Surgical Management of High-Grade Spondylolisthesis

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Abstract

Introduction: High grade spondylolisthesis is surgically challenging problem, despite its distinct minority approximately 4-8% in most series, the problem is a source of ongoing debate about the optimum surgical treatment.

Aim of the Work: The aim of this study to evaluate the clinical and radiological outcome in total of 27 patients with high grade spondylolisthesis treated by instrumented posterior fusion using reduction pedicle screw system.

Material and Methods: A total of 27 patients with high grade spondylolisthesis (grade III, IV), had been surgically treated during the period from January 2009 and December 2011 the average follow-up with (16 ± 2 months) 7 patients lost follow-up 6 months following surgical intervention. 12 out of 27 patients developed post-operative complication with was transit in the form of CSF leak in 6 patients and radicular pain in 4 patients and two patients developed new neurological deficit with was permanent. The clinical outcome was excellent in 24 patients 2 patient had good outcome and one patient had poor outcome.

Conclusion: Posterior lumbar instrumented fusion using reduction pedicular screw system is good surgical option in treating high grade spondylolisthesis, however long term outcome could enlighten more details about the validity of this system to treat such challenging problem.

Key Words: High grade – Spondylosis – Pedicular screws.

Introduction

HIGH grade spondylolisthesis is surgically challenging problem, it refers to anterior or posterior displacement of adjacent vertebrae. The Wiltse classification divides spondylolisthesis based on anatomic presentation and etiology: Isthmic, dysplastic, degenerative, traumatic, and pathological [1]. Symptoms include low back pain, radicular neuropathy, or mechanical instability, and deformity as the "listhetic posture" of hyperlordosis cephalad to the LS deformity, but many patients remain asymptomatic. The incidence of spondylolisthesis in the general population is 4-8%, with isthmic being the most common. In 1994, Bartolozzi and Marchetti developed a separate classification system that introduced “developmental spondylolisthesis,” which combined dysplastic and lytic etiology. This category highlights that many high-grade slips result from multiple stress fractures with a developmental etiology whereas lower grade slips commonly exhibit a degenerative etiology [2]. Both dysplastic and isthmic components can occur simultaneously.

Slips greater than 50% are considered as High-grade Spondylolisthesis (HGS), which accounts for 1% of spondylolisthesis patients, but constitutes a more serious pathology. Patients who progress to HGS are frequently symptomatic with back pain, radicular symptoms from nerve root irritation and postural deformities such as compensatory lumbar hyperlordosis for focal kyphosis [2].

Surgical intervention is generally favored over non-operative management for patients with symptomatic HGS to halt deformity progression and provide symptom relief [2]. However, no consensus for optimal surgical modality exists. Historically, surgeries performed for HGS mimicked those utilized for low-grade spondylolisthesis such as in situ uninstrumented posterior fusions [1]. However, due to concerns over further progression and pseudarthrosis, particularly in adults, coupled with technological and surgical advancements, surgeons now favor instrumented fusions [3,4].

Current treatment options for HGS vary greatly from in situ fusion with or without decompression to reduction and/or instrumentation and inter-body fusion through anterior or posterior-based approaches with or without decompression [5].

Material and Methods

A total of 27 patients with high grade spondylolisthesis (grade III, IV), had been surgically treated during the period from January 2009 and...
December 2011. Demographic data, neurological assessment were collected from patients files.

All patients had pre operative CT, MRI, dynamic plain X-ray lumbosacral spine.

The indications for surgery were persistent low back pain, ± radicular pain, severe displacement, a major impairment of quality of life or slip progression.

**Surgical procedure:**

General anesthetic was used for all patients. Through the standard midline approach, L4-S 1 was exposed. The laminal arch of L5 and ligamentum flavum of L4/5 and L5/S 1 were removed. Pedicle screws were placed in L4, L5 and S 1 (using reduction screw at L5) using C-arm guidance. S1 pedicle screws were placed to the anterior promontory for bicortical purchase. L5 roots were thoroughly decompressed in the isthmus region by removing bony callus and granulation tissues of the spondylolysis. The L5 roots were exposed laterally until exiting from the foramen to release the L5 roots from tension completely. The osteotomy of the sacral dome was performed from both sides in an antero-medial direction using straight osteotomes. The L5/S 1 disc was exposed bilaterally and excised. L5 slippage was gradually reduced simultaneously under lateral fluoroscopy. L5 roots were continuously visualized to make sure that they were not tightened. It is not necessary to aim for full reduction in order to avoid L5 root dysfunction. Disc spacers (polyetheretherketone (PEEK) cages) with iliac bone graft are inserted into the L5/S 1 disc space. Low profile (size 11 mm) cages were used to avoid stretching the L5 roots and to allow reconstitution of lordosis. Posterolateral intertransverse fusion from L5 to S1 was performed using cancellous bone from the resected posterior elements and iliac crest grafts, closure after insertion of suction drain.

**Radiological assessment:**

CT, and dynamic lumbosacral spine was done on the 1st post-operative day, and at 3, 6, 12, 18, 24 months post-operatively.

**Clinical assessment:**

Numeric pain scale was used to evaluate patient pre-and post-operatively.

**Outcome assessment:**

**Excellent outcome:** Patient with no or infrequent pain (back pain or sciatica) postoperatively, needs no continuous medications, and back to his normal daily activity.

**Good outcome:** Patient with infrequent pain (either back pain or sciatica), and needs medications to control his pain, can partially carry out his daily activity.

**Poor outcome:** Patient has persistent pain (either back pain or sciatica) which is not well controlled by medications, and cannot carry out his daily activity.

**Results**

A total of 27 patients with high grade spondylolysis were operated upon. The age ranged from 18 to 46 years with mean of 34±4, 6 years. There were 19 males and 8 females. The main symptoms were back pain in all patients followed by radicular pain in 24 patients. Sphentric disturbance in one patient. The average follow-up with (16±2 months) seven patients lost follow-up 6 months following surgical intervention.

12 out of 27 patients developed post-operative complications with was transit in the form of CSF leak in six patients and immediate radicular pain in 4 patients and two patients developed new neurological deficit with was permanent in one patient.

The clinical outcome after 6 months was excellent in 24 patients 2 patient had good outcome and one patient had poor outcome.

After 6 months, only 20 patients can be evaluated after this period; 17 were excellent, 2 were good and 1 was poor outcome.

After 12 months, two patients had loss of the screws at follow-up CT, and one patient had fracture L5 screw on one side. All of them have been reoperated by change of the screw with next size after filling the screw tract with cancellous bone harvested from the iliac crest.

**Radiological outcome:** No patient had evidence of slip progression on repeated imaging, and all had evidence of fusion without pseudarthrosis (n 27 (100%).

**Clinical outcome:** All patients had at least some improvement in their pain symptoms as measured by clinical report standardized scales.

**Numerical rating score for pain:** The vast majority had some improvement or at least average or better functional outcome postoperatively as measured by clinical report.

**Complications:** Immediate post-operative complications occurred in 12 out of 27 patients, includ-
ing CSF leak in six patients, radicular pain in 4 patients which remained persistent in two of them two patients developed new motor defect which was transient in one and remained in the other.

Table (1): Demographic and clinical data of 27 patients with high grade spondylolisthesis.

<table>
<thead>
<tr>
<th>Number of patients (%)</th>
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<tbody>
<tr>
<td>Sex:</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Clinical presentation:</td>
</tr>
<tr>
<td>LBP</td>
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<tr>
<td>Radicular pain</td>
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<td>Sphinctric problem</td>
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Table (2): Post-operative complications in 27 patients with high grade spondylolisthesis.

<table>
<thead>
<tr>
<th>Type of complication</th>
<th>Number of patients (%)</th>
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<tbody>
<tr>
<td>Immediate:</td>
<td></td>
</tr>
<tr>
<td>CSF leak</td>
<td></td>
</tr>
<tr>
<td>Radicular pain</td>
<td></td>
</tr>
<tr>
<td>Motor deficit</td>
<td></td>
</tr>
<tr>
<td>Late (after 6 months):</td>
<td></td>
</tr>
<tr>
<td>Radicular pain</td>
<td></td>
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<tr>
<td>Motor deficit</td>
<td></td>
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<td>Hardware failure</td>
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Table (3): Clinical outcome in 27 patients with high grade spondylolisthesis.

<table>
<thead>
<tr>
<th>Clinical outcome</th>
<th>Number of patients (%)</th>
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<tbody>
<tr>
<td>After 6 months (n=27):</td>
<td></td>
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<tr>
<td>Excellent</td>
<td></td>
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<tr>
<td>Good</td>
<td></td>
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<tr>
<td>Poor</td>
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<tr>
<td>After 12 months (n=20):</td>
<td></td>
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<tr>
<td>Excellent</td>
<td></td>
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<tr>
<td>Good</td>
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<td>Poor</td>
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Discussion

High-grade lumbar spondylolisthesis (Meyering grade III, IV, and V) can be a challenging entity to treat [1]. In adults, it is often associated with a variety of symptoms, including chronic back pain, radicular pain, paresthesias in a dermatomal distribution, and rarely leg weakness and bowel and bladder incontinence [6].

Nonoperative management of high-grade spondylolisthesis includes bracing and physiotherapy. Good results have been reported with the use of a brace, exercise programs and mixed conservative treatments [5,7]. However, these studies commonly have been retrospective with different populations of patients, which limits the validity of the conclusions. It has been shown that patient’s outcome is highly influenced by the method used to measure it. For some patients with high-grade spondylolisthesis, the most important symptom is pain, which is subjective and difficult to quantify. Moreover, there is a tendency for spontaneous improvement with time [5,7].

It was reported the long-term outcome of 11 patients who had high-grade spondylolisthesis and were never operated on. They high-lighted that these patients only required minor adjustment to remain functional in their occupations. No evidence was provided for the need of prophylactic fusion of asymptomatic high-grade spondylolisthesis [6].

The ultimate goal of treating high-grade L5-S 1 spondylolisthesis is to improve back and radicular pain and to prevent slip progression [8,9]. The goal of operative intervention is to decompress neural structures, to improve or maintain sagittal balance via slip reduction or stabilization, and to provide a stable fixation for fusion [10-13]. Exceptions to these goals are found in the literature. Reduction and instrumented fusion without decompression has been used with good results [7]; however, symptom improvement is not necessarily reliant on complete slip reduction as partial reduction with transsacral instrumentation at L5-S 1 via posterior or anterior approach has shown good results. In situ fusion without reduction is also considered acceptable if sagittal balance is preserved [13,14].

The literature supports that some patients with good quality of life were selected to undergo surgery; the results showed no improvement of quality of life post-operatively. It shows that surgery has the greatest impact for patients with significant impairment in their quality of life, while it may provide only minor improvement for those with a relatively normal quality of life at initial presentation.

The accepted treatment of high-grade spondylolisthesis is surgery. But the surgical method of high-grade dysplastic spondylolisthesis remains controversial in terms of in situ fusion versus reduction. The goal for surgical treatment of high-grade dysplastic spondylolisthesis is neural decompression and achieving a solid fusion to relieve the pain and neurological dysfunction. While satisfactory clinical outcomes have been reported after in situ fusion, this procedure is associated with high rates of pseudarthrosis and slip progression.
On the other hand, the technique of fusion with instrumentation and reduction of the L5 slippage with restoration of segmental lordosis and correction of the pelvic retroversion allows for full nerve decompression, promotion of bony union, and normalization of the overall sagittal profile. Subsequent to the report of transpedicular screw fixation for severe spondylolisthesis.

In this study, intractable pain either radicular or back pain followed by sphinctric problem were the main indications of surgery.

In considering fusion techniques, anterior and posterior column support is especially important to relief the compressive axial load and to decrease the posterior tensile load created by the spondylolisthesis. Posterior fusion techniques have included in situ noninstrumented fusion, pedicle screw instrumentation with or without sacral dome resection [15,16], transsacral fibular strut graft (Bohlman technique) with pedicle screw fixation.

Operative fixation is recommended failing a prolonged trial of conservative therapy to improve symptoms, or in the setting of radiographic slip progression. A number of operative techniques for correcting high-grade L5-S1 spondylolisthesis have been described. Although no gold standard technique exists, posterior spinal fusion with instrumentation, either alone or in conjunction with another technique had been described by many authors.

In this study, we used the posterior lumbar pedicle screw fixation, with reduction screw at L5 level, we used to do adequate decompression of the L5 root bilaterally before starting the reduction, to avoid injury of the nerve root or tethering. Then we aimed to remove the lump of the sacrum under the L5 root to prevent injury of the root during reduction, and we utilized low profile cage to help fusion also to keep the inter-vertebral foramens patent and prevent compression of the root after reduction, which we do simultaneously at both sides on the same time. The aim is always not to reduce the slip fully, but as much as we felt, if more reduction we do, the L5 root will be tethered and endanger for injury.

Treatment of high-grade spondylolisthesis, regardless of technique, has been associated with serious complications, such as new neurologic deficits, pseudarthrosis, construct failure, and accelerated adjacent segment disease [14].

In this study, the incidence of immediate postoperative complications was 44%, as most of them were transient, this percentage dropped to 22% when evaluated after 6 months of surgery. The permanent complications were persistent radicular pain in 2 (7.40%) patients, permanent motor deficit in one (3.70%) patient. However the hardware failure occurred in 3 (11.11%) patients and mainly secondary to pseudo-arthrosis which necessitate revision surgery.

The results from surgical management of high-grade spondylolisthesis usually have been reported as satisfactory and preferable [17]. However, based on a recent Scoliosis Research Society morbidity and mortality database review, surgical intervention in patients with spondylolisthesis comes with more than 10% complication risk [16]. In addition, surgical intervention to reduce the slip percentage has been associated with an increased risk of neurological deficit [18], although correction of the kyphotic slip angle is probably more important than reduction of slip.

As the incidence of permanent complications in this study were related to attempts of full reduction at the initial cases which result in root injury with subsequent either persistent radicular pain or motor deficit.

Failure of fusion was the main cause of hardware failure due to stress over the implant. However, this incidence was evaluated after one year. May be long term follow-up would reveal higher incidence of such problem.

References


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