Effects of Unilateral Endoscopic Facetectomy on Spinal Stability

Scott M. W. Haufe, MD and Anthony R. Mork, MD

Abstract: There are various definitions for spinal instability and its exact clinical usefulness is uncertain. Facetectomy has been considered a potential source of instability via conventional approaches. Studies have suggested that if the ligament structure of the spine is maintained then instability may not occur with an endoscopic facetectomy. This study is a prospective analysis of 10 patients who underwent unilateral endoscopic facetectomy for the treatment of severe foraminal stenosis to determine whether endoscopic facetectomies result in instability. The patients underwent pre and postsurgical x-rays that were evaluated via a specialized computer program that determined whether or not there was any altered mobility between the 2 sets of x-rays. These were compared with controls to determine whether instability was present. Of the 10 endoscopic facetectomy patients, none had any statistically significant change in sagittal rotational or translational motion when compared to controls. Thus, endoscopic removal of a unilateral facet joint does not necessarily cause spinal instability possibly because of the reduction in tissue damage associated with an endoscopic approach and the maintenance of the ligament structure of the spine.

Key Words: minimally invasive spinal surgery, endoscopic spinal surgery, facetectomy, foraminal stenosis, instability

(*J Spinal Disord Tech* 2007;20:146–148)

Spinal stability after conventional spinal surgery has always been an issue with spinal surgeons. Many surgeries have been performed over the issue yet there is no real definition of what constitutes spinal instability.[1] A study by Pope et al[2] defined instability as a loss of stiffness of the spine but such a definition is too vague. One of the more accepted definitions expresses a 3-subsystem that includes the spinal column, the spinal muscles, and the neutral control unit.[3,4] Other definitions of instability include increased antero-posterior translation, pathologic coupled motion, increased neutral zone, or pathologic instantaneous center of rotation, but these are findings that are common in the normal aging spine.[5] Thus, the exact method of determining spinal instability is unclear and it has been suggested that instability may not be very helpful in clinical practice.[5] Other studies have shown that processes of aging such as spinal disc degeneration does not directly correlate to mobility changes and that what could be defined as instability may be present in normal situations.[6] Therefore, even though prior data are questionable about the usage of the term stability, it has been believed that any significant removal of the facet joint is associated with some degree of instability of the vertebral spine.[7] Nonetheless, most of these beliefs of possible instability after facetectomy were due to the extensive surgical techniques required via a conventional approach.[8,9] Important structural ligaments that can be affected with conventional facetectomy include the supraspinous, interspinous, and intertransverse ligaments along with the superficial thoracolumbar fascia and various interspinous muscles depending on the approach and technique.[10] It has been suggested that unilateral facetectomy may not cause instability in certain situations when minimal ligament damage occurs.[11] This has been confirmed in a study that revealed that a 1-level unilateral conventional lumbar facetectomy could be performed with minimal instability issues if care is used to preserve structural integrity.[12] Using a conventional facetectomy with a tissue sparing approach, only one case of instability requiring fusion was noted out of 41 patients.[12] It is unknown whether a minimally invasive approach, which has been previously defined as having an incision of less than an inch, could allow a facetectomy to be performed with similar instability effects as those seen with a tissue sparing conventional approach since the trauma to the ligaments and other structural elements would be reduced.[11,13–15] Here, we present an analysis of 10 patients who underwent an endoscopic facetectomy for foraminal stenosis.

MATERIALS AND METHODS

Ten patients consisting of 7 men and 3 women who required a unilateral facetectomy for unilateral foraminal spinal stenosis were selected for the study. Although unilateral facetectomy is not always required for foraminal stenosis, the patients selected had severe cases that required such an extensive procedure and they opted for the minimally invasive approach instead of a

Received for publication April 20, 2006; accepted July 24, 2006.
From the MicroSpine Center, DeFuniak Springs, FL 32435.
Reprints: Scott M. W. Haufe, MD, MicroSpine Center, 100 Coy Burgess Loop, DeFuniak Springs, FL 32435 (e-mail: Question@MicroSpine.com).

conventional fusion with facetectomy. The diagnosis confirmed foraminal stenosis via history, physical examination, magnetic resonance imaging, and selective nerve root blocks. Selective nerve root block were used to confirm that the patient's pain was indeed from the problematic nerve root. The selective nerve root blocks involved 1% lidocaine and were deemed positive if the patient's pain was resolved after the injection for at least 1 hour. In each patient, their pain returned to their normal baseline after the injection and thus the injection was not deemed therapeutic, only diagnostic. Before surgery, patients underwent a 10-view lumbar spinal series that included anterior-posterior (AP), lateral, right and left posterior obliques, flexion, extension, right and left AP bending, L5-S1 spot, and pelvis views. These same x-ray views were obtained in each patient 2 years after the surgery. No other spinal surgeries occurred in these individuals during the 2-year period after this endoscopic lumbar facetectomy surgery.

The surgery proceeded as follows: fluoroscopy was used to identify the facet joint at approximately a 30-degree angle to the spine. At this location, a 3/4-inch incision was made and a 1.5 mm guide pin was inserted and tapped into the facet joint. The endoscopic approach involved a specialized 14 mm tubular retractor system that was inserted over the guide pin to the facet joint. The final tube constituted the working tube and the other dilating tubes were removed. Electrocautery and a holmium laser were used to cauterize, coagulate, and remove soft tissues over the facet joint. Once the joint was identified via a 5-mm, 0-degree endoscope with a 30 times magnification system, an electronic 12 mm drill bit removed the facet joint under direct fluoroscopic guidance using AP and lateral views to confirm 3 dimensional placement. After the 12 mm bit removed most of the facet joint, a 6 mm electrical burr was used to grind away the excess facet bone and kerrisons (2 to 4 mm) were used to remove the final bone edges and pieces. The entire facet region was removed and the patients were awake during the entire procedure to aid in avoiding any neurologic complications. The entire procedure takes around 1 hour.

Patients were reevaluated with the same 10-view spinal series 2 years after the initial surgery. No other spinal surgeries occurred in any of these patients during this 2-year span. Ten nonsurgical patients were used as controls and 2 sets of the same 10-view spinal x-ray series were obtained on these spinal control subjects at a similar 2-year period apart from each other. The spinal x-ray series were sent to a medical school that had developed a special computer program that could analyze the x-rays for aberrations in spinal mobility. Because variations in the x-ray films can occur owing to patient positioning and technique, the computerized program used to determine spinal instability was able to determine the changes in the angles of the spine associated with these human errors and thus compensate for them. The program marks specific points on the spinal segments and can adjust for angulations and positions of the patient and can correct for technique and position shifts. The computer program and the medical school analysis staff were blinded to which x-ray studies were from which group of patients since names and dates were removed. The computer program used the angle of sagittal rotation displacement and sagittal translation displacement from the extension to flexion films. The units for flexion-extension were given in degrees, whereas the units for translation being expressed in percent change in vertical depth of the vertebral body. These data are noted in Table 1 for the surgical group. Although there is no perfect way to analyze instability, this method of measuring spinal stability has been previously referenced and deemed acceptable for this study.[16] The control group is referenced in Table 2 with the same information.

RESULTS

Of the 10 patients who underwent the unilateral endoscopic facetectomy, none developed any statistically significant motion abnormalities when compared with the control group. Both sagittal translation and rotation had

TABLE 1. Patients Undergoing Endoscopic Facetectomy

Patient No.	Surgical Level	Presurgical Rotation (Degrees)	Pretranslation (%)	Postrotation	Posttranslation
1	L5-S1	4.36	−0.0063	5.25	0.0526
2	L4-5	1.81	−0.0473	5.49	0.0536
3	L4-5	6.04	−0.1152	1.8	0.0602
4	L4-5	1.79	−0.268	−0.71	−0.0359
5	L4-5	10.34	0.0384	7.45	0.0961
6	L5-S1	1.12	−0.0837	1.13	−0.0105
7	L4-5	0.96	0.0587	5.22	0.0225
8	L4-5	8.08	0.1411	4.08	−0.1034
9	L5-S1	0.95	−0.1117	4.06	0.1005
10	L4-5	4.88	−0.0302	−0.54	−0.0513

Information is for each patient and includes level of surgery and pre and postrotation and translation values.

TABLE 2. Control Subjects With the Same Values

Control No.	Level	Film 1 Rotation (degrees)	Film 1 Translation (%)	Film 2 Rotation	Film 2 Translation
1	L4-5	3.81	−0.0608	7.23	0.029
2	L4-5	3.09	0.0198	3.13	0.0337
3	L4-5	9.95	−0.1258	6.56	0.0371
4	L4-5	5.57	0.1185	2.79	0.0072
5	L4-5	3.45	−0.0701	6.46	0.1607
6	L4-5	2.26	0.0815	2.1	0.0051
7	L4-5	3.08	0.1581	1.66	0.0445
8	L4-5	2.83	0.0459	5.4	−0.0614
9	L4-5	1.72	0.0182	0.41	0.0294
10	L4-5	6.96	−0.1164	3.22	−0.1775

similar standard deviations for both the control and study groups and the *P* values never reached a significant level for either translation or rotation when compared with the control group (Table 3). Patient outcomes for the unilateral facetectomy group included 6 patients with complete pain relief, 2 with 50% to 75% relief, 1 with 25% to 50% relief, and 1 patient had less than 25% relief with the procedure. Pain relief was measured using a visual analog scale of 0 to 10 both presurgery and at the 2-year mark.

As discussed before, instability is a significant issue since many operations are performed on the basis of this diagnosis but the definition is vague and its usefulness is uncertain.[1,2,5] As seen in our control group, stability values can change in normal individuals from one date to another with similar variation as seen in people who underwent the minimally invasive facetectomy surgery. Thus, it is hard to deem spinal instability as a significant issue unless a true definition is agreed upon that correlates with dysfunction or pain, because spinal motion variations seem to occur in normal people and in postsurgical people.

DISCUSSION

Although the study consisted of a small group of patients, the results were significant and revealed that unilateral endoscopic facetectomy does not alter spinal stability when compared with controls. We hypothesize that this is due to the reduced tissue destruction similar to that seen with tissue sparing conventional facetectomy and thus the ligament structure of the spine is held mainly intact which has been shown to be important to structural integrity of the spine.[11,12] Thus, fusion surgery may not be necessary for foraminal stenosis treated with facetectomy

TABLE 3. Statistical Analysis of Data

	Mean of Facetectomy Patients	Mean of Controls	Standard Deviation of Patients	Standard Deviation of Controls	*P*
Rotation	2.266	0.385	2.748	2.643	0.1361
Translation	0.121	0.0978	0.086	0.065	0.25

because an endoscopic facetectomy can decompress the region without instability issues. Finally, a real definition of instability that correlates with dysfunction is needed because current definitions are vague and of questionable value in clinical practice.

REFERENCES

1. Vo P, MacMillan M. The aging spine: clinical instability. *South Med J*. 1994;87:S26–S35.
2. Pope MH, Frymoyer JW, Krag MH. Diagnosing instability. *Clin Orthop Relat Res*. 1992;60–67.
3. Kim CW, Perry A, Garfin SR. Spinal instability: the orthopedic approach. *Semin Musculoskelet Radiol*. 2005;9:77–87.
4. Panjabi MM. Clinical spinal instability and low back pain. *J Electromyogr Kinesiol*. 2003;13:371–379.
5. Krismer M, Haid C, Ogon M, et al. Biomechanics of lumbar instability. *Orthopade*. 1997;26:516–520.
6. Murata M, Morio Y, Kuranobu K. Lumbar disc degeneration and segmental instability: a comparison of magnetic resonance images and plain radiographs of patients with low back pain. *Arch Orthop Trauma Surg*. 1994;113:297–301.
7. Kaigle AM, Holm SH, Hansson TH. Experimental instability in the lumbar spine. *Spine*. 1995;20:421–430.
8. Abumi K, Panjabi MM, Kramer KM, et al. Biomechanical evaluation of lumbar spinal stability after graded facectectomies. *Spine*. 1990;15:1142–1147.
9. Lee KK, Teo EC, Qiu TX, et al. Effect of facetectomy on lumbar spinal stability under sagittal plane loadings. *Spine*. 2004;29:1624–1631.
10. Rohen J, Yokochi C. *Color Atlas of Anatomy*. 2nd ed. Bunkyo-ku, Tokyo: Igaku-Shoin, Ltd; 1988:181–210.
11. Sharma M, Langrana NA, Rodriguez J. Role of ligaments and facets in lumbar spinal stability. *Spine*. 1995;20:887–900.
12. Garrido E, Connaughton PN. Unilateral facetectomy approach for the lateral lumbar disc herniation. *J Neurosurg*. 1991;74:754–756.
13. Okawa A, Shinomiya K, Takakuda K, et al. A cadaveric study of the stability of lumbar segment after partial laminectomy and facetectomy with intact posterior ligaments. *J Spinal Disord*. 1996;9:518–526.
14. Tender GC, Kutz S, Baratta R, et al. Unilateral progressive alterations in the lumbar spine: a biomechanical study. *J Neurosurg Spine*. 2005;2:298–302.
15. Haufe SM, Mork AR. Sacroiliac joint debridement: a novel technique for the treatment of sacroiliac joint pain. *Photomed Laser Surg*. 2005;23:596–598.
16. McCane B, King T, Abbott JH. Calculating the 2 dimensional motion of lumbar vertebrae using splines. *J Biomech*. 2005;10:1016.