Surgical treatment method of isthmic spondylolisthesis

Comparison of Two and Three Vertebral Segment Posterolateral Fusion in the Treatment of Isthmic Spondylolisthesis

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ABSTRACT

Background

Optimal surgical treatment method of isthmic spondylolisthesis remains unclear. Complications can be invited while saving a segment for lumbar motion.

Objective

The aim of this retrospective study was to determine the effect of the number of fusion levels on the clinical results of adult isthmic spondylolisthesis patients who had undergone posterior instrumentation and PLF.

Patients and Methods

This retrospective study comprised 37 (20 male, 17 female) patients with isthmic spondylolisthesis who had undergone posterior instrumentation and PLF (Postero-lateral fusion) between January 2005 and May 2011. Pre and post-operative radiological evaluation was made by anteroposterior, lateral, oblique and lateral flexion-extension x-rays. Preoperative spondylolisthesis slippage grading was evaluated according to the Meyerding classification from the preoperative radiographs.

Results

The mean age of the patients was 36. 4± 9. 2 years and the mean follow-up period was 34. 3 months. Two-level fusion was applied to 22 patients and single-level fusion was applied to 15 patients. Decompression was performed on 7 patients in the two-level fusion group and on 6 patients in the single-level fusion group. There were no neurological complication after surgery in either group. No union complications were seen in the two-level PLF group but in the single-level PLF group, screw loosening occurred in 3 patients and screw breakage in 1 due to the pseudoarthrosis. These four patients were revised with two-level PLF.

Conclusion s

This study has demonstrated that two-level posterior instrumentation and PLF with local bone grafts and DBM have significantly better clinical and radiological results than single-level surgery. To avoid potential complications of PLIF, two-level PLF can be an alternative treatment option.

Key words: Istmic spondylolisthesis, Posterior lumbar interbody fusion, Fixation

1. Background

Lumbar spondylolisthesis is present in about 5% to 6% of the population with various etiopathogenesis. Due to its variant pathological anatomy, the radiological appearance, age and clinical aspect of the patients are different on diagnosis. It generally starts as spondylolysis, a bilateral pars fatigue

fracture and becomes spondylolisthesis with a slip of a vertebra over the adjacent one. As the slip increases, disc degeneration and pain starts (1-3).

Although conservative treatment is the first treatment option, surgery for symptomatic spondylolisthesis in adults has been found to have better clinical results than conservative treatment choices (3, 4). However, it remains unclear which surgical strategy should be adopted, as there is limited scientific evidence on which to base an optimal treatment method. Discussions on spondylolisthesis treatment have generally focussed on reduction, fusion levels, graft choices, and surgical techniques (5-7).

One of the most preferred surgical treatment options for spondylolisthesis is posterior transpedicular instrumentation of the relevant segments and posterolateral fusion (PLF) (5, 7). However, it is still a matter of controversy in literature as to how many levels should be fused and instrumented.

2. Objectives

The aim of this retrospective study was to determine the effect of the number of fusion levels on the clinical results of adult isthmic spondylolisthesis patients who had undergone posterior instrumentation and PLF.

3. Materials and Methods

This retrospective study comprised 37 (20 male, 17 female) patients with isthmic spondylolisthesis who had undergone posterior instrumentation and PLF between January 2005 and May 2011. Patients with spondylolisthesis other than Type 2 according to the Wiltse classification were excluded from

the study. Pre and post-operative radiological evaluation was made by anteroposterior, lateral, oblique and lateral flexion-extension x-rays. Preoperative spondylolisthesis slippage grading was evaluated according to the Meyerding classification from the preoperative radiographs. The decompression decision was made preoperatively according to magnetic resonance imaging (MRI) and patients' preoperative neurological evaluation. Preoperative and postoperative neurological status, duration of surgery, number of fused and instrumented levels, total blood loss and complications were evaluated from the clinical database. For clinical evaluation of surgical outcomes, the Oswestry Disability Index (ODI) and Visual Analog Scale (VAS) applied at the final follow-up were used.

3. 1 Surgical procedure:

Exposure was obtained from the spinous processes to the transverse processes bilaterally throughout segments planned for fusion. Under fluoroscopic control, 6. 5 mm pedicle screws were placed by free-hand technique. No reduction manoeuvre was used. Decompression of the segments, which had been determined by preoperative MRI and clinical examination was performed for the patients with neurological deficit. In all cases PLF was performed. In the area planned for fusion, the spinous processes were resected, peeled off from soft tissues and used for grafting with demineralized bone matrix. Patients were mobilized with a soft brace on the first postoperative day and the brace was continued for 3 months. (Figure 1, 2)

3. 2 Statistical analysis

We used the SPSS software package (version 15. 0, SPSS, Chicago, IL) and expressed categorical variables as percentages and continuous variables as mean± standard deviation (SD) or median (quartiles). Kolmogorov-Smirnov test was used to evaluate whether the distribution of continuous variables was normal. For parameters that showed normal distribution we used the paired sample t test and for parameters that did not show normal distribution the Mann-Whitney U-test was used . Chi-square test was used to analyze categorical variables. Statistical significance was set at $p < 0.05$.

4. Results

All patients had a history of at least 3 months of lumbar pain due to the spondylolisthesis, which had proved to be resistant to conservative treatment. The mean age of the patients was 36. 4± 9. 2 years and the mean follow-up period was 34. 3 months. Low-grade isthmic spondylolisthesis was present at L5-S1 level in 23 patients, at L4-5 level in 13 patients and at L3-4 level in 1 patient. Two-level fusion was applied to 22 patients and single-level fusion was applied to 15 patients. Decompression was performed on 7 patients in the two-level fusion group and on 6 patients in the single-level fusion group. There were no neurological complications after surgery in either group. Mean duration of surgery for single-level and two-level surgery was 160 minutes and 190 minutes (160-240), and average blood loss was 285 ml and 390 ml respectively. There were no differences between the two groups in terms of demographic properties (Table 1).

One of the patients in the two-level PLF group had superficial infection and was treated with debridement and antibiotheraphy. No union complications

were seen in the two-level PLF group but in the single-level PLF group, screw loosening occurred in 3 patients and screw breakage in 1 due to the pseudoarthrosis. These four patients were revised with two-level PLF. (Figure 3)

ODI scores from the final follow-up were 12. 2±6. 2 in the single-level PLF group, and 9. 2 ± 6. 4 in the two-level PLF group (p= 0, 035). VAS scores were 3. 2±1. 7 in the single-level PLF group and 2. 9±1. 6 in the two-level PLF group (p= 0. 043). The ODI and VAS scores of the patients revised with two- level PLF were excluded from the clinical evaluation.

5. Discussion

Lumbar spondylolysthesis has several etiopathogenetic factors as was shown by Marchetti and Bartolozzi giving rise to variations in pathological anatomy, radiological findings, age and clinical symptoms of the patients on diagnosis. When conservative treatment options fail, surgery becomes the next step. Although there have been a large number of studies on spondylolisthesis, there is no clear evidence for a single superior treatment option. Anterior lumbar interbody fusion (ALIF), posterior lumbar interbody fusion (PLIF) and PLF with/without instrumentation are the most widely accepted surgical methods. Whilst PLF with instrumentation is the most preferred treatment for most authors, there is no scientific evidence showing that PLF is disadvantageous compared to PLIF or circumferential fusion (8-11) even though the major theoretical advantage of PLIF and circumferential fusion seems to have resulted in improved outcomes compared with PLF. Ekman et al (12) found that the type of fusion, whether PLIF or PLF, did not affect the

outcome of surgical treatment of adult isthmic spondylolisthesis over a two year follow-up period. Furthermore, PLIF is a more invasive, technically more difficult method requiring a longer operative time, which may result in increased blood loss and higher complication rates (12, 13). Similarly, Kim et al. could not demonstrate any difference between ALIF and PLF with instrumentation (11). Although circumferential fusion was reported as significantly better than PLF at 6 months and 1 year in a study by Swan, no difference was determined at two years (14). In a systematic review of 29 high quality studies, Jacobs and al. found no difference between different fusion techniques (15). In the current study the treatment choice was PLF with instrumentation which is a relatively easy method with a shorter operating time and lower blood loss compared to other techniques in literature.

When performing PLF, slip reduction can be achieved during the same procedure. The advantages of slip reduction include improved spine biomechanics, better nerve root decompression and a better opportunity for fusion by relieving tension and shear forces (5). Although the major disadvantage of slip reduction is increased risk of neurological injury, there have been numerous studies evaluating slip reduction for adult low grade spondylolisthesis (14, 16-18). In the current study, slip reduction was not performed to avoid the possibility of potential neurological damage and as all the cases had low grade isthmic spondylolisthesis.

To protect one more mobile segment, some authors have preferred single-level postero-lateral instrumentation and fusion instead of two-level (6, 13, 15). However, there is no scientific proof to help determine the number of

fusion levels and this decision is based on the surgeon’s empirical experience. In a prospective study by Inage et al, two-level fusion with local bone grafts was shown to cause increased pseudoarthrosis (6). Similarly in a study by Deguchi et al, single-level fusions showed an 82% fusion rate, and two-level fusions, a 74% rate radiologically (19). Higher fusion rates in the two-level fusion group were achieved with rigid spinal implants. The clinical success of that study correlated with the radiological fusion rates. Contrary to the information in literature, local bone grafts mixed with demineralized bone matrix (DBM) were used in the current study to achieve union for both groups and no union problem was seen in the two-level fusion group. Pseudoarthrosis was observed in four cases in the one -level fusion group.

Although some authors have reported incongruity between the clinical results of spondylolisthesis patients and union rates, VAS and ODI are the most reliable clinical tests to evaluate spondylolythesis (9, 10, 20). The results of the current study reveal that two-level posterior instrumentation with PLF has better results than single-level surgery according to VAS and ODI.

This study has some limitations. Firstly, the retrospective design did not allow for uniformity of the groups. The number of patients was also limited to achieve generalized results. Although the pedicle screws were all 6. 5 mm in size, they were not all from the same manufacturer, so implant problems were disregarded.

In conclusion, this study has demonstrated that two-level posterior instrumentation and PLF with local bone grafts and DBM have significantly

better clinical and radiological results than single-level surgery. To avoid potential complications of PLIF, two-level PLF can be an alternative treatment option.

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Tables

	Surgery Time (min)	Blood Loss (ml)	p
Single-	160±	285	0,

			1
level	29	±89	2
			7
			0,
	190±	390	0
Two-level			
	34	±95	8
			4

Table 1. Paramaters of groups during surgery

1