Background: Transforaminal lumbar endoscopic discectomy is a minimally invasive spine surgery procedure performed principally for the treatment of lumbar herniated discs. Endoscopic spine surgeons around the world have noted how far patients will travel to undergo this minimally invasive spine surgery, but the actual distance patients travel has never been investigated.

Objective: We present here our analysis of how far patients will travel for endoscopic spine surgery by studying the referral patterns of patients to 3 centers in 3 different countries.

Study Design: Retrospective chart review of de-identified patient data was performed to analyze the distance patients travel for spine surgery.

Methods: Patient demographic data was analyzed for patients undergoing transforaminal lumbar endoscopic discectomy procedures over the same 8 month period in 2015 at centers in the United States (U.S.), Netherlands, and Germany.

Results: Travel distances for patients were determined for 327 patients. The average distance traveled for the U.S. center was 91 miles, the Dutch center was 287 miles, and the German center was 103 miles. For the U.S. center 16% of patients traveled out of state for surgery and for the European centers combined, 4% of patients traveled out of the country for surgery.

Limitations: The period of data analyzed was less than one year and the data collected was analyzed retrospectively.

Conclusions: Quality metrics in health care tend to be focused on how health care is delivered. Another health care metric that focuses more on what patients desire is presented here: how far patients will travel for innovative spine care.

Key words: Endoscopic spine surgery, transforaminal, minimally invasive, travel, lumbar disc herniation

Transforaminal lumbar endoscopic discectomy is a minimally invasive surgical option for the treatment of lumbar herniated discs. The development of improved endoscopes and instruments, the increased experience of endoscopic spine surgeons, and the continued demand by patients for minimally invasive spine techniques have led to an explosion of innovation in endoscopic spine surgical techniques since the first endoscopic views of a herniated nucleus pulposus were published by Kambin et al in 1988 (1). Published experience is available to patients and physicians on cervical approaches (2), thoracic approaches (3), and approaches to the thoracolumbar junction (4), as well as the treatment of far lateral disc herniations (5-7), reherniations (8-9), extruded discs (10-13), spondylolysis (14-15), radiculopathy in the setting of instrumented fusion (16), discitis (17), discogenic back pain (18), and spinal tumors (19-20).
Centers that offer the most efficient, effective, or innovative health care solutions often attract patients from outside their local catchment area. Quality measures in health care are developed to give us means to compare institutions and processes in the delivery and outcomes in health care. The metrics measured are often related to achieving the goals of effective, safe, efficient, and patient-centered care. One unique perspective on measuring the quality of health care delivery is observing the distances patients will travel for specialty care. Here we investigate the distances patients will travel for minimally invasive, awake, endoscopic spine surgery for the treatment of lumbar disc disease. The data from 3 centers in the United States, the Netherlands, and Germany is presented.

**METHODS**

Patient de-identified demographic data from 8 consecutive months in 2015 were examined from 3 international centers performing endoscopic spine surgery in awake patients. All surgeries were performed as outpatient procedures under local analgesia and intravenous sedation. The Joimax TESSYS endoscopic system was used for the procedure. Percutaneous entry was established entering through the skin 8 – 14 cm lateral to the midline depending on patient anatomy and disc level treated. Using intermittent fluoroscopic guidance, alternating between lateral and anterior-posterior (AP) view, a 25 cm 18 gauge needle was advanced and placed in the disc space through Kambin’s triangle, between the exiting and traversing nerves. Sequential reamers and drills were used to enlarge the neural foramen by removing the ventral aspect of the superior facet. A 7.5 mm outer diameter beveled cannula was then docked in the foramen and the discectomy was performed through a working channel endoscope using straight, up going, and bendable graspers with the disc and nerve roots directly visualized through the high definition endoscopic camera.

**RESULTS**

**Rhode Island, United States**

The city of Providence is the capital of the state of Rhode Island and the surgeries studied were performed at Rhode Island Hospital, the principal teaching hospital of the Warren Alpert School of Medicine at Brown University. Rhode Island is unique in that it is the smallest state in the United States. Other major Ivy League medical centers are only 50 (Harvard) and 102 miles (Yale) away, so patients have considerable options for choosing where they go for specialized surgical care. A total of 77 patients underwent endoscopic lumbar spine surgeries in the 8 month period in 2015 at the Rhode Island center. Twelve (16%) came from out of state. The average distance patients traveled was 91 miles. Table 1, Fig. 1A, and Fig. 2 demonstrate the geographic data for Rhode Island. Rhode Island residents who underwent surgery traveled on average 30 miles while out of state residents traveled on average 416 miles.

**Veenhuizen, Netherlands**

Veenhuizen is a village with approximately 800 inhabitants in the province of Drenthe in the northern part of the Netherlands. It is 95 miles from Amsterdam. The orthopedic surgeon Menno Iprenburg has a private clinic there. He has performed over 2,000 endoscopic lumbar spine surgeries. In the 8 month period in 2015 he performed 122 endoscopic lumbar discectomies. Seven (6%) came from outside of the Netherlands. The average distance patients traveled was 287 miles. Table 2, Fig. 1B, and Fig. 2 demonstrate the geographic data for Veenhuizen. Veenhuizen residents who underwent surgery traveled on average 30 miles while out of state residents traveled on average 416 miles.

Table 1. Rhode Island, United States.

<table>
<thead>
<tr>
<th>Number of Patients</th>
<th>Miles traveled (Average +/- Standard Deviation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Patients</td>
<td>77</td>
</tr>
<tr>
<td>Rhode Island Patients</td>
<td>65 (84%)</td>
</tr>
<tr>
<td>Out of State Patients</td>
<td>12 (16%)</td>
</tr>
</tbody>
</table>

Table 2. Veenhuizen, Netherlands.

<table>
<thead>
<tr>
<th>Number of Patients (%)</th>
<th>Miles traveled (Average +/- Standard Deviation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Patients</td>
<td>122</td>
</tr>
<tr>
<td>Netherlands Patients</td>
<td>115 (94%)</td>
</tr>
<tr>
<td>International Patients</td>
<td>7 (6%)</td>
</tr>
</tbody>
</table>
Fig. 1. Distance patients will travel for surgery. Pie charts depict the percentage of patients in A. Rhode Island, B. the Netherlands, and C. Germany who traveled more than or less than 50 miles for surgery.

Fig. 2. Box and Whisker plots for distance patients traveled for surgery. Plots graphically display the median, quartiles, and extremes of data to show the distribution of distances patients traveled for surgery in Rhode Island, the Netherlands, and Germany. The left and right edges of the box indicate the lower and upper quartiles and the center line in the box is the median. The “whiskers” attached to the box indicate the extremes of the data.

There are many distinguished university medical centers within close proximity in the region. The orthopedic surgeon Ralf Wagner has a private clinic in Frankfurt. In the 8 month period in 2015 he performed 128 endoscopic lumbar discectomies. Three patients (2%) came from outside of Germany for surgery. The average distance traveled was 103 miles. Table 3, Fig. 1C, and Fig. 2 demonstrate the geographic data for the Frankfurt site. Residents of Germany who underwent surgery traveled on average 55 miles (n = 125). German patients not from the city of Frankfurt (n = 108) traveled 63 miles on average. International patients traveled 2,075 miles on average for surgery.

**Discussion**

Minimally invasive endoscopic spine surgery offers patients the advantage of an awake outpatient surgical treatment for lumbar disc herniation through an endoscopic cannula the di-
ameter of a number 2 pencil. Health care delivery in the United states is, for the most part, based on local (most primary care) and regional (primary and specialty care) models. The geographic data presented here provides 1) a means to evaluate the distances patients will travel for specialized elective surgical treatment, 2) an opportunity to compare how far patients will travel for specialty spine surgical care in the U.S. and Europe, and 3) an answer to the question of whether patients will overstep even large university health care systems in seeking out what they perceive to be the most minimally invasive spine surgical options.

One study in the British Medical Journal in 1990 surveyed 116 patients in the British National Health System about the acceptability of traveling a distance for elective surgery versus waiting for local care (21). Patients were waiting an average of 28 months for surgery. The study points out that many assumptions have been made about patients’ attitudes toward traveling for routing elective surgery but there is little researched material. A large portion of patients preferred to travel than wait for surgery: 39% would travel rather than wait one month, 53% would travel rather than wait 3 months, and 91% would travel rather than wait 12 months. Of the patients surveyed, 90% would travel 50 miles and 60% would travel 300 miles.

There certainly are many significant reasons that make local specialty surgical care preferable to patients: cost, convenience, and dealing with complications would certainly top the list. Patients who leave local insurance networks often pay additional costs in the U.S. Travel expenses involved in leaving local areas for care are a burden. Complications after surgery are more easily dealt with if the surgical provider is local. In the case of lumbar discectomy surgery, the reherniation rate is as high at 5% – 15% and additional physician visits or surgeries become more burdensome the further the distance the patient has to travel (22-23).

The transforaminal lumbar endoscopic discectomy procedure is not very well known in the US. The popularity of the procedure is greater outside the U.S., especially in Europe and Asia. Worldwide roughly 2,800 physicians have been trained in TESSYS surgery, and TESSYS surgical procedures are actively performed in about 700 centers. Patients presented in the data from the U.S. center and German center were patients who used health insurance to pay for their procedures. There did not seem to be a bias in the data on patients seeking out a less expensive minimally invasive spine surgery procedure.

In the data presented here, the surgeon (Dutch) with the greatest experience in endoscopic spine surgery had the patients who traveled the furthest. The most striking feature in regards to the European data was that patients were obviously bypassing multiple academic medical centers with full spectrum orthopedic and neurosurgical spine care to be treated in private clinics for their disc pathology. For the U.S. data, it was interesting that many patients chose to travel further for surgical care in Rhode Island than be treated at another Ivy League medical center nearer their homes. In conclusion, distance patients are willing to travel for elective spine surgical care may be a quality metric that reflects the broader spectrum of quality and reminds health care providers that in the end what we provide may not be as important as what the patient wants.

Table 3. Frankfurt am Main, Germany.

<table>
<thead>
<tr>
<th></th>
<th>Number of Patients (%)</th>
<th>Miles traveled (Average +/- Standard Deviation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Patients</td>
<td>128</td>
<td>103 +/- 362</td>
</tr>
<tr>
<td>German Patients</td>
<td>125 (98%)</td>
<td>55 +/- 63</td>
</tr>
<tr>
<td>All Non-locals (Patients residing outside of Frankfurt)</td>
<td>111 (87%)</td>
<td>118 +/- 386</td>
</tr>
<tr>
<td>German Non-Locals (German Patients residing outside of Frankfurt)</td>
<td>108 (84%)</td>
<td>63 +/- 63</td>
</tr>
<tr>
<td>International Patients</td>
<td>3 (2%)</td>
<td>2075 +/- 1179</td>
</tr>
</tbody>
</table>


References


