

Comparison of Functional Outcomes following Surgical Decompression and Posterolateral Instrumented Fusion in Single Level Low Grade Lumbar Degenerative versus Isthmic Spondylolisthesis

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Background: The two most common types of surgically treated lumbar spondylolisthesis in adults include the degenerative and isthmic types. The aim of this study was to compare the functional outcomes of surgical decompression and posterolateral instrumented fusion in patients with lumbar degenerative and isthmic spondylolisthesis.

Methods: In this retrospective study, we reviewed the clinical outcomes in surgically treated patients with single level, low grade lumbar degenerative, and isthmic spondylolisthesis (groups A and B, respectively) from August 2007 to April 2011. We tried to compare paired settings with similar initial conditions. Group A included 52 patients with a mean age of 49.2 ± 6.1 years, and group B included 52 patients with a mean age of 47.3 ± 7.4 years. Minimum follow-up was 24 months. The surgical procedure comprised neural decompression and posterolateral instrumented fusion. Pain and disability were assessed by a visual analog scale (VAS) and the Oswestry Disability Index (ODI), respectively. The Wilcoxon and Mann-Whitney *U*-tests were used to compare indices.

Results: The most common sites for degenerative and isthmic spondylolisthesis were at the L4–L5 (88.5%) and L5–S1 (84.6%) levels, respectively. Surgery in both groups significantly improved VAS and ODI scores. The efficacy of surgery based on subjective satisfaction rate and pain and disability improvement was similar in the degenerative and isthmic groups. Notable complications were also comparable in both groups.

Conclusions: Neural decompression and posterolateral instrumented fusion significantly improved pain and disability in patients with degenerative and isthmic spondylolisthesis. The efficacy of surgery for overall subjective satisfaction rate and pain and disability improvement was similar in both groups.

Keywords: *Degenerative spondylolisthesis, Isthmic spondylolisthesis, Lumbar spine, Instrumentation, Fusion*

Received June 19, 2013; Accepted August 26, 2013

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Displacement or slip of a vertebra on the vertebra below is usually referred to as spondylolisthesis. The slipped vertebra usually moves forward, but displacement may occur in any direction.¹⁾ The two most common types of surgically treated lumbar spondylolisthesis in adults are the degenerative and isthmic types.^{2,3)} Most of the current literature

focuses on minimally invasive techniques, and specialty instruments have been used to surgically treat lumbar spondylolisthesis. There has been much discussion about the dissimilarities between these minimally invasive surgeries and open approaches,⁴⁻⁸⁾ but only a few studies have investigated differences in functional outcomes of surgery in these two common types of adult spondylolisthesis.^{9,10)}

Lumbar degenerative spondylolisthesis is more common at the L4–L5 level, and these patients often present with central spinal stenosis and predominant symptoms of intermittent claudication due to an intact neural arch, whereas the primary site of stenosis in isthmic spondylolisthesis is the lateral recess and foramina with a predominant complaint of radicular pain at the L5–S1 level.¹¹⁻¹³⁾ These differences may affect functional recovery of the affected cases. Therefore, the aim of this study was to compare the functional outcomes of surgical decompression and posterolateral instrumented fusion in patients with lumbar degenerative and isthmic spondylolisthesis.

METHODS

After local Institutional Review Board approval (code number 920628), we retrospectively reviewed and analyzed the clinical outcomes of our surgically treated patients with diagnoses of lumbar degenerative and isthmic spondylolisthesis (groups A and B, respectively) from August 2007 to April 2011. Group A initially included 86 patients with mean age of 59.3 ± 9.2 years, and group B included 54 patients with mean age of 48.6 ± 9.4 years. We finally studied 52 patients in each group with a mean age of 49.2 ± 6.1 years (range, 43 to 74 years) and 47.3 ± 7.4 years (range, 38 to 72 years) in groups A and B, respectively to compare paired settings with similar initial conditions. Our inclusion criteria were single level lumbar spondylolisthesis in patients aged > 18 years, slip percentage < 50% (low-grade spondylolisthesis), refractory complaints after at least 3 months of aggressive conservative treatment, the presence of significant or progressive neurologic deficit, and follow-up period > 24 months. Those cases with previous lumbar surgery, significant associated diseases (uncontrolled diabetes mellitus, severe psychoneurotic or autoimmune diseases, and severe untreated hip or knee osteoarthritis), and the presence of lumbar congenital or traumatic lesion were excluded. We considered only those patients who had been treated with posterior neural decompression, posterolateral fusion, and pedicular screw and rod instrumentation (without any associated interbody fusion). We also excluded patients with high grade (slip percentage > 50%) isthmic spondy-

lolisthesis to have two homogeneous groups.

The preoperative imaging work-ups comprised standing plain radiographs and magnetic resonance imaging scans of the lumbosacral spine. We pre- and postoperatively assessed patient pain and disability states with a visual analog scale (VAS, a 0–10 numerical rating scale) and the Oswestry Disability Index questionnaire (ODI, ver. 2.1), respectively.¹⁴⁻¹⁶⁾ After the patients signed informed consent, all surgical procedures were carried out by a surgical team using a similar technique (neural decompression by laminectomy and foraminotomy; and spinal stabilization by posterolateral fusion, pedicular screw and rod instrumentation). After posterolateral decortication was carried out, fusion was performed by applying a mixture of an autogenous bone graft from a local laminectomy and an allograft (10 pieces of $5 \times 5 \times 35$ mm of freeze-dried cortical cancellous matchstick (Tissue Regeneration Co., Kish, Iran).

We recorded any intra- and postoperative adverse events. Patients usually started walking while wearing a rigid lumbosacral orthosis on the second day after the operation. Postoperative follow-up visits occurred at 6 weeks, 3, 6, and 12 months and then annually. Plain anteroposterior or Ferguson radiographs showing the bridging bone between the transverse processes were used to demonstrate osseous union. Computed tomography (CT) scanning was used only in symptomatic patients. According to criteria of the North American Spine Society Low Back Outcome Instrument, patients selected one of the following responses regarding their satisfaction with the surgical operation at the latest follow-up visit: (1) surgery met my expectations; (2) surgery did not meet all my expectations, but if I get the same disease again I would undergo the same procedure for the same result; (3) surgery helped but I would not undergo the same procedure for the same result; and (4) I am the same as or worse than I was before the surgery.¹⁷⁾

Statistical Analysis

The SPSS ver.11.5 (SPSS Inc., Chicago, IL, USA) was used to perform the statistical analysis. We used Wilcoxon test to compare the group characteristics pre- and postoperatively, and the Mann-Whitney *U*-test to compare characteristics between the two groups. A $p < 0.05$ was considered significant.

RESULTS

After all inclusion and exclusion criteria were considered, we finally analyzed the results of 52 patients in each

Table 1. Demographic Data of the Treated Patients

Group	Sex (male : female)	Age (yr)	Follow-up (mo)
A (n = 52)	24 (46.2) : 28 (53.8)	49.2 ± 6.1 (43–74)	34.7 ± 6.3 (25–61)
B (n = 52)	20 (38.5) : 32 (61.5)	47.3 ± 7.4 (38–72)	43.6 ± 4.9 (26–65)

Values are presented as number (%) or mean ± SD (range).

Table 2. Prevalence of Spondylolisthetic Levels in the Treated Patients

Group	Frequency (%)
Group A	52 (100)
L3–L4	2 (3.8)
L4–L5	46 (88.5)
L5–S1	2 (3.8)
L4–L5 & L5–S1	2 (3.8)
Group B	52 (100)
L4–L5	8 (15.4)
L5–S1	44 (84.6)

group. Demographic characteristics of our treated cases are shown in Table 1. As expected, the most common sites for degenerative and isthmic spondylolisthesis were at the L4–L5 (88.5%) and L5–S1 (84.6%) levels, correspondingly (Table 2).

Surgery in both groups improved the VAS and ODI scores significantly (Table 3). The efficacy of surgery for pain and disability improvement was similar in the degenerative and isthmic groups (Table 4). The overall subjective satisfaction rate was also similar in both groups.

We had three postoperative superficial wound infections (two in group A and one in group B). All occurred in patients with diabetes, and they all responded well to blood glucose control, appropriate antibiotic therapy, and local wound care. No deep infections occurred in any patient. Postoperative refractory radicular pain occurred in two cases in group A due to malpositioning of the pedicular screw; both were among the first surgically treated patients, and we were obliged to revise them. We had two patients (one in group A and one in group B) with screw breakage; both were at the distal part of the construct. Although CT revealed underlying pseudoarthrosis in both of these cases, only one of them was so uncomfortable that he consented to reoperation (with anterior lumbar interbody fusion). Additionally, we were also unable to demonstrate

Table 3. Improvement in Pain and Disability

Group	Preoperative	Last visit	Z	p-value
Group A				
Visual analog scale	7.23 ± 1.17	1.34 ± 1.85	4.39	0.001
Oswestry Disability Index	71.61 ± 1.57	22.07 ± 1.39	4.46	0.001
Group B				
Visual analog scale	6.84 ± 1.91	1.92 ± 1.89	4.22	0.001
Oswestry Disability Index	63.53 ± 1.39	13.15 ± 1.52	4.41	0.001

Values are presented as mean ± SD.

Table 4. Intergroup Comparisons for Pain Reduction, Disability Improvement, and Satisfaction Rate

Score	Difference between pre- and postoperative		Patients' satisfaction
	Visual analog scale	Oswestry disability index	
Group A	5.88 ± 2.42	49.53 ± 21.55	1.38 ± 0.75
Group B	4.92 ± 3.22	50.38 ± 21.48	1.11 ± 0.32
Z	0.94	0.37	1.25
p-value	0.34	0.37	0.21

Values are presented as mean ± SD.

osseous bridging fusion in five other cases (three in group A and two in group B) with plain radiographs. All of them were clinically asymptomatic.

DISCUSSION

We retrospectively evaluated and compared the surgical outcome of two of the most common types of adult lumbar spondylolisthesis in 104 cases. Although the literature review revealed that many studies exist about the surgical results of these two types of listhesis, those studies usually focused separately on only one type, and little research has been conducted on comparing these two groups.

Gehrchen et al.¹⁰⁾ evaluated functional and radiological outcome of surgical decompression and posterolateral instrumented fusion in patients with lumbar isthmic spondylolisthesis and degenerative disc disease in a retrospective comparative study. In contrast to our study, they also assessed cases in a degenerative group without vertebral slippage but who had disrupted discs. Functional and fusion states were described by a questionnaire and plain radiographs, respectively. The questionnaire assessed

medication, pain, occupational status, and subjective satisfaction with the surgery. They achieved an overall satisfaction rate of 70% without any significant difference in functional outcomes. They reported male gender, having a job, and being a non-smoker as good preoperative prognostic factors. Finally, they stated that surgical indications for lumbar spinal stenosis are more important than the surgery. According to the North American Spine Society Low Back Outcome Instrument, the percentage of scales 1–4 in group A in our study comprised 78.8%, 11.5%, 5.8%, and 3.8%, respectively. In group B, these percentages were 84.6%, 7.7%, 7.7%, and 0%. In comparison with the study by Gehrchen et al.,¹⁰⁾ we did not find a significant difference in patient satisfaction rate among the treated cases with isthmic and degenerative spondylolisthesis. Albeit, in our study we focused on surgical outcomes, and we did not consider the risk factors affecting the prognosis of patients.

Lauber et al.⁹⁾ evaluated the surgical outcomes of transforaminal lumbar interbody fusion (TLIF) in patients with low grade lumbar degenerative and isthmic spondylolisthesis in a prospective clinical study. They studied 19 patients with degenerative and 19 patients with isthmic spondylolisthesis and followed them for > 24 months. Similar to our study, they also used the ODI to evaluate patients. They reported about a 10 point improvement on the ODI in all patients with a 94.8% fusion rate and a 7.6% reoperation rate. Their results showed that functional outcomes of TLIF in patients with isthmic spondylolisthesis were significantly better relative to degenerative ones, although they finally recommended TLIF as a safe and effective treatment for both types and prevented typical adverse effects of anterior or posterior interbody fusion. In comparison, mean ODI improvement in our patients in groups A and B comprised 49.5 and 50.4 points, respectively. This significant difference in ODI in our study was primarily due to lower preoperative ODI scores. The rates of symptomatic pseudoarthrosis and reoperation in our study were 1.9% and 2.9%, respectively. Perhaps economic and cultural differences and also the amount of insurance coverage influenced the rate of reoperation in these two studies.

Moon et al.¹⁸⁾ reported the results of anterior surgery in 26 cases (16 degenerative and 10 isthmic low grade

spondylolisthesis) treated by the modified extraperitoneal Bailey-Badgley fusion construct. Non-union, graft crumbling, and redisplacement were significantly higher in the isthmic type; therefore, they concluded that isthmic type spondylolisthesis has more inherent instability relative to degenerative spondylolisthesis, and that anterior interbody fusion should not to be performed routinely in these cases. In our study, although the type of surgery and the approach were completely different, the rate of pseudoarthrosis in the degenerative and isthmic types was not significantly different (7.7% vs. 5.8%; $p = 1.645$).

Although our study was performed by a common surgical procedure (not by a minimally invasive spine surgery), it's the results are useful due to the significant number of patients and the homogeneity of the groups. Another disadvantage of our study was its retrospective design; therefore, a randomized controlled trial is strongly recommended with a type of minimally invasive surgery to be performed on patients with these two types of spondylolisthesis. In such a way, we can give patients a better explanation about the surgical efficacy on pain and disability improvement preoperatively.

In conclusion, neural decompression and posterolateral instrumented fusion significantly improved pain and disability in patients with degenerative and isthmic spondylolisthesis. The efficacy of surgery on overall subjective satisfaction rate, pain, and disability improvement was similar in both groups. Neurologic decompressive surgery on lumbar nerve roots seems to be associated with satisfactory outcomes, whether the region of compression was at the central canal, lateral recess, or foraminal area.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

ACKNOWLEDGEMENTS

We thank Dr. Ebrahimzadeh MH, the head of Orthopedic Trauma and Research Center, for his guidance in conducting this project. We also thank the Deputy of Research, Mashhad University of Medical Sciences for financial support.

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