

# Short Term Comparison of Functional Results in Transforaminal Interbody Fusion and Posterolateral Fusion for Spondylolisthesis

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**Abstract:** *Spondylolisthesis is a subluxation of vertebral body over another in sagittal plane. Earlier it was thought to be due to defect in the pars interarticularis at birth but now newer concept suggests that the defect occurs due to small stress fractures that fail to heal and form a chronic nonunion in the most common type that is isthmic subtype B. The treatment in spondylolisthesis is based on the severity of symptoms and not the grade. Usually the lower the grade the lesser the symptoms. When the slip is more significant, there may be a higher risk of the problem progressing, and surgery may be favoured. In addition, patients who have symptoms of nerve compression are more likely to have surgery recommended. Basically the ideal treatment remains controversial. A common consensus has not yet been reached on surgical management of isthmic spondylolisthesis especially regarding surgical procedure. Both transforaminal interbody fusion (TLIF) and posterolateral fusion (PLF) have been described as a surgical modality in the literature but with the available literature it is still difficult to describe which among the two has a better outcome. Hereby in our study we are comparing the results of the two procedures done on patients of spondylolisthesis*

**Keywords:** TLIF, PLF, Spondylolisthesis, pedicle screws

## 1. Introduction

Spondylolisthesis is defined as anterior or posterior slipping of one segment of the spine on the next lower segment. The term spondylolisthesis was given by Kilian in 1854 and is derived from the Greek word spondylos, meaning “vertebra,” and olisthenein, meaning “to slip”.<sup>1</sup> Herbiniaux, a Belgian obstetrician, noted a bone prominence in front of the sacrum that caused problems in delivery. So he was first to describe spondylolisthesis. Compensatory mechanisms are lost which maintain adequate posteriorly directed force vector, thus a shear force exists in the intervertebral disc space which cause anterior slippage of vertebral body<sup>1</sup>.

Spondylolisthesis is characterized by failure of three-column support with severe complex instability.<sup>2,3</sup> Spondylolisthesis is a common cause for lower-back pain, radiculopathy, and neurogenic claudication among the adult population<sup>4</sup>. Chronic pain affects function and quality of life of large number of individuals. “Back-problems” is among the most common cause of medical and socioeconomic problems in the world today<sup>5</sup>. Chronic LBP alone represents 1.7% of the gross national product of European countries.<sup>6,7</sup> Failure in the isthmic form is caused by a defect in the pars interarticularis, and occurs in up to 8% of the general population in individuals of all ages.<sup>2</sup> Earlier it was thought to be due to defect in pars interarticularis at birth but now newer concept suggests that the defect occurs due to small stress fractures that fail to heal and form a chronic nonunion in the most common type that is isthmic subtype B. The treatment in spondylolisthesis is based on the severity of symptoms and not the grade. Multiple treatment options

from conservative and medical management to surgical treatment i.e. short segment fusion procedures with or without instrumentation are given in literature. Usually the lower the grade the lesser the symptoms. When the slip is more significant, there may be a higher risk of the problem progressing, are more likely to have surgery recommended. Basically the ideal treatment remains controversial.

At present, posterolateral fusion (PLF) is still considered to be “the gold standard for fusion of the isthmic spondylolisthesis. However, a wide variety of other fusion procedures including pedicle screw fixation, anterior lumbar interbody fusion (ALIF) or “360°-fusion” e.g., PLF in combination with ALIF, PLIF or TLIF offer at least in theory, advantages over PLF alone. To date, no significant differences in the outcomes obtained with different fusion procedures has been documented.<sup>9,10</sup>

Higher rate of fusion but without better clinical outcome, has been reported with instrument guided fusion<sup>11</sup>. Fusion of spine increases mechanical load on adjacent spinal segments. Due to increase in load degenerative changes appear earlier<sup>12</sup>. Fusion with or without instrumentation has thus showed very good results in earlier stages but a poor outcome on long term evaluation. A common consensus has not yet been reached on surgical management of isthmic spondylolisthesis especially regarding surgical procedure. Some authors have recommended decompression and arthrodesis while others have recommended arthrodesis alone.

„Isthmic“ is word derived from greek language which means narrow. The isthmic type involves a lesion in the pars

interarticularis (the part of bone between the superior and inferior articular processes)<sup>13</sup>. Bilateral pars defects are needed to allow slippage. It occurs in up to 8% of the general population in individuals of all ages and upto 6% of the population by young adulthood<sup>2</sup>. It occurs about equally in men and women. Adult isthmic spondylolisthesis is nonprogressive, although symptoms of back pain and radiculopathy are common. Isthmic spondylolisthesis affects L5 in 89% of patients, L4 in 8%, and L3 in 3%. In adults, the slip usually is less than 50% and usually causes accelerated degeneration of the disc at the level of the pars defect. The slip occurs due to defect in pars interarticularis which interferes with bony hook of affected spinal motion segment. The bony hook consists of pars, pedicle, and inferior articular facet of cephalad segment and superior articular facet of caudal segment. The posterior elements subsequently separate through the pars fracture, leading to translation of entire trunk anteriorly over sacrum or caudal vertebral body. Severe slips affects sagittal balance because of forward shift of body's centre of gravity<sup>1</sup>. Developmental spondylolisthesis with lysis occurs due to stress fracture that occurs in children with a genetic predisposition for the defect. Lumbar lordosis is accentuated by the normal flexion contractures of the hip in childhood and that this posture places the weight bearing forces on the pars interarticularis. Letts et al. suggested that shear stresses are greater on the pars interarticularis when the lumbar spine is extended. Cyron and Hutton found that the pars interarticularis is thinner and the vertebral disc is less resistant to shear in children and adolescents than in adults. It also is more common in certain types of sporting activities with repetitive hyperextension and rotational loads applied to the lumbar spine. The incidence is as high as 47% in athletes who participate in sports. These observations indicate that the condition is acquired rather than congenital. Around 50% of Eskimos were reported to have spondylolisthesis, about 6-7% of white males and 1.1% of adult black women have this condition, indicating a definite genetic predisposition<sup>1</sup>.

## 2. Biomechanics of Spondylolisthesis

While maintaining erect posture during standing and sitting, tensile stress within the parsinterarticularis is produced due to vertical loading which leads to fatigue failure and microfractures in the pars. Because of defect in pars interarticularis there is a failure of the compensatory mechanisms to maintain an adequate posteriorly directed force vector, the shear forces thus leads to anterior vertebral body slippage.

Erector spinae produces extensor torque because of its attachment to the spinous process which increases the stress on the pars which may be a cause for fracture.

Spondylolisthesis is a condition characterized by a failure of the three-column support with severe complex instability requiring reconstruction of the altered supporting structures<sup>2</sup>.

There is high incidence (30%) of isthmic or dysplastic spondylolisthesis among first-degree relatives, along with its association with spina bifida occulta indicate that there is a hereditary pre-disposition for this defect. The incidences among athletes and individuals experiencing repeated stress

to the lumbar back are elevated, lending support to the proposal that spondylolysis and isthmic spondylolisthesis result from a fatigue fracture caused by activities associated with ambulation.

## 3. Material and Methods

A non randomised study was done on 40 patients of lumbar spondylolisthesis with single or double level listhetic vertebrae. Two groups were made each of 20 patients, where either instrumented posterolateral fusion or transforaminal interbody fusion was done. In both the groups decompression of the nerve roots was done. The graft for fusion was taken from the spinous process and the bone removed in partial facetectomy and laminectomy. All patients were operated by the same surgeon and all the radiographs were reviewed by independent observer.

### Inclusion Criteria

- 1) patients with spondylolisthesis between 18 to 60yrs which requires surgical stabilization.
- 2) Single or double adjacent level listhesis.

### Exclusion Criteria

- 1) Other causes of spondylolisthesis like degenerative, traumatic, dysplastic and pathological.
- 2) Patients with age less than 18 and more than 60 yrs
- 3) Patients with any other spine pathologies.

### Patient selection and Pre operative planning

Patient with low back pain or radiculopathy were assessed and the initial diagnosis of spondylolisthesis was made by AP and Lateral plain radiographs. Patients were thoroughly examined clinically and detailed history was taken to select the cases. All cases were subjected to standing Lateral flexion and extension stress radiographs to confirm the instability and diagnosis. Lesion in pars interarticularis was confirmed by CT scan. MR scan was done on all the cases to rule out other causes of back pain, radiculopathy and extent of nerve root involvement. All the patients who had failed conservative management or patients who required initial surgical management were planned for operative management.

### Operative procedure

All patients were thoroughly evaluated pre operatively for any contraindications for general anaesthesia. Patients who were fit to undergo the procedure were selected. Patients were operated under general anaesthesia. Patient was positioned prone on a Realton hall frame as this helps in decreasing intraabdominal pressure and thus helps in reducing intraoperative bleeding. The knees were kept inflexed position by keeping a pillow below the legs. Proper padding in all pressure points i.e.knee, axilla and forearms is done. All patients are preoperatively catheterised. The level of spondylolisthesis is confirmed by C-arm following which a posterior midline incision over the spinous processes is taken. Under complete hemostasis by packing and bipolar electrocauterisation the paraspinal musculature is subperiosteally elevated and the transverse process is exposed on both sides. Adequate decompression is ensured by excision of pseudoarthrosis, foraminotomy and laminotomy.

Posterior instrumentation using pedicle screws followed by using the bone graft posterolateral fusion was done in one group and using a TLIF cage interbody fusion was done in the other group of patients.

#### 4. Post Operative Protocol

The suction drain were removed after second post operative day. Sutures removal was done on 14th post operative day. Ambulation was started on the 2nd post operative day with a lumbosacral belt or KT brace. After removal of sutures patient is followed up at 1st month, 3rd month, 6month, 9 month, 1yr and following that yearly. Plain radiographs were taken on each follow up day to assess the implant position and fusion.

#### Analysis

Cases were regularly followed up postoperatively for a minimum of 6 months and maximum of 2 yrs to gather information regarding clinico-radiological outcome of the surgery. Fusion and stability was assessed clinically by subjective pain and neurological manifestation assessment using VAS & Functional status was assessed using Prolo's scale.

#### Fusion assessment

- 1) Absence of loosening of implants in both anteroposterior and lateral views will be an indirect evidence of fusion in short term follow up
- 2) Features of consolidation of graft in posterolateral or Interbody region.
- 3) Presence of fusion in patients with more than 1 yr follow up

#### 5. Observation

	Mean preop VAS	Mean Post op VAS at 6 months
Posterolateral fusion	7.7	1.5
Transforaminal interbody fusion	8	1.2

#### 6. Functional Status

##### Posterolateral fusion

Prolo's scale	Poor	Moderate	Excellent
Pre op	70%	30%	0%
Post op	5%	80%	15%

##### Transforaminal interbody fusion

Prolo's scale	Poor	Moderate	Excellent
Pre op	85%	15%	0%
Post op	0%	90%	10%



**Figure 1, 2, 3, 4:** pre and post operative radiographs of patient of TLIF (transforaminal interbody fusion)



**Figure 5, 6, 7, 8:** Pre and post operative radiographs of patient undergoing PLF (posterolateral fusion)

## 7. Discussion

Spondylolisthesis is a very common cause for low back pain and radiculopathy. There is increased prevalence of spondylolysis among first-degree relatives of patients with isthmic spondylolysis or spondylolisthesis. This strongly supports an inherited predisposition. It is more common in sportsperson suggesting that mechanical factors also play a significant role. The peak mechanical stress of lumbar spine is centred at the isthmus. Thus it has been accepted that these isthmic defects are the result of successive fatigue fractures and are more common in patients with genetic predisposition. It is important to isolate the specific symptoms, signs, and functional disabilities that distinguish spondylolisthesis from other types of low-back pain and sciatica.

In 2010 Denard et al found in their study that in US around 20-25% females and 4-8% males suffer from lumbar spondylolisthesis<sup>14</sup>. In our study we found that the females were more prone for developing lumbar spondylolisthesis and females to male ratio was 1.5:1. Most commonly affected level of the spine in spondylolisthesis is L4-L5<sup>15</sup>. 22 out of 40 patients were having L4-L5 involvement and 78% of the cases were having low grade slip (Meyerding grade 1 and 2) and is similar to most studies done earlier suggesting that isthmic spondylolisthesis is usually low grade types. Even after extensive research on the disease and its treatment, still a conclusion is yet to be made about a single most effective treatment option. Although traditional conservative treatment option has shown good outcome in many patients, however in patients with chronic symptoms associated with neurodeficits or radiculopathy, conservative management i.e. medical management with physiotherapy alone is not satisfactory. Thus the role of surgical intervention comes in such patients and the decision of surgery is made not on the grade of the spondylolisthesis but on the symptomatology.

## 8. Results

Clinically the pain improvement shown by visual analogue scale was comparable in both the groups. The mean VAS score of 7.7 among patients undergone PLF improved to 1.5 and in patients undergone TLIF the VAS score improvement was from 8 to 1.2 at 6 months followup.

## 9. Functional Results

Using prolo's scale 95% of the patients who had undergone PLF had moderate to excellent results with 5% poor results as compared to TLIF where 100% of the patients had moderate to excellent results with no poor result.

## 10. Conclusion

Our study was a comparison study of clinicoradiological outcome in patients undergoing posterolateral fusion and transforaminal interbody fusion. We could infer from our study that both posterolateral fusion and transforaminal interbody fusion provide good results in patients with symptomatic spondylolisthesis. We still would like to

mention that we found better results of interbody fusion (TLIF) in patients with instability and higher grade spondylolisthesis as compared to posterolateral fusion. Still to establish the above fact a larger group of patients randomised with regard to grading and instability with a longer follow up is required.

We thus noticed that both posterolateral fusion with instrumentation and transforaminal interbody fusion suffice in restoring the functional status to near normal in a short period and both the procedures are effective in treating spondylolisthesis.

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