MBBs over a 3-year period, the overall incidence of intravascular penetration during facet joint nerve blocks was reported as 3.5% (974). A total of 14,312 separate MBBs were performed during the review period. The authors demonstrated differential risks for intravascular injection at various spinal levels. The risk of intravascular injection was 3.9% for cervical spine MBBs, 3.7% for lumbar spine MBBs, and 0.7% for thoracic spine MBBs (974). In another investigation involving 1,433 lumbar MBBs, intravascular penetration was demonstrated in 6.1% of procedures (975). Another study also demonstrated 6.1% inadvertent intravascular injections during lumbar spine MBBs (976). One of the largest prospective evaluations of facet joint nerve blocks, involving 7,500 episodes and 43,000 MBBs, demonstrated no major complications (972). The procedures were performed in sterile operating room settings within ASCs. Multiple side effects and complications were observed. Intravascular penetration occurred in 11.4% of episodes, with 20% occurring in the cervical region, 4% in the lumbar region, and 6% in the thoracic region. Other complications included local bleeding in 76.3% of episodes, with the highest bleeding risk occurring in the thoracic region and the lowest in the cervical region. Similarly, oozing was noted in almost 20% of encounters. Local hematoma formation was observed in only 1.2% of patients. Profuse bleeding, bruising, soreness, nerve root irritation, and other effects such as vasovagal reactions were observed in 1% or fewer episodes.

Kim et al (973) demonstrated that intraarticular facet joint steroid injections are associated with a low incidence of adverse events and rare major complications. However, most current literature (13) does not support the use of these injections. When steroids are utilized, factors such as patient weight, immunosuppression, hormonal imbalance, and adrenal suppression should be considered.

Overall, adverse events have primarily been reported in case studies; however, intravascular injections, bleeding, and infection have also been evaluated in larger studies (973-978). Intravascular penetration during cervical, thoracic, and lumbar MBBs occurred with an incidence ranging from 3.5% to 6.1% (974-976). Local bleeding occurred in 76.3% of cases, with oozing reported in nearly 20% (972). Local hematomas were rare at 1.2%, whereas other effects such as profuse bleeding,

bruising, soreness, and nerve root irritation occurred in 1% or fewer cases (972).

Reported complications of RFA include worsening pain, dysesthesia, and decreased sensation. Cases of inadvertent lesioning of the spinal nerve or ventral ramus have resulted in motor deficits, sensory loss, and deafferentation pain. Dropped head syndrome has been reported in several cases as a rare complication following multilevel bilateral cervical RFA (994-996). In addition, patients may experience bowel and bladder dysfunction, Brown-Sequard syndrome, and spinal cord infarction (979-993).

Spinal epidural abscess is rare, with an estimated annual incidence of 0.2 to 2.8 per 10,000 individuals (997,998). It has been postulated that the incidence may be increasing because of the growing use of invasive spinal procedures. Abscesses may arise from multiple sources, including contiguous spread from vertebral osteomyelitis, hematogenous dissemination, or direct inoculation during a surgical procedure (999). Reported risk factors include immunosuppression, intravenous drug use, diabetes mellitus, HIV, trauma, tattooing, and bacteremia (998,1000). Spinal epidural abscesses produce a mass effect on the underlying spinal cord, nerves, and vascular structures, leading to pain and, in some cases, neurological impairment or cord infarction (998-1001). Clinical presentation is often nonspecific and may include malaise, fever, back pain, and neurological deficits. Spinal epidural abscesses have been reported following multiple interventional techniques, including facet joint interventions and epidural steroid injections (1002-1005). Only a few documented cases of epidural abscess following RFA have been reported. Epidural abscess is considered rare because the electrodes are placed to ablate the facet joints, and the epidural space is not intentionally accessed during RFA. Consequently, epidural abscess represents a rare and unexpected complication. Two published case reports are available in the literature (998,1003). The literature also describes epidural abscess formation following facet joint injections (987,1003,1004), in which intraarticular facet joint injections may represent a unique risk because of the proximity of the ventral joint capsule to the ligamentum flavum (1006). The capsule itself may serve as a nidus of infection. In a retrospective review and case series of patients with septic arthritis of the facet joint, Ross et al (1007) reported that epidural abscesses were present in 56% of patients. There is also a report of spinal abscess occurring in patients with diabetes mellitus undergoing epidural catheter replacement followed by PRF for herpes zoster (1008). Although spinal epidural abscesses may develop in healthy individuals, multiple risk factors increase susceptibility, particularly immunocompromised states. Unfortunately, epidural abscesses may also develop in patients without major risk factors. Multiple unpublished anecdotal reports of infection and epidural abscess formation following facet joint interventions, specifically RFA, have also been described.

Local anesthetic and steroid-related side effects may be clinically significant. In general, steroids are not extensively utilized in facet joint interventions except in very small doses. The effectiveness of steroids has been shown to be minimal and remains controversial. Steroids are indicated only in intraarticular injections; however, intraarticular injections have not demonstrated significant positive outcomes in any spinal region. Despite their limited use, issues related to increased weight, fat redistribution, immunosuppression, hormonal imbalance, and adrenal suppression require monitoring.

There are no RCT-reported deaths following RFA. Likewise, no serious or life-threatening complications have been reported. Several studies specifically noted that no complications occurred (727,729,741,1009,1010). In one study (728), the incidence of pain, sensory disturbances, and motor deficits in the RF group was compared with that in the sham group, with no significant differences observed. In an RCT evaluating RF denervation in the cervical spine, Lord et al (772) reported sensory disturbances in 5 of 12 patients following RF denervation. One patient with psoriatic arthritis developed Koebner's phenomenon following RFA.

In an observational study involving 26,151 interventions, including 181 MBBs and 86 RFAs, 11 procedures were terminated prematurely, primarily because of vasovagal reactions, pain, and persistent vascular uptake, while 5 vasovagal syncopal episodes were observed during MBBs (1011). Neurological complications and bleeding events did not occur. Another observational study reported pain or neuropathic pain lasting longer than 2 weeks in 1% of patients undergoing RFAs (1012). These complications were generally self-limited and classified as mild. No additional serious complications were reported. In a review by Engel et al (57) evaluating RF denervation of the cervical spine according to GRADE criteria, 4 observational studies were assessed regarding risks. Although the quality of evidence was low, no serious complications were identified.

The available studies demonstrate that prolonged pain is the most common complication following RFA (728,1012), followed by sensory disturbances

(728,772,1013). Neuropathic pain was previously described by Bogduk (1014) in a case report. In cases involving denervation of the third occipital nerve (TON), ataxia has been described as a typical temporary side effect (782,783), and temporary sensory disturbances or dysesthesia (782) have been reported in many patients. In a study by Gazelka et al (1015), neuralgia following RFA of the TON was reported in 12 of 64 patients without neurological deficits.

Skin burns due to extensive lesioning (1016), issues related to the neutral electrode (1017), or malfunction of the RF generator (1018) are possible and have been described in case reports (1019,1020). There may be an increased risk with cooled RF because of the larger lesion size (1021) and with strip electrodes (1016).

Injuries to the lumbar spinal nerves are rare. A single case report described radicular L5 pain and sensory disturbances following RFA (1022). Bogduk et al (1023) described 2 unpublished spinal cord injuries following cervical RFA, one resulting in Brown-Sequard syndrome and the other in infarction likely related to coagulation of an artery supplying the spinal cord within the foramen. Donohue and White (1024) described thoracic spinal cord changes following thoracic spine RFA, although the mechanism of injury could not be clarified. In medical fields where there is a lack of high-quality clinical trials to guide treatment and limited consensus regarding best practices, the development of comprehensive guidelines becomes increasingly important.

Williams et al (1025), in a prospective observational study, assessed whether RFA alone was inferior to RFA combined with steroids for post-procedure pain. Among 365 participants who completed baseline assessments, 175 received steroids and 190 did not. Pain intensity at 7 days post-procedure was similar between the steroid and non-steroid groups, with a mean difference of –0.23. The 95% CI of the estimate (–0.76 to 0.30) remained within the prespecified noninferiority margin of 1.5 NRS points. Similar results were obtained at 60 days, with a mean difference of 0.09 and a 95% CI of –0.48 to 0.65. No significant differences between groups were observed for anxiety, depression, or physical function at either 7 or 60 days. The authors concluded that the addition of steroids to RFA procedures did not provide additional benefit and therefore was not justified given the additional risks associated with steroid administration.

Fitzpatrick et al (1026) reviewed the issue of post-neurotomy neuritis, describing it as neuropathic pain often characterized by a sunburn-like sensation with variable pain patterns lasting up to 6 months. In a prospective study evaluating the value of local corticosteroid administration following RFA on the incidence of post-neurotomy neuritis (1026), 39 patients undergoing 47 RFAs were evaluated. Nineteen patients received corticosteroids following 25 RFAs, whereas the remaining 21 patients underwent 22 RFAs without corticosteroids. The results demonstrated no statistically significant differences between groups when comparing post-RFA Douleur Neuropathique 4 Questions (DN4) scores. However, the authors also reported that the incidence of post-neurotomy neuritis in their study population was 0% in both treatment groups. Consequently, the practical applicability of this study may be limited.

In a second study, Singh et al (1027) investigated the incidence of post-neurotomy neuritis in patients who received corticosteroids following RFA compared with those who did not receive corticosteroids. Overall, 164 patients were evaluated, including 87 in the non-steroid group and 77 in the steroid group. The proportion of patients with post-neurotomy neuritis was 5 of 77 patients (6.4%) in the steroid-treated group and 6 of 87 patients (6.9%) in the non-steroid group. Consequently, no significant differences were observed between the groups.

Thus, both studies demonstrated no significant benefit associated with post-procedure steroid administration.

Table 40 shows potential side effects and complications of facet joint interventions.

Table 40. *Potential side effects and complications of facet joint interventions.*

Pain • Pain at the site of the needle insertion • Exacerbation of existing pain • Pain in the spine	Trauma • Soft tissue • Medial branch • Nerve root • Spinal cord • Pneumothorax
Infection • Soft tissue abscess • Epidural abscess • Facet joint abscess • Meningitis • Encephalitis	Inadvertent injection • Dural puncture • Subdural injection • Epidural injection • Foraminal injection • Intravascular injection
Bleeding • Soft tissue hematoma • Epidural hematoma • Spinal cord hematoma • Nerve root sheath hematoma	Radiofrequency • Nerve root ablation • Spinal cord ablation • Dysesthesias • Allodynia • Dropped head syndrome
Steroid effects	Hypoesthesia
Local anesthetic effects	

12.0 Precautions and Safety

Multiple issues related to safety and precautions must be considered, including appropriate diagnosis, sterile preparation, technical parameters, safety considerations in patients with implantable devices or metallic implants, and management of anticoagulant therapy.

12.1 Anticoagulant Therapy and Facet Joint Interventions

Key Question 17: What are the precautions in patients on anticoagulant and antiplatelet therapy while performing facet joint interventions?

12.1.1 Risks in Facet Joint Interventions

ASIPP conducted a comprehensive review with an extensive literature search (16,66) to analyze multiple guidelines and develop recommendations specific to interventional techniques and their associated bleeding risks. These recommendations are influenced by multiple factors, including patient-specific risk profiles and the clinical judgment of the treating physician (16,66,1028-1033). Thromboembolic events must also be considered, as all interventional procedures carry some degree of bleeding risk. Appropriate clinical correlation with the patient's medical history, social history, and individual risk factors is essential.

12.1.2 Safe and Efficient Administration of Facet Joint Interventions

The use of facet joint interventions in patients receiving anticoagulants and antiplatelet therapy is increasing (66). This trend necessitates a multidisciplinary approach to appropriately balance the importance of anticoagulation therapy with the requirements of interventional procedures, including the timing, discontinuation, or temporary interruption of therapy (66). Anticoagulants and antiplatelet agents are commonly prescribed to reduce thromboembolic risk in patients with conditions such as angina, atherosclerosis, atrial fibrillation, cerebrovascular accidents, ischemic heart disease, myocardial infarction, pulmonary embolism, and peripheral vascular disease. Management strategies may include continuation of oral anticoagulants, transition to alternative agents, addition of antiplatelet therapy, performance of left atrial appendage closure, or combinations of these approaches (1034).

The 2024 ASIPP updated guidelines provide consensus-based recommendations regarding the perioperative management of antiplatelet and anticoagulant therapy in patients undergoing interventional procedures. These guidelines are based on best evidence synthesis, evaluation of bleeding risks, assessment of practice patterns, and perioperative management strategies (66). Risk stratification for interventional procedures incorporates anatomic considerations, procedural factors, bleeding risk factors, anticoagulant and antiplatelet-related risks, as well as medical and physiological risk factors. Table 41 summarizes factors associated with increased bleeding risk (1035).

12.1.3 Determination of Timing of Anticoagulant Interruption

The timing of anticoagulant use and its interruption is a critical consideration and varies among specialties and authors. Table 42 presents sample recommended preoperative withholding times for oral antiplatelet and anticoagulant medications as reported in the literature (1036). Figure 40 illustrates an algorithm for discontinuation of anticoagulant and antiplatelet therapy in patients undergoing interventional procedures.

Figure 41 depicts recommended perioperative withholding times for antiplatelet and anticoagulant medications based on recommendations from various authorities. For high-risk procedures, aspirin, clopidogrel (Plavix), and prasugrel (Effient) are discontinued 6 days before the procedure and may be resumed the following day. Ticagrelor (Brilinta) is discontinued 5 days before the procedure and resumed the day after the procedure. For intermediate- or moderate-risk procedures, aspirin is discontinued 3 days prior to the procedure, clopidogrel (Plavix) 5 days prior, prasugrel (Effient) 5 days prior, and ticagrelor (Brilinta) 3 days prior. Recommendations for low-risk procedures are variable, and these medications may either be continued or withheld based on clinical judgment and procedural risk.

Figure 42 presents the perioperative management of patients receiving direct oral anticoagulants during interventional procedures. For high-risk patients, direct oral anticoagulants are interrupted for 2 days before the procedure, on the day of the procedure, and for one day following the procedure, totaling 4 days of interruption, except in patients with creatinine clearance $\leq$ 50 mL/min. In such patients, dabigatran (Pradaxa) is discontinued for 4 days before the procedure and re-

sumed on the second day after the procedure, resulting in a total interruption period of 6 days. For intermediate- or moderate-risk patients, preprocedural cessation consists of 2 days, including the day before and the day of the procedure, with resumption on the following day. In this category, dabigatran is interrupted for 2 days with resumption on the first postoperative day, totaling 3 days of interruption. For low-risk patients, cessation is generally not required; however, modifications may be considered based on individual patient variables, following intermediate-risk recommendations when indicated.

Regarding warfarin (Coumadin), Douketis et al (1037,1038) recommend continuation for procedures associated with minimal bleeding risk. For low- to moderate-bleeding-risk procedures, warfarin is withheld for 5 days with bridging therapy, although the guidance notes limited benefit associated with bridging. For interventional procedures, interruption for one to 3 days is recommended to achieve an optimal INR ≤ 3.0 for low-risk procedures, 2 to 3 days with an INR ≤ 2.0 for intermediate-risk procedures, and 3 to 5 days with an INR ≤ 1.5 for high-risk procedures. Bridging with low molecular weight heparin may be considered for high-risk procedures such as SCS and intrathecal implantable device placement. Bridging therapy may be managed by a cardiologist or, when appropriate, by the interventional pain physician.

Based on these considerations, ASIPP guidance has developed an algorithmic approach for interventional procedures in patients receiving anticoagulant or antiplatelet therapy, as illustrated in Fig. 40.

12.1.4 Guidelines for Managing Anticoagulant and Antiplatelet Therapy During Interventional Techniques

ASIPP guidelines and recommendations are based on a comprehensive review of the literature address-

Table 41. *Factors associated with increased bleeding risk.*

Need for oral anticoagulation in addition to dual antiplatelet therapy
Advanced age (older than 75 years)
Frailty
Anemia with hemoglobin < 110 g/L
Chronic renal failure (creatinine clearance < 40 mL/min)
Low body weight (<60 kg)
Hospitalization for bleeding within past year
Previous stroke/intracranial bleed
Regular need for NSAIDs or prednisone

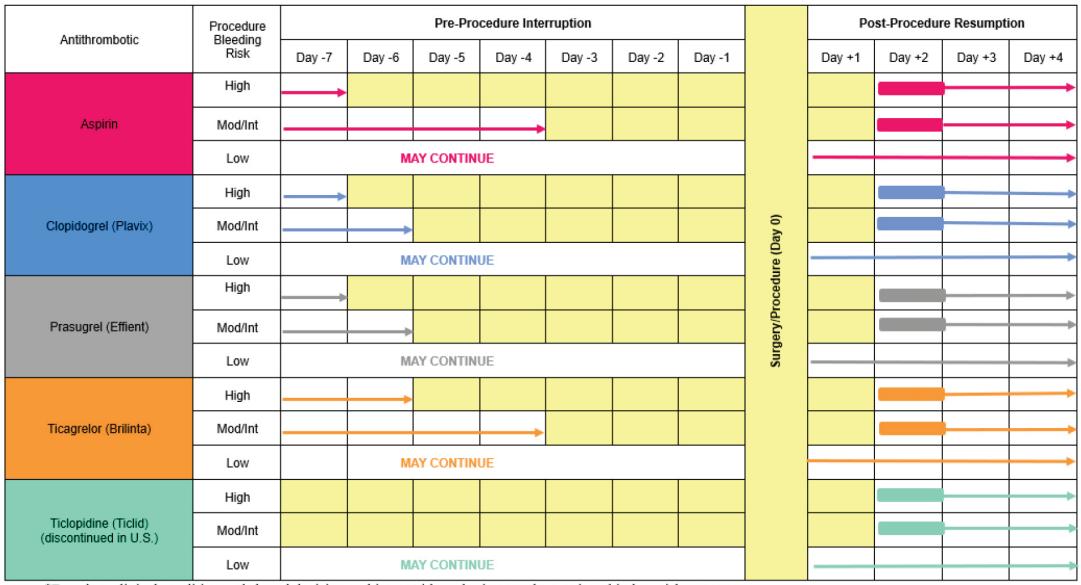
NSAIDs: nonsteroidal anti-inflammatory drugs
Source: Mehta SR, Bainey KR, Cantor WJ, et al; members of the Secondary Panel. 2018 Canadian Cardiovascular Society/Canadian Association of Interventional Cardiology focused update of the guidelines for the use of antiplatelet therapy. *Can J Cardiol* 2018; 34:214-233 (1035).

Table 42. *Recommended preoperative withholding times of oral antiplatelet and anticoagulant drugs.*

Drug	Half-life	Time to withhold prior to		Time to restart after	
		Minor surgery	Major surgery	Minor surgery	Major surgery
Warfarin (Coumadin)	20–60 h	3–5 days*	3–5 days	24 h, overlapping therapy with heparin	48–72 h; overlapping therapy with heparin
Apixaban (Eliquis)	8–15 h	24 h**	48 h**	24 h	24–48 h
Rivaroxaban (Xarelto)	5–9 h (Elderly: 11–13 h)	24 h**	48 h**	24 h	24–48 h
Edoxaban (Savaysa, Lixiana)	10–14 h	24 h**	48 h**	24 h	24–48 h
Betrixaban (Bevyxxa)	19–27 h	≥ 4 days	≥4 days	24 h	24–48 h
Dabigatran (Pradaxa)	12–17 h	CrCl > 50 mL: 24 h CrCl < 50 mL: 72 h	CrCl > 50 mL: 72 h CrCl < 50 mL: 120 h	24 h	24–48 h
Aspirin	7–10 days	usually continued	usually continued	usually continued	usually continued
Clopidgrel (Plavix)	7–10 days	5–7 days	5–7 days	24 h	24–48 h
Prasugrel (Effient)	7–10 days	5–7 days	5–7 days	24 h	24–48 h
Ticagrelor (Brilinta)	5–7 days	3–5 days	3–5 days	24 h	24–48 h

*In some cases, continued drug administration is feasible
**In case of impaired renal function, withholding interval should be prolonged and/or drug level should be evaluated by laboratory tests
CrCl: creatinine clearance

Adapted and modified: Moster M, Bolliger D. Perioperative guidelines on antiplatelet and anticoagulant agents: 2022 update. *Curr Anesthiol Rep* 2022; 12:286-296 (372).

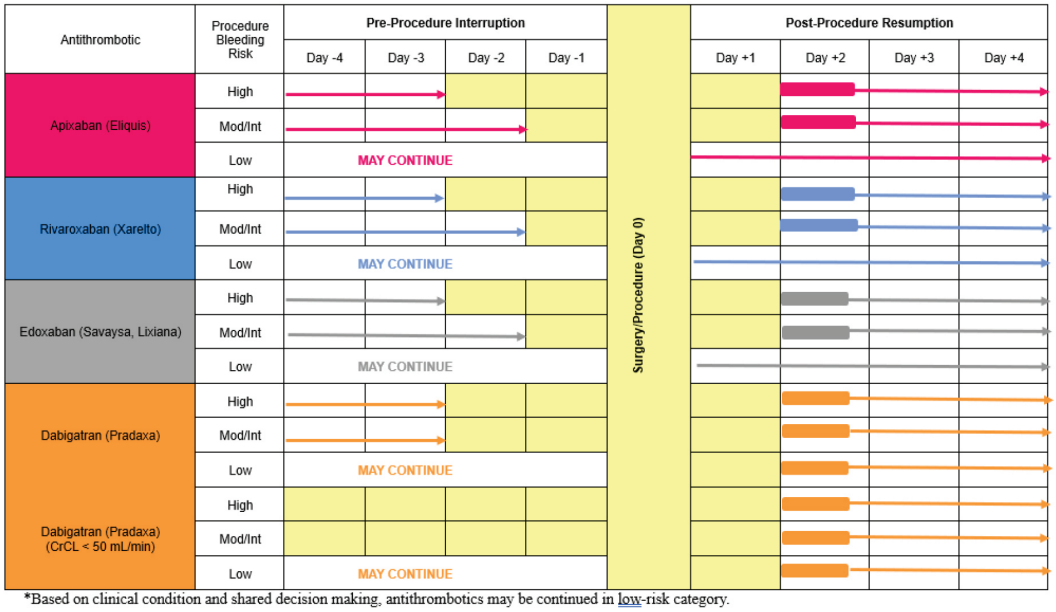


*Based on clinical condition and shared decision making, antithrombotics may be continued in low-risk category.

No antithrombotic administered that day

*DOAC can be resumed ~24 hours after low/moderate-bleed-risk procedures, and 48-72 hours after high-bleed-risk procedures. In selected patients at high risk for VTE, low-dose anticoagulants (i.e., enoxaparin, 40 mg daily or dalteparin, 5,000 IU daily) can be given for the first 48-72 hours post-procedure.

Fig. 41. *Perioperative management of antiplatelet or anticoagulant drugs for interventional procedures.*



*Based on clinical condition and shared decision making, antithrombotics may be continued in low-risk category.

CrCl = creatinine clearance

No DOAC administered that day

*DOAC can be resumed ~24 hours after low/moderate-bleed-risk procedures, and 48-72 hours after high-bleed-risk procedures. In selected patients at high risk for VTE, low-dose anticoagulants (i.e., enoxaparin, 40 mg daily or dalteparin, 5,000 IU daily) can be given for the first 48-72 hours post-procedure.

Fig. 42. *Perioperative management of interventional techniques in patients on direct oral anticoagulants (DOACs).*

ing thromboembolic risk, bleeding risk, anatomical considerations, procedural factors, and medical or physiological status. Previous guidelines related to interventional pain management, general surgery, endoscopy, and ophthalmic surgery from multiple organizations were also reviewed. Table 43 presents recommended management strategies for antiplatelet and anticoagulant medications during interventional procedures (66), whereas Table 44 provides a procedural checklist for the management of anticoagulant and antiplatelet therapy during interventional techniques.

Table 43. *ASIPP guidelines for antithrombotic medication management and interventional techniques.*

MEDICATION	Time to Wait After Last Dose of Medication Before Interventional Techniques Are Performed			Timing of Therapy Restoration or Restarting
	LOW RISK PROCEDURES	MODERATE OR INTERMEDIATE RISK PROCEDURES	HIGH-RISK PROCEDURES	
	• Trigger point and intramuscular injections • Peripheral nerve blocks • Sacroiliac joint injections • All facet joint interventions (intra-articular injections, medial branch and L5 dorsal ramus nerve blocks and radiofrequency neurotomy) • Intraarticular injections of extremities • Pocket revision and implantable pulse generator/intrathecal pump replacement • Peripheral nerve stimulation trial and implantation of extremities and other superficial nerves • Lumbar transforaminal epidural injections at L3, L4, L5, and S1 • Ganglion impar blocks • Sacroiliac joint nerve radiofrequency • Trigeminal branch nerve blocks (mandibular, maxillary, and other branches)	• Caudal epidural injections • Caudal epidural adhesiolysis • Lumbar interlaminar epidural at L5, S1 • Cervical, thoracic, and lumbar transforaminal at L1 and L2 • Peripheral nerve stimulation trial and implantation of lumbar medial branches	• Cervical, thoracic, and lumbar (above L5) interlaminar epidurals • Peripheral nerve stimulation trial and implantation of thoracic and cervical medial branches • Trigeminal ganglion, ophthalmic division, and sphenopalatine ganglion blocks • Discography and intradiscal procedures • Dorsal column and dorsal root ganglion stimulator trial and implantation • Intrathecal catheter and pump implant • Vertebral augmentation • Percutaneous and endoscopic disc decompression procedures • Minimally invasive lumbar decompression (MILD) • Trigeminal and cranial nerve blocks and stimulation • Sympathetic blocks (stellate ganglion, thoracic sympathetic, splanchnic, celiac plexus, lumbar sympathetic, hypogastric plexus) • Percutaneous adhesiolysis with interlaminar or transforaminal approach (cervical, thoracic, and lumbar) • Intervertebral spinous prosthesis including lateral fusion • SI joint fusion • Intracept procedure	
NSAIDS (COX 1) (COX 2)	May continue or stop 1-10 days due to lack of protective effect	May continue or stop 1-10 days due to lack of protective effect	May continue or stop 1-10 days due to lack of protective effect	24 hours
THC/CBD	May continue or stop 1-10 days	May continue or stop 1-10 days	Stop for 5 days	24 hours
Garlic	Continue or may stop for 3 days	Continue or may stop for 3 days	Stop for 6 days	24 hours
Vitamin E	Continue or may stop for 3 days	Continue or may stop for 3 days	Stop for 6 days	24 hours
Fish Oil	Continue or may stop for 3 days	Continue or may stop for 3 days	Stop for 6 days	24 hours

Table 43 cont. *ASIPP guidelines for antithrombotic medication management and interventional techniques.*

MEDICATION	Time to Wait After Last Dose of Medication Before Interventional Techniques Are Performed			Timing of Therapy Restoration or Restarting
	LOW RISK PROCEDURES	MODERATE OR INTERMEDIATE RISK PROCEDURES	HIGH-RISK PROCEDURES	
Aspirin				
Low-Dose Aspirin	Continue or may stop for 3 days	Continue or may stop for 3 days	Stop for 6 days	24 hours
High Dose Aspirin	Continue or may stop for 3 days	Continue or may stop for 3 days	Stop for 6 days	24 hours
Antiplatelet Agents (Phosphodiesterase Inhibitors)				
Dipyridamole (Persantine)	May continue	May continue	May continue or stop for 2 days	12 hours
Cilostazol (Pletal)	May continue	May continue	May continue or stop for 2 days	12 hours
Aggrenox (dipyridamole plus aspirin)	May continue	May continue	Stop for 6 days	24 hours
Platelet Aggregation Inhibitors				
Clopidogrel (Plavix)	May continue	May continue or stop for 5 days	Stop for 6 days	12 hours
Prasugrel (Effient)	May continue	May continue or stop for 5 days	Stop for 6 days	24 hours
Ticagrelor (Brilinta)	May continue	May continue or stop for 3 days	Stop for 5 days	24 hours
Vitamin K Antagonists				
Warfarin	May continue or stop for 1-2 days INR ≤ 3.0	May continue or stop for 2-3 days INR ≤ 2.0	Stop for 3-5 days INR ≤ 1.5	12-24 hours
Direct Oral Anticoagulants (DOACs)				
Dabigatran (Pradaxa)	May continue or stop for 1 day	Stop for 2 days	Stop for 2 days	24 hours
Dabigatran (Pradaxa) (CrCl ≤ 50 ml/min)	May continue or stop for 1 day	Stop for 3-4 days	Stop for 3-4 days	24 hours
Apixaban (Eliquis)	May continue or stop for 1 day	Stop for 1 day	Stop for 2 days	24 hours
Rivaroxaban (Xarelto)	May continue or stop for 1 day	Stop for 1 day	Stop for 2 days	24 hours
Edoxaban (Savaysa, Lixiana)	May continue or stop for 1 day	Stop for 1 day	Stop for 2 days	24 hours
Heparins				
Heparin (treatment) - IV	Discontinue for 4 hours	Discontinue for 4 hours	Discontinue for 4 hours	24 hours
Heparin (treatment) - SC	Discontinue for 6 hours	Discontinue for 6 hours	Discontinue for 24 hours	24 hours
Low Molecular Weight Heparin	Discontinue for 24 hours	Discontinue for 24 hours	Discontinue for 24 hours	24 hours

Adapted and modified from: Manchikanti L, Sanapati MR, Nampiaparampil D, et al. Perioperative management of antiplatelet and anticoagulant therapy in patients undergoing interventional techniques: 2024 updated guidelines from the American Society of Interventional Pain Physicians (ASIPP). *Pain Physician* 2024; 27:S1-S94 (66).

Table 44. *Procedural checklist for managing anticoagulant and antiplatelet therapy during interventional techniques.*

PROCEDURE:
1.0 Patient evaluation and Identification of Risk Factors ❑ 1.1 Age ❑ 1.2 Diabetes ❑ 1.3 Bleeding disorders ❑ 1.4 Hypertension ❑ 1.5 Obesity ❑ 1.6 Low body weight ❑ 1.7 Renal disease ❑ 1.8 Low creatinine clearance
2.0 Identification of Anticoagulant or Antithrombotic Medication ❑ 2.1 Aspirin Use: • Primary Prophylaxis: Absence of established cardiovascular disease or risk factor • Secondary Prophylaxis: Presence of cardiovascular or cerebrovascular disease ❑ 2.2 Antiplatelets • Clopidogrel (Plavix) • Prasugrel (Effient) • Ticagrelor (Brilinta) ❑ 2.3 Direct oral anticoagulants (DOACs) • Dabigatran (Pradaxa) • Apixaban (Eliquis) • Rivaroxaban (Xarelto) • Edoxaban (Savaysa, Lixiana) ❑ 2.4 Warfarin (Coumadin) ❑ 2.5 Identification of over-the-counter drugs influencing thrombolysis: • Garlic • Vitamin E ❑ 2.6 Fish Oil • Primary Prophylaxis: Absence of established cardiovascular disease or risk factor • Secondary Prophylaxis: Presence of cardiovascular or cerebrovascular disease ❑ 2.7 SSRIs • Citalopram (Celexa) • Fluoxetine (Prozac) • Escitalopram (Lexapro) • Paroxetine (Paxil) • Sertraline (Zoloft) ❑ 2.8 NSAIDs
❑ 3.0 Risk Stratification and Recommendations • Low risk • Moderate or intermediate risk • High risk
❑ 4.0 Informed Decision Making
❑ 5.0 Restarting of Drugs
❑ 6.0 Postoperative Monitoring

13.0 Guidelines for Diagnostic and Therapeutic Interventions

Key Question 18: What are the guidelines for diagnostic interventions in managing spinal facet joint pain?

Key Question 19. What are guidelines for therapeutic interventions in managing spinal facet joint pain?

Key Question 20. What are the guidelines for type and frequency of diagnostic and therapeutic facet joint interventions in managing chronic spinal pain?

The diagnostic interventions are based on nonconservative approaches following the failure of appropriate conservative management and the use of diagnostic facet joint interventions. Therapeutic interventions are based on establishing an appropriate diagnosis of spinal facet joint pain.

The approach described herein is based on the best available evidence regarding the epidemiology of various identifiable sources of chronic spinal pain (383,385,1039-1041). This approach is intended to promote the efficient utilization of IPM techniques based on the best available evidence. However, it may not be applicable to every patient. The purpose of the described algorithmic approach is to provide a disciplined framework for the utilization of spinal interventional techniques in the management of spinal pain. This framework includes evaluation, diagnostic, and therapeutic approaches, which in turn help avoid unnecessary care as well as poorly documented practices.

This approach does not establish a standard of care; rather, these are guidelines. Furthermore, because of space limitations, comprehensive initial evaluations and all associated findings are not included.

13.1 Local Coverage Determination Policies and Medical Policies

An LCD is a determination by a Medicare Administrative Contractor (MAC) regarding whether a particular item or service is covered on a contractor–wide basis in accordance.

13.1.1 Coverage Indications, Limitations, and/or Medical Necessity

Facet joint interventions generally consist of four types of procedures: Intraarticular (IA) facet joint injections, medial branch blocks (MBB), radiofrequency ablations (RFA) and facet cyst rupture/aspiration:

Facet joint interventions are considered medically reasonable and necessary for the diagnosis and treatment of chronic pain in patients who meet **ALL** the following criteria:

1. Moderate to severe chronic neck or low back pain, predominantly axial, that causes functional deficit measured on pain or disability scale*
2. Pain present for minimum of 3 months with documented failure to respond to noninvasive conservative management (as tolerated)
3. Absence of untreated radiculopathy or neurogenic claudication (except for radiculopathy caused by facet joint synovial cyst)
4. There is no non-facet pathology per clinical assessment or radiology studies that could explain the source of the patient's pain, including but not limited to fracture, tumor, infection, or significant deformity.

   *Pain assessment must be performed and documented at baseline, after each diagnostic procedure using the same pain scale for each assessment. A disability scale must also be obtained at baseline to be used for functional assessment (if patient qualifies for treatment).

13.1.2. Diagnostic Facet Joint Procedures (IA or MBB):

The primary indication of a diagnostic facet joint procedure is to diagnose whether the patient has facet syndrome. Intraarticular (IA) facet block(s) are considered reasonable and necessary as a diagnostic test only if medial branch blocks (MMB) cannot be performed due to specific documented anatomic restrictions or there is an indication to proceed with therapeutic intraarticular injections. These restrictions must be clearly documented in the medical record and made available upon request.

Diagnostic procedures should be performed with the intent that if successful, radiofrequency ablation (RFA) procedure would be considered the primary treatment goal at the diagnosed level(s). (**In patients with implants, therapeutic intraarticular injections, or MBB may be provided. Added by Guideline Panel).

A second diagnostic facet procedure is considered medically necessary to confirm validity of the initial diagnostic facet procedure when administered at the same level. The second diagnostic procedure may only

be performed a minimum of 2 weeks after the initial diagnostic procedure. Clinical circumstances that necessitate an exception to the two-week duration may be considered on an individual basis and must be clearly documented in the medical record.

For the first diagnostic facet joint procedure:

a. For the first diagnostic facet joint procedure to be considered medically reasonable and necessary, the patient must meet the criteria outlined under indications for facet joint interventions.
b. A second confirmatory diagnostic facet joint procedure is considered medically reasonable and necessary in patients who meet **ALL** the following criteria:
    i. The patient meets the criteria for the first diagnostic procedure; **AND**
    ii. After the first diagnostic facet joint procedure, there must be a consistent positive response of at least 80% relief of primary (index) pain (with the duration of relief being consistent with the agent used)

Frequency limitation: For each covered spinal region no more than four (4) diagnostic joint sessions will be reimbursed per rolling 12 months, in recognition that the pain generator cannot always be identified with the initial and confirmatory diagnostic procedure.

13.1.3 Therapeutic Facet Joint Procedures (IA or MBB):

Therapeutic facet joint injections are considered medically reasonable and necessary for patients who meet ALL the following criteria:

a. The patient has had two (2) medically reasonable and necessary diagnostic facet joint procedures with each one providing a consistent minimum of 80% relief of primary (index) pain (with the duration of relief being consistent with the agent used); **AND**
b. Subsequent therapeutic facet joint procedures at the same anatomic site results in at least consistent 50% pain relief for at least three (3) months from the prior therapeutic procedure or at least 50% consistent improvement in the ability to perform previously painful movements and ADLs as compared with baseline measurement using the same scale; **AND**
c. Documentation of why the patient is not a candidate for radiofrequency ablation (such as established spinal pseudarthrosis, implanted electrical device)

Frequency Limitations: For each covered spinal region, no more than four (4) therapeutic facet joint sessions will be reimbursed per rolling 12 months.

13.1.3.1 Facet Joint Denervation:

The thermal radiofrequency destruction of cervical, thoracic, or lumbar paravertebral facet joint (medial branch) nerves are considered medically reasonable and necessary for patients who meet the following criteria:

a. Initial thermal radiofrequency destruction after the patient has had at least two (2) medically reasonable and necessary diagnostic MBBs, with each one providing a consistent minimum of 80% sustained relief of primary (index) pain (with the duration of relief being consistent with the agent used)
b. Repeat thermal facet joint RFA at the same anatomic site is considered medically reasonable and necessary provided the patient had a minimum of consistent 50% improvement in pain or consistent improvement in the ability to perform previously painful movements and ADLs as compared with baseline measurement using the same scale for at least six (6) months

Frequency Limitation: For each covered spinal region, no more than two (2) radiofrequency sessions will be reimbursed per rolling 12 months.

13.1.3.2 Facet Cyst Aspiration/Rupture

Intraarticular facet joint injection performed with synovial cyst aspiration is considered medically necessary when both of the following criteria are met:

1. Advanced diagnostic imaging study (e.g. MRI/CT/myelogram) confirm compression or displacement of the corresponding nerve root by a facet joint synovial cyst; **AND**
2. Clinical and physical symptoms related to synovial facet cyst are documented

Frequency Limitation: Cyst aspiration/rupture may be repeated **once** per individual cyst and only if there is 50% or more consistent improvement in pain for at least three (3) months.

13.1.4 Limitations

1. Facet joint interventions done without CT or fluoroscopic guidance are considered not reasonable and necessary. This includes facet joint interven-

tions done without any guidance, performed under ultrasound guidance, or with MRI.

2. Use of Moderate or Deep Sedation, General Anesthesia, and Monitored Anesthesia Care (MAC) is not considered medically reasonable and necessary during facet injections
3. The use of Moderate Sedation for RFA or cyst rupture/aspiration will be considered in individual cases with documentation of medical necessity such as a longstanding well-documented history of inability to cooperate, medical conditions that would prohibit performance of the procedure, or inability to remain motionless. Patient anxiety or preference alone is not sufficient justification. Routine use of Moderate Sedation or Monitored Anesthesia Care (MAC) or use of General Anesthesia or Deep Sedation for RFA is not considered reasonable and necessary.
4. It is not expected that patients will routinely present with pain in both cervical/thoracic and lumbar spinal regions. Therefore, facet joint interventions (both diagnostic and therapeutic) are limited to one spinal region per session.
5. It is not routinely necessary for multiple blocks (e.g., epidural injections, sympathetic blocks, trigger point injections, etc.) to be provided to a patient on the same day as facet joint procedures. Multiple blocks on the same day could lead to improper or lack of diagnosis. If performed, the medical necessity of each injection (at the same or a different level[s]) must be clearly documented in the medical record. For example, the performance of both paravertebral facet joint procedures(s) and a transforaminal epidural injection (TFESI) at the same or close spinal level at the same encounter would not be expected unless a synovial cyst is compressing the nerve root. In this situation, TFESI may provide relief for the radicular pain, while the facet cyst rupture allows nerve root decompression. Frequent reporting of multiple blocks on the same day may trigger a focused medical review.
6. Facet joint intraarticular injections and medial branch blocks may involve the use of anesthetic, corticosteroids, anti-inflammatories and/or contrast agents, and does not include injections of biologicals or other substances not FDA designated for this use.
7. One to two levels, either unilateral or bilateral, are allowed per session per spine region. Three or four-level procedures are not medically necessary and therefore are non-covered. A session is a time period, which includes all procedures (i.e., medial branch block (MBB), intraarticular injections (IA), facet cyst ruptures, and RFA ablations that are performed during the same day.
8. If there is an extended time, two years or more, since the last RFA and there is a question as to the source of the recurrent pain then diagnostic procedures must be repeated.
9. Therapeutic facet injections are not covered unless there is justification in the medical documentation on why RFA cannot be performed. Facet joint procedures in patients for the indication of generalized pain conditions (such as fibromyalgia) or chronic centralized pain syndromes are considered not reasonable and necessary. Individual consideration may be considered under unique circumstances and with sufficient documentation of medical necessity on appeal.
10. In patients with implanted electrical devices, providers must follow manufacturer instructions and extra planning as indicated to ensure safety of procedure.

    The following are considered not reasonable and necessary and therefore will be denied:

    1. Intraarticular and extraarticular facet joint prolotherapy
    2. Non-thermal modalities for facet joint denervation including chemical, low-grade thermal energy (less than 80 degrees Celsius), laser neurolysis, and cryoablation.
    3. Intra-facet implants
    4. Facet joint procedure performed after anterior lumbar interbody fusion or ALIF.
    5. Definitive clinical and/or imaging findings pointing to a specific diagnosis other than facet joint syndrome
    6. Diagnostic injections or MMB at the same level as the previously successful RFA procedure

Note: The scales used for measurement of pain and/or disability must be documented in the medical record. Acceptable scales include but are not limited to: verbal rating scales, Numerical Rating Scale (NRS) and VAS for pain assessment, and Pain Disability Assessment Scale (PDAS), ODI, Oswestry Low Back Pain Disability Questionnaire (OSW), Quebec Back Pain Disability Scale (QUE), Roland Morris Pain Scale, Back Pain Functional Scale (BPFS), and the PROMIS profile domains to assess function.

Notice: Services performed for any given diagnosis

must meet all the indications and limitations stated in this policy, the general requirements for medical necessity as stated in CMS payment policy manuals, all existing CMS national coverage determinations, and all Medicare payment rules.

13.2 Documentation Requirements

13.2.1 Conservative Management Prior to Diagnostic Blocks

Conservative management of facet joint pain represents a critical initial step prior to considering more invasive treatments, including diagnostic blocks. The goals of conservative management are to reduce pain, improve functional status, and prevent the need for invasive procedures. Multiple noninterventional therapies are supported by evidence demonstrating effectiveness in the short-term management of facet joint pain.

13.2.1.1 Physical Modalities

Multiple modalities include physical therapy or occupational therapy, chiropractic care, ESWT, and structured exercise programs.

Physical therapy is among the most commonly recommended conservative treatments for facet joint pain. Targeted exercise programs focusing on strengthening the muscles surrounding the spine, improving flexibility, and promoting appropriate posture may help reduce mechanical stress on the facet joints. Hayden et al demonstrated that physical therapy, including manual therapy and exercise, significantly improved outcomes in patients with facet joint-related low back pain (225).

13.2.1.2 Nonsteroidal Anti-Inflammatory Drugs (NSAIDs)

NSAIDs, such as ibuprofen and naproxen, are frequently prescribed to reduce inflammation and pain associated with facet joint dysfunction. Multiple studies have demonstrated that NSAIDs are effective in providing short-term pain relief, making them a fundamental component of conservative treatment. NSAIDs have shown well-documented benefits in the management of facet joint pain, particularly when combined with physical therapy (732,1042). However, because of the potential for long-term adverse effects, including gastrointestinal complications, NSAIDs should be administered at the lowest effective dose and for the shortest possible duration.

Manual therapy, including spinal manipulation, is commonly utilized by physical therapists and chiropractors for the management of facet joint pain. Multiple studies have reported that spinal manipulation may provide moderate improvement in pain relief and functional status in patients with facet joint-related low back pain, especially in those with acute or subacute symptoms (237,1043). Nevertheless, careful patient selection is essential, as spinal manipulation may not be suitable for all individuals.

13.2.1.3 Psychological Interventions and Cognitive Behavioral Therapy (CBT)

Facet joint pain, particularly when chronic, may contribute to secondary psychological conditions such as anxiety and depression, which can further intensify the perception of pain. Cognitive Behavioral Therapy (CBT) has been shown to assist patients in managing these psychological factors by modifying pain-related thoughts, emotions, and behaviors (1044-1046).

13.2.1.4 TENS (Transcutaneous Electrical Nerve Stimulation)

TENS therapy involves the application of low-voltage electrical currents to relieve pain through stimulation of nerve fibers and modulation of pain signal transmission. Although the evidence regarding the effectiveness of TENS for facet joint pain remains mixed, several studies have demonstrated that it may provide pain relief and improve functional status in patients with back pain (1047,1048).

13.2.1.5 Documentation of Interventional Procedures

All spinal interventional techniques are considered surgical procedures (385,1049,1050).

Documentation requirements are as follows:

- History and physical examinations.
- Indications and medical necessity.
- Intra-operative procedural description.
- Post-operative monitoring and ambulation orders.
- Discharge/disposition.

13.2.1.6 Physical Assessment and Documentation of Findings

The physician's history should include the following elements:

- Documentation of the signs and symptoms warranting the interventional procedure.
- A listing of the patient's current medications including dosages, route, and frequency of admission.

- Any existing co-morbid conditions and previous surgeries.
- Documentation of any social history or conditions which would have an impact on the patient's care upon discharge from the facility following the procedure.

The physician's physical examination should reflect not only the appropriateness of the interventional procedure, but also the type of anesthesia planned. In general, for interventional techniques performed without anesthesia, the physical examination is limited to an assessment of the patient's mental status and an examination specific to the proposed procedure, including evaluation of any co-morbid conditions (385,1049,1050).

However, when intravenous sedation or another form of anesthesia is planned, the physical examination should additionally include documentation of the findings from cardiovascular and pulmonary examinations, along with an assessment and written statement regarding the patient's overall health status, in addition to the assessment of mental status and the procedure-specific examination, including any co-morbid conditions (1049).

13.2.1.7 Imaging

At a minimum, imaging evaluation should include x-rays and advanced imaging with CT or MRI to assess for discogenic pathology, as well as other potential pain generators or procedural hazards. Additional imaging modalities may be utilized when appropriate, provided there is adequate documentation supporting the indications and medical necessity.

13.2.1.8 Procedural Documentation

This includes documentation of the procedure performed, post-operative monitoring, and discharge/disposition (385,1049-1052) (Table 45).

It is essential to document both preoperative and postoperative pain scores following diagnostic blocks using pain rating scales and the percentage of pain relief, in addition to documenting the patient's ability to perform previously painful movements for both diagnostic blocks.

It is also essential to document preoperative and postoperative pain levels, as well as the patient's ability to perform previously painful movements, such as extension and lateral rotation, following therapeutic interventions.

Table 45. *Procedural documentation guidelines for interventional techniques.*

1. History and physical
2. Indications and medical necessity
3. Description of the procedure Consent Monitoring Sedation Positioning Site preparation Fluoroscopy Drugs utilized Needle placement Complications
4. Post-operative monitoring
5. Discharge and instructions

14.0 Recommendations and Statements

Non-interventional Diagnosis:

1. The **level of evidence is II** for selecting patients for facet joint nerve blocks after at least 3 months of pain onset and failure of conservative management in patients demonstrating axial pain, tenderness over the facet joints, reduced range of motion with exacerbation of pain during extension and lateral rotation, pain relief with rest, and absence of a radicular pattern, with **strong strength of recommendation** for physical examination and assessment.
2. The **level of evidence is III** for the accurate diagnosis of facet joint pain by physical examination based on symptoms and signs, with **strong strength of recommendation**.
3. The **level of evidence is I with strong strength of recommendation** for mandatory fluoroscopic or computed tomography (CT) guidance for all facet joint interventions.
4. The **level of evidence is III** supporting the use of SPECT in identifying painful facet joints prior to diagnostic facet joint nerve blocks, with **weak strength of recommendation**.
5. The **level of evidence is V with weak strength of recommendation** for scintigraphy, MRI, and CT in identifying painful facet joints.

Interventional Diagnosis:

6. Lumbar Spine: The **level of evidence is I to II with moderate to strong strength of recommendation** for diagnosing lumbar facet joint pain and performing lumbar diagnostic facet joint nerve blocks.
7. Cervical Spine: The **level of evidence is II with moderate strength of recommendation** for the diagnosis of cervical facet joint pain by performing cervical diagnostic facet joint nerve blocks.
8. Thoracic Spine: The **level of evidence is II with moderate strength of recommendation** for the diagnosis of thoracic facet joint pain by performing thoracic diagnostic facet joint nerve blocks.
9. The **level of evidence is II** supporting the application of interventional diagnostic approaches during the chronic phase of pain after 3 months from onset, following failure of conservative modalities including medical management, structured exercise programs, and physical therapy, with noninvasive diagnostic assessment leading to diagnostic facet joint nerve blocks, with **strong strength of recommendation**.
10. The **level of evidence is III** for the influence of psychological factors affecting the diagnosis with **moderate strength of recommendation** to exercise caution in patients with combined depression, anxiety, and somatization disorder.
11. The **level of evidence is II** indicating that intraoperative opioids may affect the diagnostic validity of facet joint nerve blocks, with **strong strength of recommendation** to avoid opioids.
12. The **level of evidence is II** demonstrating that benzodiazepines do not affect the validity of diagnostic facet joint nerve blocks, with **moderate strength of recommendation** that they may be utilized in low doses for mild sedation.
13. The **level of evidence is III** indicating that mild sedation may be required and utilized during facet joint interventions, with **moderate strength of recommendation** for providing sedation during therapeutic interventions.
14. The **level of evidence is III** indicating that the prevalence of facet joint pain and false-positive results may be higher in patients with involvement of multiple regions, that the prevalence of facet joint pain is lower in post-surgery syndrome, and that older patients have a higher prevalence of facet joint pain, with **moderate strength of recommendation** to consider these factors when establishing diagnosis and therapy.

Therapeutic Facet Joint Interventions:

15. Radiofrequency Ablation:
    - The **level of evidence is II with moderate strength of recommendation** for the clinical effectiveness of cervical RFA.
    - The **level of evidence is III with weak to moderate strength of recommendation** for the clinical effectiveness of thoracic RFA.
    - The **level of evidence is II with moderate strength of recommendation** for the clinical effectiveness of lumbar RFA.
16. Therapeutic Intraarticular Injections:
    - The **level of evidence is III** for short-term improvement and V for long-term improvement, with **weak strength of recommendation** for the clinical effectiveness of cervical intraarticular facet joint injections.
    - The **level of evidence is III with weak to moderate strength of recommendation** for the clinical effectiveness of thoracic intraarticular facet joint injections.

- The **level of evidence is IV with weak strength of recommendation** for the clinical effectiveness of lumbar facet joint intraarticular injections.

17. Therapeutic Facet Joint Nerve Blocks:
    - The **level of evidence is II with moderate strength of recommendation** for the clinical effectiveness of therapeutic cervical facet joint nerve blocks.
    - The **level of evidence is II with moderate strength of recommendation** for the clinical effectiveness of thoracic therapeutic facet joint nerve blocks.
    - The **level of evidence is II with moderate strength of recommendation** for the clinical effectiveness of therapeutic lumbar facet joint nerve blocks.

Special Considerations:

18. Repeat Facet Joint Interventions:
    The **level of evidence is II, with moderate to strong strength of recommendation** for the safety and effectiveness of repeat facet joint interventions, including RFA, with outcomes comparable to the initial procedures.
19. Impact of Temperature, Duration of Lesioning, and Size of the Lesion:
    The **level of evidence is II with strong strength of recommendation** regarding the impact of temperature, lesion duration, and lesion size when procedures are performed using an 18-gauge cannula in the lumbar spine and a 20-gauge cannula in the cervical and thoracic spine, with an active tip of 10 mm in the lumbar spine and 5 or 10 mm in the cervical and thoracic spine.
20. Type of Electrodes and Needles:
    The **level of evidence is IV with no specific recommendation** regarding the use of a particular type of electrode or needle for RFA.
21. Position of the Electrode:
    The **level of evidence is IV with weak strength of recommendation** for placement of the electrode either parallel or perpendicular to the nerve.
22. Stimulation Parameters:
    The **level of evidence is II, or moderate, with strong strength of recommendation** for performing either motor or sensory stimulation testing prior to RFA.
23. Radiofrequency Ablation in Patients with Metallic Implants:
    The **level of evidence is IV with weak strength of recommendation** for performing RFA in patients with metallic implants.
24. Radiofrequency Ablation in Patients with Cardiac Implantable Devices:
    - The **level of evidence is III with moderate strength of recommendation** for the safety and effectiveness of RFA in patients with cardiac pacemakers when appropriate preparation and precautions are utilized, including bipolar RFA and maintenance of distance of 15 cm or 6 inches.
    - The **level of evidence is II with moderate to strong strength of recommendation** in patients with cardiac pacemakers who have demonstrated positive dual therapeutic facet joint nerve blocks instead of RFA.

Stimulators and Intrathecal Infusion Systems: Deep Brain (DBS), Spinal Cord Stimulators (SCS), and Other Implants:

25. The **level of evidence is III to V with weak strength of recommendation** for performing RFA in patients with implantable stimulators and intrathecal infusion systems while utilizing appropriate safety precautions, including bipolar RFA and maintenance of a distance of 15 cm or 6 inches.
26. The **level of evidence is V with weak strength of recommendation** for performing RFA in patients with stimulators and pumps implanted in the cervical spine, including hypoglossal nerve stimulators, vagus nerve stimulators, and cervical leads, while utilizing appropriate safety precautions, including bipolar RFA and maintenance of a distance of 15 cm, although this distance may not always be feasible.
27. The **level of evidence is II** including bipolar RFA and maintenance of distance of 15 cm or 6 inches with **moderate to strong recommendation** for performing therapeutic facet joint nerve blocks as a substitute for RFA in the management of spinal facet joint pain, particularly in the cervical and thoracic spine, and potentially in the lumbar spine.

Antithrombotic Therapy:

28. Facet joint interventions are considered moderate to low risk procedures; consequently, antithrombotic therapy may be continued based on the patient's overall clinical status.

Sedation:

29. The **level of evidence is III** indicating that mild sedation may be required and utilized during the performance of facet joint interventions, with **moderate strength of recommendation**.
30. The **level of evidence is III** that moderate sedation or monitored anesthesia care may be required for RFA, with **moderate strength of recommendation**.

15.0 Conclusion

In summary, these guidelines provide a comprehensive and evidence-based framework for the diagnosis and management of spinal facet joint pain. By incorporating systematic reviews of the literature, methodological rigor, and graded recommendations, the guidelines offer clinicians practical and scientifically supported guidance for both diagnostic and therapeutic interventions. Although the current evidence supports the clinical utility of facet joint nerve blocks and RFA in appropriately selected patients, limitations persist because of the relative lack of high-quality studies in several areas. Consequently, ongoing research and well-designed clinical trials are necessary to further strengthen the evidence base and refine clinical decision-making. Nevertheless, these guidelines represent a valuable resource for promoting safe, effective, and standardized care in interventional pain management.

Acknowledgments

The authors wish to thank Tonie M. Hatton, Diane E. Neihoff, and Melinda "Mindy" D. Adams, transcriptionists, for their assistance in preparation of this article. We would like to thank the editorial board of *Pain Physician* for review and criticism in improving the article.

Funding

There was no external funding in the preparation of the guidelines. Internal funding provided by the American Society of Interventional Pain Physicians (ASIPP) was limited to preparation of the publication.

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Conflict of Interest

Dr. Singh received grants to the institution from NIH and Woven Health Collectives; is speaker honoraria for Tennessee Pain Society and North American Neuromodulation Society; receives support for attending meters or travel from Tennessee Pain Society, North American Neuromodulation Society, American Society of Regional Anesthesia and Pain Medicine, American Society of Interventional Pain Physicians, American Society of Pain and Neuroscience, Indian Society of Study of Pain and Indian Society of Anesthesiology.

Dr. Soin has several patents in non-opioid pain pharmaceuticals and neuromodulation (SCS and PNS) and artificial intelligence, has leadership roles: OHSIPP-CEO and ASIPP- Director, has stock options with Neuros Medical, has received equipment, materials, drugs, medical writing, gifts or other services from Avanos for research, and has other financial or nonfinancial interests with Alyea Therapeutics, Neuros Medical, Neuronoff, and Avanos.

Dr. Navani is a board member and shareholder of Semnur Pharmaceutical.

Dr Christo is part of The Alliance for Patient Advocacy. No compensation.

Dr. Ferguson receives consulting fees from Boston Scientific, consultant for spinal cord stimulator and Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid for Wisconsin State Medical Board, Board member.

Dr. Bottros receives consulting fees and payments or honoraria from Avanos, Averitas, Boston Scientific and Vertex

Dr. Shah is a consultant for SPR Therapeutics & Vertex Pharma.

Dr Abdi receives grants from NIH/NCI- R21 (PI), NIH/HIDDK-R44 (MPI), DoD (Co-I), NIH-R01 (site Co-I), DSMB officer for NIH/NIAMS, Specialty Chief Editor- Frontiers in Pain Research/Cancer Pain

Dr. Calodney receives consulting fees from Medtronic, Vertos, Companion Spine and PainTeq, payment or honoraria for lectures, presentations, speakers, bureaus, manuscript writing or educational events from Nevro, Boston Scientific and Relievant.

Dr. Gupta receives payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or education from Vertex Pharmaceuticals, Pain Speaker Bureau – non fiduciary – payment to institution; Participation on a Data Safety Monitoring Board or Advis for Semnur Pharmaceuticals Scientific Advisory Board- non fiduciary – payment to intuition and KSIPP President, Board of Directors – non-fiduciary – volunteer; Leadership or fiduciary role in society, committee or advocacy group or unpaid, ASIPP Director-at-Large Board of Directors 2025-2027 – nonfiduciary – volunteer and NANS PNS Guidelines Committee – non-fiduciary – volunteer.

Dr. Wargo received payment or honoraria for lectures, presentations, speaker, manuscript writing or educations expended from Vertex Pharmaceuticals and Leadership of fiduciary role in other board, society, committee, advocacy group or unpaid from

AOA- Bureau of Osteopathic Specialists and AOA American Osteopathic Board of Anesthesiologists

Dr. Kalia receives consulting fees from Abbott; support for attending meeting and travel from North American Spine Society (NASS), North American Neuromodulation Society, (NANS) and American Society of Pain & Neuroscience (ASPN).

Dr. Schwartz receives consulting fees from Pacira, Virtex for Smart alpha, payment or honoraria for lectures, presentations, speakers bureau, manuscript writing or educational expenses from Pacira, Vertex, leadership or fiduciary role Subcommittee Chair FASA ASA- Unpaid, AMA Delegate- ASRA PM unpaid, Industry Relations Chair ASRA-PM unpaid and hold stocks in Commure Health.

Dr. Hirsch receives grants or contracts from the Neiman Health Policy Institute, participates on DSMB work Regeltech, Arsenal, Rapid Medical, and volunteers as an ASIPP Board Member, JNIS Deputy Editor, SNIS Chair health policy committee

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Appendix Table 1. *Quality Appraisal of Diagnostic Reliability (QAREL) checklist.*

Item	Yes	No	Unclear	N/A
1. Was the test evaluated in a spectrum of subjects representative of patients who would normally receive the test in clinical practice?				
2. Was the test performed by examiners representative of those who would normally perform the test in practice?				
3. Were raters blinded to the reference standard for the target disorder being evaluated?				
4. Were raters blinded to the findings of other raters during the study?				
5. Were raters blinded to their own prior outcomes of the test under evaluation?				
6. Were raters blinded to clinical information that may have influenced the test outcome?				
7. Were raters blinded to additional cues, not intended to form part of the diagnostic test procedure?				
8. Was the order in which raters examined subjects varied?				
9. Were appropriate statistical measures of agreement used?				
10. Was the application and interpretation of the test appropriate?				
11. Was the time interval between measurements suitable in relation to the stability of the variable being measured?				
12. If there were dropouts from the study, was this less than 20% of the sample.				
TOTAL				

Source: Lucas NP, Macaskill P, Irwing L, Bogduk N. The development of a quality appraisal tool for studies of diagnostic reliability (QAREL). *J Clin Epidemiol* 2010; 63:854-861 (664).

Appendix Table 2. *Quality appraisal of the diagnostic accuracy of lumbar facet joint nerve block diagnostic studies.*

	Manchikanti et al (102)	**Pang et al (122)**	**Schwarzer et al (123,124)**	**Schwarzer et al (125)**	**Manchikanti et al (126)**	**DePalma et al 2011 (127)**	**Manchikanti et al (128)**	**Manchikanti et al (129)**	**Manchikanti et al (130)**	**Manchikanti et al (131)**	**Manchikanti et al (132)**
1. Was the test evaluated in a spectrum of subjects representative of patients who would normally receive the test in clinical practice?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2. Was the test performed by examiners representative of those who would normally perform the test in practice?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3. Were raters blinded to the reference standard for the target disorder being evaluated?	N	N	N	N	N	N	N	N	N	N	N
4. Were raters blinded to the findings of other raters during the study?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
5. Were raters blinded to their own prior outcomes of the test under evaluation?	N	N	N	N	N	N	N	N	N	N	N
6. Were raters blinded to clinical information that may have influenced the test outcome?	N	N	N	N	N	N	N	N	N	N	N

Appendix Table 2 cont. *Quality appraisal of the diagnostic accuracy of lumbar facet joint nerve block diagnostic studies.*

	Manchikanti et al (102)	Pang et al (122)	Schwarzer et al (123,124)	Schwarzer et al (125)	Manchikanti et al (126)	DePalma et al 2011 (127)	Manchikanti et al (128)	Manchikanti et al (129)	Manchikanti et al (130)	Manchikanti et al (131)	Manchikanti et al (132)
7. Were raters blinded to additional cues, not intended to form part of the diagnostic test procedure?	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
8. Was the order in which raters examined subjects varied?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
9. Were appropriate statistical measures of agreement used?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
10. Was the application and interpretation of the test appropriate?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
11. Was the time interval between measurements suitable in relation to the stability of the variable being measured?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
12. If there were dropouts from the study, was this less than 20% of the sample.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
TOTAL	9/12	8/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12

Y=yes; N=no; U=unclear; N/A=not applicable

Source: Lucas NP, Macaskill P, Irwing L, Bogduk N. The development of a quality appraisal tool for studies of diagnostic reliability (QAREL). *J Clin Epidemiol* 2010; 63:854-861 (111).

Appendix Table 2 cont. *Quality appraisal of the diagnostic accuracy of lumbar facet joint nerve block diagnostic studies.*

	Manchikanti et al (133)	Manchikanti et al (134)	Manchikanti et al (135)	Manchukonda et al (136)	Manchikanti et al (137)	Manchikanti et al (30)
1. Was the test evaluated in a spectrum of subjects representative of patients who would normally receive the test in clinical practice?	Y	Y	Y	Y	Y	Y
2. Was the test performed by examiners representative of those who would normally perform the test in practice?	Y	Y	Y	Y	Y	Y
3. Were raters blinded to the reference standard for the target disorder being evaluated?	N	N	N	N	N	N
4. Were raters blinded to the findings of other raters during the study?	Y	Y	Y	Y	Y	Y
5. Were raters blinded to their own prior outcomes of the test under evaluation?	N	N	N	N	N	N
6. Were raters blinded to clinical information that may have influenced the test outcome?	N	N	N	N	N	N
7. Were raters blinded to additional cues, not intended to form part of the diagnostic test procedure?	Y	Y	Y	Y	Y	Y
8. Was the order in which raters examined subjects varied?	Y	Y	Y	Y	Y	Y
9. Were appropriate statistical measures of agreement used?	Y	Y	Y	Y	Y	Y
10. Was the application and interpretation of the test appropriate?	Y	Y	Y	Y	Y	Y
11. Was the time interval between measurements suitable in relation to the stability of the variable being measured?	Y	Y	Y	Y	Y	Y
12. If there were dropouts from the study, was this less than 20% of the sample.	Y	Y	Y	Y	Y	Y
TOTAL	9/12	9/12	9/12	9/12	9/12	9/12

Y=yes; N=no; U=unclear; N/A=not applicable

Source: Lucas NP, Macaskill P, Irwing L, Bogduk N. The development of a quality appraisal tool for studies of diagnostic reliability (QAREL). *J Clin Epidemiol* 2010; 63:854-861 (111).

Appendix Table 3. *Quality appraisal of diagnostic accuracy of cervical facet joint nerve block diagnostic studies.*

	Aprill & Bogduk (675)	**Manchikanti et al (676)**	**Manchikanti et al (671)**	**Manchukonda et al (673)**	**Manchikanti et al (672)**	**Barnsley et al (652)**	**Yin and Bogduk (443)**	**Speldewinde et al (577)**	**Barnsley et al (678)**	**Lord et al (680)**	**Barnsley et al (679)**	**Manchikanti et al (43)**
1. Was the test evaluated in a spectrum of subjects representative of patients who would normally receive the test in clinical practice?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2. Was the test performed by examiners representative of those who would normally perform the test in practice?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3. Were raters blinded to the reference standard for the target disorder being evaluated?	N	N	N	N	N	N	N	N	N	N	N	N
4. Were raters blinded to the findings of other raters during the study?	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
5. Were raters blinded to their own prior outcomes of the test under evaluation?	N	N	N	N	N	N	N	N	N	N	N	N
6. Were raters blinded to clinical information that may have influenced the test outcome?	N	N	N	N	N	N	N	N	N	N	N	N

Appendix Table 3 cont. *Quality appraisal of diagnostic accuracy of cervical facet joint nerve block diagnostic studies.*

	Aprill & Bogduk (675)	**Manchikanti et al (676)**	**Manchikanti et al (671)**	**Manchukonda et al (673)**	**Manchikanti et al (672)**	**Barnsley et al (652)**	**Yin and Bogduk (443)**	**Speldewinde et al (577)**	**Barnsley et al (678)**	**Lord et al (680)**	**Barnsley et al (679)**	**Manchikanti et al (43)**
7. Were raters blinded to additional cues, not intended to form part of the diagnostic test procedure?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
8. Was the order in which raters examined subjects varied?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
9. Were appropriate statistical measures of agreement used?	U	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
10. Were the application and interpretation of the test appropriate?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
11. Was the time interval between measurements suitable in relation to the stability of the variable being measured?	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
12. If there were dropouts from the study, was this less than 20% of the sample.	NA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
TOTAL	5/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12

Y=yes; N=no; U=unclear; N/A=not applicable

Source: Lucas NP, Macaskill P, Irwing L, Bogduk N. The development of a quality appraisal tool for studies of diagnostic reliability (QAREL). *J Clin Epidemiol* 2010; 63:854-861 (664).

Appendix Table 4. *Quality appraisal of diagnostic accuracy of thoracic facet joint nerve block diagnostic studies.*

	Manchikanti et al (672)	Manchikanti et al (681)	Manchukonda et al (673)
1. Was the test evaluated in a spectrum of subjects representative of patients who would normally receive the test in clinical practice?	Y	Y	Y
2. Was the test performed by examiners representative of those who would normally perform the test in practice?	Y	Y	Y
3. Were raters blinded to the reference standard for the target disorder being evaluated?	N	N	N
4. Were raters blinded to the findings of other raters during the study?	Y	Y	Y
5. Were raters blinded to their own prior outcomes of the test under evaluation?	N	N	N
6. Were raters blinded to clinical information that may have influenced the test outcome?	N	N	N
7. Were raters blinded to additional cues, not intended to form part of the diagnostic test procedure?	Y	Y	Y
8. Was the order in which raters examined subjects varied?	Y	Y	Y
9. Were appropriate statistical measures of agreement used?	Y	Y	Y
10. Were the application and interpretation of the test appropriate?	Y	Y	Y
11. Was the time interval between measurements suitable in relation to the stability of the variable being measured?	Y	Y	Y
12. If there were dropouts from the study, was this less than 20% of the sample.	Y	Y	Y
TOTAL	9/12	9/12	9/12

Y=yes; N=no; U=unclear; N/A=not applicable

Source: Lucas NP, Macaskill P, Irwing L, Bogduk N. The development of a quality appraisal tool for studies of diagnostic reliability (QAREL). *J Clin Epidemiol* 2010; 63:854-861 (664).

Appendix Table 5. *Sources of risk of bias and Cochrane Review rating system.*

Bias Domain	Source of Bias		Possible Answers
Selection	(1) Was the method of randomization adequate?	A random (unpredictable) assignment sequence. Examples of adequate methods are coin toss (for studies with 2 groups), rolling a dice (for studies with 2 or more groups), drawing of balls of different colors, drawing of ballots with the study group labels from a dark bag, computer-generated random sequence, preordered sealed envelopes, sequentially-ordered vials, telephone call to a central office, and preordered list of treatment assignments.	Yes/No/Unsure
		Examples of inadequate methods are: alternation, birth date, social insurance/security number, date in which they are invited to participate in the study, and hospital registration number.	
Selection	(2) Was the treatment allocation concealed?	Assignment generated by an independent person not responsible for determining the eligibility of the patients. This person has no information about the persons included in the trial and has no influence on the assignment sequence or on the decision about eligibility of the patient.	Yes/No/Unsure
Performance	(3) Was the patient blinded to the intervention?	Index and control groups are indistinguishable for the patients or if the success of blinding was tested among the patients and it was successful.	Yes/No/Unsure
Performance	(4) Was the care provider blinded to the intervention?	Index and control groups are indistinguishable for the care providers or if the success of blinding was tested among the care providers and it was successful.	Yes/No/Unsure

Appendix Table 5 cont. *Sources of risk of bias and Cochrane Review rating system.*

Bias Domain	Source of Bias		Possible Answers
Detection	(5) Was the outcome assessor blinded to the intervention?	Adequacy of blinding should be assessed for each primary outcome separately. This item should be scored "yes" if the success of blinding was tested among the outcome assessors and it was successful or: • for patient-reported outcomes in which the patient is the outcome assessor (e.g., pain, disability): the blinding procedure is adequate for outcome assessors if participant blinding is scored "yes" • for outcome criteria assessed during scheduled visit and that supposes a contact between participants and outcome assessors (e.g., clinical examination): the blinding procedure is adequate if patients are blinded, and the treatment or adverse effects of the treatment cannot be noticed during clinical examination • for outcome criteria that do not suppose a contact with participants (e.g., radiography, magnetic resonance imaging): the blinding procedure is adequate if the treatment or adverse effects of the treatment cannot be noticed when assessing the main outcome • for outcome criteria that are clinical or therapeutic events that will be determined by the interaction between patients and care providers (e.g., cointerventions, hospitalization length, treatment failure), in which the care provider is the outcome assessor: the blinding procedure is adequate for outcome assessors if item "4" (caregivers) is scored "yes" • for outcome criteria that are assessed from data of the medical forms: the blinding procedure is adequate if the treatment or adverse effects of the treatment cannot be noticed on the extracted data	Yes/No/Unsure
Attrition	(6) Was the drop-out rate described and acceptable?	The number of participants who were included in the study but did not complete the observation period or were not included in the analysis must be described and reasons given. If the percentage of withdrawals and drop-outs does not exceed 20% for short-term follow-up and 30% for long-term follow-up and does not lead to substantial bias a "yes" is scored (N.B. these percentages are arbitrary, not supported by literature).	Yes/No/Unsure
Attrition	(7) Were all randomized participants analyzed in the group to which they were allocated?	All randomized patients are reported/analyzed in the group they were allocated to by randomization for the most important moments of effect measurement (minus missing values) irrespective of noncompliance and cointerventions.	Yes/No/Unsure
Reporting	(8) Are reports of the study free of suggestion of selective outcome reporting?	All the results from all prespecified outcomes have been adequately reported in the published report of the trial. This information is either obtained by comparing the protocol and the report, or in the absence of the protocol, assessing that the published report includes enough information to make this judgment.	Yes/No/Unsure
Selection	(9) Were the groups similar at baseline regarding the most important prognostic indicators?	Groups have to be similar at baseline regarding demographic factors, duration and severity of complaints, percentage of patients with neurological symptoms, and value of main outcome measure(s).	Yes/No/Unsure
Performance	(10) Were cointerventions avoided or similar?	If there were no cointerventions or they were similar between the index and control groups.	Yes/No/Unsure
Performance	(11) Was the compliance acceptable in all groups?	The reviewer determines if the compliance with the interventions is acceptable, based on the reported intensity, duration, number and frequency of sessions for both the index intervention and control intervention(s). For example, physiotherapy treatment is usually administered for several sessions; therefore it is necessary to assess how many sessions each patient attended. For single-session interventions (e.g., surgery), this item is irrelevant.	Yes/No/Unsure
Detection	(12) Was the timing of the outcome assessment similar in all groups?	Timing of outcome assessment should be identical for all intervention groups and for all primary outcome measures.	Yes/No/Unsure
Other	(13) Are other sources of potential bias unlikely?	Other types of biases. For example: • When the outcome measures were not valid. There should be evidence from a previous or present scientific study that the primary outcome can be considered valid in the context of the present. • Industry-sponsored trials. The conflict of interest (COI) statement should explicitly state that the researchers have had full possession of the trial process from planning to reporting without funders with potential COI having any possibility to interfere in the process. If, for example, the statistical analyses have been done by a funder with a potential COI, usually "unsure" is scored.	Yes/No/Unsure

Source: Furlan AD, et al; Editorial Board of the Cochrane Back, Neck Group. 2015 updated method guideline for systematic reviews in the Cochrane back and neck group. *Spine (Phila Pa 1976)* 2015; 40:1660-1673 (722).

Appendix Table 6. *Item checklist for assessment of randomized controlled trials of interventional pain management techniques utilizing IPM-QRB.*

		Scoring
I.	TRIAL DESIGN AND GUIDANCE REPORTING	
1.	CONSORT or SPIRIT	
	Trial designed and reported without any guidance	0
	Trial designed and reported utilizing minimum criteria other than CONSORT or SPIRIT criteria or trial was conducted prior to 2005	1
	Trial implies it was based on CONSORT or SPIRIT without clear description with moderately significant criteria for randomized trials or the trial was conducted before 2005	2
	Explicit use of CONSORT or SPIRIT with identification of criteria or trial conducted with high level reporting and criteria or conducted before 2005	3
II.	DESIGN FACTORS	
2.	Type and Design of Trial	
	Poorly designed control group (quasi selection, convenient sampling)	0
	Proper active-control or sham procedure with injection of active agent	2
	Proper placebo control (no active solutions into active structures)	3
3.	Setting/Physician	
	General setting with no specialty affiliation and general physician	0
	Specialty of anesthesia/PMR/neurology/radiology/ortho, etc.	1
	Interventional pain management with interventional pain management physician	2
4.	Imaging	
	Blind procedures	0
	Ultrasound	1
	CT	2
	Fluoro	3
5.	Sample Size	
	Less than 50 participants in the study without appropriate sample size determination	0
	Sample size calculation with less than 25 patients in each group	1
	Appropriate sample size calculation with at least 25 patients in each group	2
	Appropriate sample size calculation with 50 patients in each group	3
6.	Statistical Methodology	
	None or inappropriate	0
	Appropriate	1
III.	PATIENT FACTORS	
7.	Inclusiveness of Population	
	For facet or sacroiliac joint interventions:	
	No diagnostic blocks	0
	Selection with single diagnostic blocks	1
	Selection with placebo or dual diagnostic blocks	2
8.	Duration of Pain	
	Less than 3 months	0
	3 to 6 months	1
	> 6 months	2
9.	Previous Treatments	
	Conservative management including drug therapy, exercise therapy, physical therapy, etc.	
	Were not utilized	0
	Were utilized sporadically in some patients	1
	Were utilized in all patients	2

Appendix Table 6 cont. ***Item checklist for assessment of randomized controlled trials of interventional pain management techniques utilizing IPM-QRB.***

		Scoring
10.	Duration of Follow-up with Appropriate Interventions	
	Less than 3 months or 12 weeks for epidural or facet joint procedures, etc. and 6 months for intradiscal procedures and implantables	0
	3 to 6 months for intradiscal injections, epidural or facet joint procedures, etc., or 1 year for intradiscal procedures or implantables	1
	6 months to 12 months for intradiscal injections, epidurals or facet joint procedures, etc., and 2 years or longer for intradiscal procedures and implantables	2
	18 months or longer for intradiscal injections, epidurals and facet joint procedures, etc., or 5 years or longer for intradiscal procedures and implantables	3
IV.	OUTCOMES	
11.	Outcomes Assessment Criteria for Significant Improvement	
	No descriptions of outcomes OR < 20% change in pain rating or functional status	0
	Pain rating with a decrease of 2 or more points or more than 20% reduction OR functional status improvement of more than 20%	1
	Pain rating with decrease of ≥ 2 points AND ≥ 20% change or functional status improvement of ≥ 20%	2
	Pain rating with a decrease of 3 or more points or more than 50% reduction OR functional status improvement with a 50% or 40% reduction in disability score	3
	Significant improvement with pain and function ≥ 50% or 3 points and 40% reduction in disability scores	4
12.	Analysis of all Randomized Participants in the Groups	
	Not performed	0
	Performed without intent-to-treat analysis without inclusion of all randomized participants	1
	All participants included with or without intent-to-treat analysis	2
13.	Description of Drop Out Rate	
	No description of dropouts, despite reporting of incomplete data or ≥ 20% withdrawal	0
	Less than 20% withdrawal in one year in any group	1
	Less than 30% withdrawal at 2 years in any group	2
14.	Similarity of Groups at Baseline for Important Prognostic Indicators	
	Groups dissimilar with significant influence on outcomes with or without appropriate randomization and allocation	0
	Groups dissimilar without influence on outcomes despite appropriate randomization and allocation	1
	Groups similar with appropriate randomization and allocation	2
15.	Role of Co-Interventions	
	Co-interventions were provided but were not similar in the majority of participants	0
	No co-interventions or similar co-interventions were provided in the majority of the participants	1
V.	RANDOMIZATION	
16.	Method of Randomization	
	Quasi randomized or poorly randomized or not described	0
	Adequate randomization (coin toss, drawing of balls of different colors, drawing of ballots)	1
	High quality randomization (Computer generated random sequence, pre-ordered sealed envelopes, sequentially ordered vials, telephone call, pre-ordered list of treatment assignments, etc.)	2
VI.	ALLOCATION CONCEALMENT	
17.	Concealed Treatment Allocation	
	Poor concealment of allocation (open enrollment) or inadequate description of concealment	0
	Concealment of allocation with borderline or good description of the process with probability of failure of concealment	1

Appendix Table 6 cont. ***Item checklist for assessment of randomized controlled trials of interventional pain management techniques utilizing IPM-QRB.***

		Scoring
	High quality concealment with strict controls (independent assignment without influence on the assignment sequence)	2
VII.	BLINDING	
18.	Patient Blinding	
	Patients not blinded	0
	Patients blinded adequately	1
19.	Care Provider Blinding	
	Care provider not blinded	0
	Care provider blinded adequately	1
20.	Outcome Assessor Blinding	
	Outcome assessor not blinded or was able to identify the groups	0
	Performed by a blinded independent assessor with inability to identify the assignment-based provider intervention (i.e., subcutaneous injection, intramuscular distant injection, difference in preparation or equipment use, numbness and weakness, etc.)	1
VIII.	CONFLICTS OF INTEREST	
21.	Funding and Sponsorship	
	Trial included industry employees	-3
	Industry employees involved; high levels of funding with remunerations by industry or an organization funded with conflicts	-3
	Industry or organizational funding with reimbursement of expenses with some involvement	0
	Industry or organization funding of expenses without involvement	1
	Funding by internal resources only with supporting entity unrelated to industry	2
	Governmental funding without conflict such as NIH, NHS, AHRQ	3
22.	Conflicts of Interest	
	None disclosed with potential implied conflict	0
	Marginally disclosed with potential conflict	1
	Well disclosed with minor conflicts	2
	Well disclosed with no conflicts	3
	Hidden conflicts with poor disclosure	–1
	Misleading disclosure with conflicts	–2
	Major impact related to conflicts	–3
TOTAL		48

Source: Manchikanti L, et al. Assessment of methodologic quality of randomized trials of interventional techniques: Development of an interventional pain management specific instrument. *Pain Physician* 2014; 17:E263-E290 (723).