Multilevel Lumbar Spondylolisthesis: Comparative Study between two Surgical Fusion Techniques

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ABSTRACT

Background: Degenerative lumbar spinal stenosis is a common pathology characterized by multilevel disc herniation and lumbar spondylolisthesis, which are difficult to treat. Objectives: The current study aimed to compare the short-term clinical outcomes of two surgical techniques of management of this pathology. Patients & Methods: 40 patients of multilevel lumbar spondylolisthesis were included in this study. Patients were randomly divided into two groups according to the surgical approach used in treatment. Group (A): Were operated upon by posterior decompression, transpedicular screw fixation and posterolateral intertransverse bony fusion. Group (B): was operated upon by posterior decompression, transpedicular screw and transforminal lumbar interbody fusion (TLIF). Results: Statistical significance was reached in terms of surgery time, blood loss, hospital stay, and fusion rates, but there was no significant difference between the two groups as regards the post-operative JOA score and the complication rates. Conclusion: The application of the lumbar interbody cage (TLIF cage) proved to have better fusion rates than intertransverse bony fusion, but still intertransverse bony fusion gives same results regarding postoperative clinical improvement with shorter hospital stay and operative time.

Keywords: multilevel lumbar spondylolisthesis, fusion rates, JOA score, TLIF, posterolateral fusion.

INTRODUCTION

Spondylolisthesis is defined as the forward displacement of one vertebra relative to another. This “slip” usually occurs when the locking mechanism constituted by the laminae and facet joints has failed, 90% of cases occur at the L4/L5 and L5/S1 levels (7). Six types of listhesis have been described according to the Wiltse-Newman-MacNab classification system and include the isthmic, degenerative, dysplastic, traumatic, pathologic and iatrogenic forms. Spondylolisthesis can be graded by Meyerding grading system according to the degree of anterior translation of the top vertebral body in relationship to the bottom vertebral body into four grades (4).

Nonoperative management is the primary treatment for patients with low-grade adult degenerative spondylolisthesis who present with acute or chronic low back pain. However, studies have shown that up to one third of patients with isthmic or degenerative spondylolisthesis are at risk for progressive lithesis which may lead to neurological deficiencies (9).

Indications for operative treatment include failure of conservative therapy for at least two months, disturbing postural abnormality, neurological deficit, observed slip progression (11). Operative treatment employs variable combinations of decompression, bony fusion, and instrumentation. This can be achieved by a variety of methods including anterior interbody, posterior interbody, posterior, intertransverse, or transforminal lumbar interbody fusion. However, intertransverse fusion has gained the widest clinical acceptance (5). The fusion rates in lumbar spine surgery can vary according to the technique. Although numerous studies on spinal fusion have been conducted, their outcomes are so inconsistent that it is difficult to determine which approach provides the highest fusion rate. Therefore, in this study, an attempt was made to compare fusion rates between two of the most prevalent surgical fusion techniques. The addition of multiple levels in the surgery increases the complexity of the procedure somewhat and also increases the risks compared to single-level fusion surgery. Potential problems with blood loss, arterial and venous thrombosis, and post-operative wound infections are directly related to the length of surgery, and multilevel procedures generally take longer than single-level fusions (13).

PATIENTS & METHODS

This study included 40 patients of multilevel lumbar spondylolisthesis. All cases tried conservative measures for at least two months of active physiotherapy program, non-steroidal anti-inflammatory medications & lumbosacral brace before going to surgical treatment. The patients were randomly chosen and divided into two groups according to the surgical approach used in treatment.

• Group (A): patients will be operated upon by posterior decompression, transpedicular screw fixation and posterolateral intertransverse bony fusion.
• **Group (B):** patients will be operated upon by posterior decompression, transpedicular screw and transforminal lumbar interbody fusion (TLIF).

All cases were operated upon in Kasr El-Aini Hospitals, Cairo University between November 2011 and August 2012. The follow-up period ranged from 6 to 11 months.

Full personal history was taken from all cases. Full preoperative and postoperative neurological examination was also done for all cases. The Japanese Orthopedic Association (JOA) evaluation system for measuring low-back pain syndrome was utilized.

Operative technique: General anesthesia was administered in all cases; patients were positioned in the prone position. The C-arm was used to confirm the location of the pathology and to plan the pedicle screw insertion. A midline skin incision was used overlying the affected level with exposure of one or two levels above and below that level for adequate exposure; the dissection was carried down to the fascial level. The paraspinous musculature was dissected off the spinous processes, laminae and facets using electro cauterization or subperiosteal muscle separation. Adequate bony and ligamentous decompression was then performed in all cases followed by transpedicular screw fixation of the affected levels.

In **group (A) patients** dissection was continued laterally over the transverse processes using electro cauterization. The bony surface of the transverse processes was decorticated with a pituitary rongeur or a drill. The bone removed from the decompression was packed over the decorticated transverse process after the soft tissue had been removed adequately.

In **group (B) patients** Exposure of the disc space was done on one side by removing the facet joints and protecting the nerve roots. The disc space was entered and disc material was removed. An interbody cage, filled with bone graft was placed into the disc space to maintain the disc height.

Clinical follow-up: Assessment was done with JOA score and physical examination immediately post-operative, and then at 3 months intervals postoperatively.

**Statistical Methods:** All of the statistical analyses were processed on a personal computer running commercially available software (SPSS, Inc. & Microsoft Office Excel 2010). Depending on the characteristics of the variables being compared, various tests were used. A probability value of less than or equal to 0.05 was considered to indicate statistical significance. Mean data were presented.

**RESULTS**

The data collected from 40 cases of surgically managed spondylolisthesis was analyzed. Patients were randomly divided in the two groups. The mean age in group (A) was 45.3 years, while in Group (B) it was 52 years, which shows no statistical significance. In group (A); 8 cases were males (40%) and 12 cases were females (60%), while in group (B) 9 males (45%) and 11 females, this has no statistical significance (By Chi-square $x^2$). The mean BMI (body mass index) was 31.7 in group (A) and 32.5 in group (B), this also had no statistical significance. (BY student t test) **Clinical presentation:** Most of the cases presented with back pain and claudicating pain in both groups. In group (A) patients had higher percentage of cases presenting with sciatica 46.6% than group B 22.6%.( fig.1). **Radiologically** The number of fusion levels in group (A) was 3 levels in 14 cases 4 levels in 6 cases, while in group B was 3 levels in 16 cases and 4 levels in 4 cases, and this has no statistical significance (By Chi-square $x^2$).

![Figure (1): presenting clinical picture in both groups.](image-url)
Table (1): Preoperative (JOA score)

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>Significance *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative (JOA score)</td>
<td>6.8</td>
<td>6.6</td>
<td>N.S</td>
</tr>
<tr>
<td>Low-back pain</td>
<td>1.2</td>
<td>1.1</td>
<td>N.S</td>
</tr>
<tr>
<td>Leg pain</td>
<td>1.5</td>
<td>1.3</td>
<td>N.S</td>
</tr>
<tr>
<td>Walking ability</td>
<td>1.4</td>
<td>1.5</td>
<td>N.S</td>
</tr>
<tr>
<td>Straight leg raising test</td>
<td>0.7</td>
<td>0.6</td>
<td>N.S</td>
</tr>
<tr>
<td>Sensory abnormality</td>
<td>0.9</td>
<td>1.1</td>
<td>N.S</td>
</tr>
<tr>
<td>Manual muscle testing</td>
<td>1.1</td>
<td>1</td>
<td>N.S</td>
</tr>
</tbody>
</table>

* By Student t test  \( p \)-value > 0.05

**Post-operative Clinical Evaluation:** No statistical difference between the two groups as regard the post-operative JOA score except that group (A) had significant lower post-operative walking ability score (shorter claudicating distance) than does the fusion group (B) (\( P < 0.05 \)).

- Group (B) had higher mean rate of improvement 92.1% than does group (A) 89.1% with no statistical difference (\( P > 0.05 \)). Table (2)

Table (2): post-operative clinical evaluation.

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>Significance *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postoperative (JOA score)</td>
<td>14.1</td>
<td>14.3</td>
<td>0.137</td>
</tr>
<tr>
<td>Low-back pain</td>
<td>2.8</td>
<td>2.9</td>
<td>0.13</td>
</tr>
<tr>
<td>Leg pain</td>
<td>2.9</td>
<td>2.8</td>
<td>0.07</td>
</tr>
<tr>
<td>Walking ability</td>
<td>2.6</td>
<td>2.9</td>
<td>0.042</td>
</tr>
<tr>
<td>Straight leg raising test</td>
<td>2</td>
<td>2</td>
<td>0.23</td>
</tr>
<tr>
<td>Sensory abnormality</td>
<td>1.9</td>
<td>1.8</td>
<td>0.35</td>
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<tr>
<td>Manual muscle testing</td>
<td>1.9</td>
<td>1.9</td>
<td>0.47</td>
</tr>
<tr>
<td>Rate of improvement %</td>
<td>89.1</td>
<td>92.1</td>
<td>0.137</td>
</tr>
</tbody>
</table>

*By Student t test

**Complications and hospital stay:** The mean hospital was 2.7 days in Group (A) and 4.2 days in Group (B), which was statistically significant (\( P < 0.05 \)). 2 cases had infection in group (A) and 1 case in group (B). 1 case has CSF leak in group (B), this wasn’t statistically significant. The mean operative time was 3 hours (2-4 hours) in group (A), significantly shorter than group (B) which was 5 hours (3-6 hours). The mean blood loss was significantly lower in group (A) 400cc, than group (B) 700cc. Figure (2)

**Figure (2):** mean duration of operation and blood loss in both groups.

**Postoperative fusion:** There was a clear statistical significance between fusion rates in both groups. 85% of cases (17 patients) showed signs of fusion in Group B versus 65% in group A (13 patients). \( P = 0.029 \).
Figure (3): A and B: Preoperative X-ray and MRI of a female patient with history of trauma 1 year ago, showing fracture pars L4-5, L5S1 and spondylolysis. C and D: Postoperative X-ray showing decompression and posterolateral fusion.

Figure (4) showing images of a 55 yrs. male patient with past history of previous laminectomy L3,4,5 and discectomy L3-4, L4-5 one year ago. Left: MRI showing L3,4,5 spondylolysis. Right: postoperative image after L3, 4,5 fixation with posterolateral screws and TLIF cages.
DISCUSSION

Multilevel lumbar spondylolisthesis is a common problem. Treatment choices are either conservative care or operative intervention. Non operative methods are effective in the treatment of most patients with symptomatic lumbar spondylolisthesis and spinal stenosis. Surgery was advised to patients in this study who failed to respond to a reasonable trial of non-operative treatment for 8 weeks.

The mean age in our study was 49 years, which is noticeably younger than many studies. Jacobsen et al., reported a mean age of 68 years in men and 71 years in women. Booth et al., reported mean age of 66 years in their study.

Both groups were operated upon by adequate decompression of the nervous structures through removal of compressing bony, ligamentous and disc elements. This was reflected in results regarding postoperative clinical improvement, no statistical significance was found between the degree of improvement, by comparing pre and post-operative JOA score, 89.1 in group A versus 92.1% in groups B. (p=0.137).

We found no significant difference in complications rate between the two studied groups. This is coinciding with Ghogawala et al., who reported similar rate of superficial infection and no difference in complication rate between two groups. This could be explained by the limited number of cases that lead to an overall low complication rate. Hospital stay is non-significantly higher in TLIF fusion group than PL fusion group; too many authors also reported this finding.

The main statistical difference in our study was noticed in aspects of operative time, blood loss, and postoperative fusion rates. The average blood loss in posterolateral fusion was 400ml compared to 700ml blood losses in interbody fusions, this results was coinciding with results reported by McAfee et al. and Coe and Vaccaro. In our study the average time for multilevel posterolateral fusion was 3 hours, versus 5 hours in TLIF group, which is significant, which also coincided with the results reported by Coe and Vaccaro.

As regard fusion we have a fusion rate of 85% in the TLIF group in a mean follow up period of 11 months, this is coinciding with Tokuhashi et al., who had a fusion rate of 92.8% over 3 years follow up. The posterolateral group showed 65% fusion rate after 9 months follow up. La Rosa et al evaluated 35 consecutive patients who underwent pedicle screw fixation for isthmic spondylolisthesis, with 18 cases having PL fusion and 17 having PLIF. At 2-year follow-up, the correction of subluxation, disc height, and foraminal area were maintained in the PLIF group but not in the PL fusion group, these differences were statistically significant.

CONCLUSION

The application of the lumbar interbody cage (TLIF cage) proved to have better fusion rates than intertransverse bony fusion, but still intertransverse bony fusion gives same results regarding postoperative clinical improvement with shorter hospital stay, intraoperative blood loss, and operative time.
REFERENCES


