

Prospective study on spondylolisthesis patients managed by posterior fixation

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Abstract

Introduction: CT: The increasing incidence of spondylolisthesis is probably due to the present day hectic lifestyle, supplemented with poor posture, wrong dietary habits leading to obesity and lack of regular exercises. **Aims:** Our aim of the study the stability of fixation in spondylolisthesis with follow up period and to study symptomatic and neurological improvement and complications. **Materials and methods:** It is Observational and prospective study for a period of 4 years in 20 Patient with L5-S1 spondylolisthesis whose symptoms were not relieved even after conservative management for 6 months, or patients who had severe/long standing symptoms, or patients who had severe slip at L5-S1 of varied etiology were admitted on elective basis and were taken up for surgery by posterior fixation with pedicle screws and rods. **Results:** We analysed results in our 20 patients, 16 were females and 4 males. Maximum patients were in the age range of 20 to 50 years. 75% of the patients had bilateral L5 spondylolysis, isthmia type is commonest at L5-S1 slip. 80% of patients were Meyerding grade 1 and 2 preoperatively. Post operatively grade 1 and grade 2 patients were only 50% and 40% had no slip. In this study clinically successful results was 65% (excellent 15% + good 50%). **Conclusion:** Symptomatic relief and clinical results are evaluated based on KIM-KIM criteria, which is a reliable and easily assessed criteria.

Keywords: Spondylolysis, Meyerding grade, Kim and Kim criteria.

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Introduction

Spondylolysis is defined as a defect in the pars interarticularis of the posterior vertebral arch and is a common cause of back pain and disability spondylolysis may lead to instability of the spinal column and leads to anterior translation of the vertebral body relative to the level inferior to the defect. Even in the absence of symptoms from the pars defects themselves, spondylolisthesis may lead to clinically significant radiculopathy and progressive neurologic deficits secondary to nerve root impingement. Both conditions vary in their presentations and require judicious application of conservative and surgical treatment strategies. The clinical syndrome of spondylolisthesis was first described by the Belgian obstetrician Herbiniaux, before an understanding of its pathophysiology [1]. The care of patient with spondylolisthesis with or without neurological deficit has evolved dramatically over the past 30 years with the emergence of more effective spinal instrumentation and anaesthesia techniques, despite these advances the majority of patients with spondylolisthesis are treated non-operatively with physiotherapy, lumbar brace and NSAIDs. More aggressive treatment is guided by the use of classification system that detail the mechanism of spondylolisthesis, the degree of slippage of vertebra and the potential for late mechanical instability or neurological deficit. The goal of treatment remains attainment of spinal stability with protection or improvement of the patient neurological status, allowing rapid and maximal functional recovery [2].

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The advent of improved anaesthetic management, the introduction of image intensifier, and advanced instrumentation helped the orthopedic surgeons greatly in the management of spondylolisthesis. Modern techniques of segmental instrumentation with pedicle screws have clear advantages over distraction constructs and luque rods or rectangles, which are reported to worsen the condition. Earlier surgical methods like posterior insitu fusion and posterior decompression have given way to the more surgeon friendly instrumentation with pedicle rod screw fixation [3].

The system by reducing displaced vertebra helped the early relief of neurological symptoms and deficit recovery preventing further progression and more risky surgeries. Of late we are receiving more number of these patients mostly with back ache and sciatica with or without deficit. Our aim of the study the stability of fixation in L5-S1 spondylolisthesis with follow up period and to study symptomatic and neurological improvement and complications.

Materials and methods

It is Observational and prospective study from August 2011 To August 2015 at Orthopaedics Department, Gandhi Medical College, Secunderabad in 20 Patient with L5-S1 spondylolisthesis whose symptoms were not relieved even after conservative management for 6 months, or patients who had severe/long standing symptoms, or patients who had severe slip at L5-S1 of varied etiology were admitted on elective basis and were taken up for surgery by posterior fixation with pedicle screws and rods.

Inclusion Criteria

Male and female patients between 20 – 70 years with All types of spondylolisthesis i.e., degenerative, traumatic, isthmia, dysplastic type

at L5-S1, Associated with or without degenerative disc disease, Symptomatic grade 1 and symptomatic 2 pts and all grade 3, grade 4 pts.

Exclusion Criteria

Age less than 20 years and more than 70 years associated with other comorbidities like cardiac and respiratory ailments who are not fit for surgery and asymptomatic grade 1 and asymptomatic grade 2 pts Patients were admitted and evaluated for severity of low back ache, sciatica and neurological assessment including SLRT, motor and sensory deficits was done. Radiological evaluation including Lumbosacral spine AP view, Flexion & Extension lateral and oblique views were done. MRI was done to evaluate spinal canal, nerve root compression and status of intervertebral discs that would necessitate decompression.

In plain radiographs the degree of displacement evaluated by MEYERDINGS grading.

Patients were taken to surgery by posterior approach fixation was done at L5-S1 or L4 and S1 with pedicle screws and rods. All patients were followed at regular intervals after discharge i.e., 6 weeks, 12 weeks, 24 weeks, (prospective study). In this study longest follow up was 1 year. Range of follow up was 3 months to 1 year.

In all follow ups patients were examined about symptomatic improvement, SLRT, recovery from neurological deficits, maintenance of reduction, stability of fixation, and complications.

The results of surgical procedure were evaluated as Symptomatic improvement of low back ache and sciatica, Neurological improvement -in SLRT, and recovery from any neurological deficits, Reduction of slip and stability of fixation assessed by improvement in slip percentage and Clinical results were evaluated based on Kim and Kim criteria.

Results

In our study 20 patients of spondylolisthesis of varied etiology were operated by posterior instrumentation with pedicle screws and rods.

Table-1: Demographic distribution

| Age | Number of patients | Percentage |
|------------|--------------------|------------|
| 21-30 | 6 | 30 |
| 31-40 | 5 | 25 |
| 41-50 | 6 | 30 |
| 51-60 | 1 | 5 |
| 61-70 | 2 | 10 |
| Sex | | |
| Male | 4 | 20% |
| Female | 16 | 80% |
| Total | 20 | 100% |

Youngest patient in this study is 21 years, and maximum number of patients are between 21 to 50 years. Average age is 39.5 years (Range 21-61 years). In this study spondylolisthesis is more common in females.

Pars interarticularis defect: in this study about 15 patients were found to have bilateral pars lysis of L5, which indicates most common type of listhesis at L5 S1 is isthmic/lytic type.

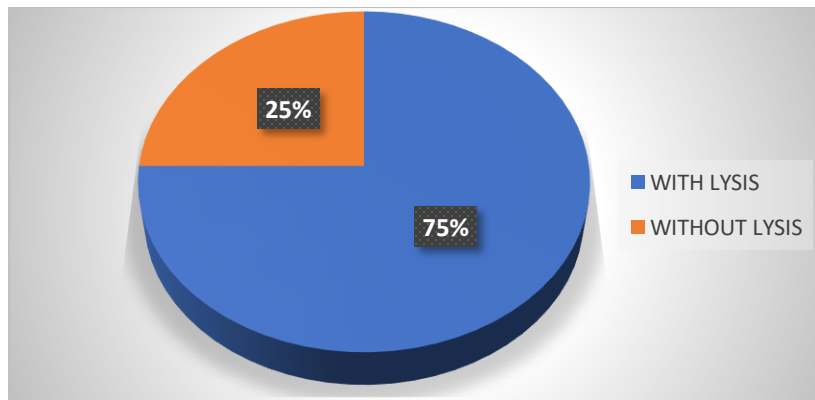


Fig. 1: Incidence of spondylolysis at L5-S1

The main presenting complaint was low back ache radiating to lower limbs. There was no difference in symptoms among males and females. Palpable step deformity present in few cases, hamstring spasm and waddling gait present in a case.

SLRT was 45 degrees in few cases and 60 degrees in few cases. PRE-OP Sensory deficits in L5 dermatomal distribution was found in few cases and dermatomal distribution in few cases. PRE-OP Motor deficits were found EHL / both EHL and ankle weakness.

Table-3: Pre-Operative Meyerding Grading

| Meyerding Grade | Number of Patients | Percentage |
|-----------------|--------------------|------------|
| Grade I | 8 | 40% |
| Grade II | 8 | 40% |
| Grade III | 2 | 10% |
| Grade IV | 2 | 10% |

Table-4: Post-operative Meyerding grading of L5-s1 spondylolisthesis

| Spondylolisthesis | Number of Patients | Percentage |
|----------------------|--------------------|------------|
| Grade 0/Without Slip | 8 | 40% |
| Grade I | 8 | 40% |
| Grade II | 4 | 20% |

Intra operative complications

Dural tear: no dural tear was found during my study
Screw malposition: one patient had pedicle screw mal position during fixation, mal positioned pedicle screw removed and re inserted.

Post-operative complications:

Superficial wound infection: no patients developed any infection during my study.

Deep wound infection: no case was recorded in my study.

Implant failure: no patient experienced implant failure during follow up.

Persistent low back ache with sciatica was found in once case during 3 months follow up, which was decreasing in intensity gradually. One patient had pre op ankle weakness, which did not improve post operatively during follow up of 6 months.

Two patients had lumbo sacral stiffness due to prolonged immobilization and lumbar flexion was only 60.

Follow up

All patients had regular follow up at 6 weeks, 12 weeks and 24 weeks, with minimum follow up was 3 months and the longest follow up was 1 year.

Table-5: Kim-Kim Criteria for Evaluation of clinical results

| Kim-Kim Criteria | Number of Patients | Percentage |
|------------------|--------------------|------------|
| Excellent | 3 | 15% |
| Good | 10 | 50% |
| Fair | 6 | 30% |
| Poor | 1 | 5% |

In this study final clinical outcome based on Kim Kim criteria is good results. In this study 15% had excellent results, 5% had poor results, 50% had good results and 30% had fair results.

Clinically successful results was 65% (excellent 15% + good 50%).

Discussion

Spondylolisthesis incidence is increased in the last few decades due to increased sporting activities and activities involving repetitive hyperextension. The concept of treatment of spondylolisthesis has been evolved from conservative measures like analgesics, muscle relaxants, activity restriction, lumbosacral corset, and physiotherapy to open reduction and internal fixation with pedicle screw and rod fixation, reduction of slippage. The goal of treatment of spondylolisthesis includes Reduction of slip, not necessarily to an anatomical position. Decompression of the spinal canal, is necessary, achieved mostly with adequate reduction. Symptomatic relief, correction of deformity, limitation of movement instability, pain relief and Early mobilization.

Management of spondylolisthesis is one of the most controversial areas in modern spinal surgery. Reduction and posterior fixation with pedicle screws and rods is a generally accepted treatment method for patients with spondylolisthesis and a neurological deficit, it results in more rapid symptomatic relief, effective reduction of displacement, fewer complications, and lower medical costs. In treatment of adolescents and young adults primary aim of surgical treatment is correction of deformity and spinal realignment. The mainstay of surgery in the adult and elderly patient is decompression, whereby the aim is to relieve radicular and claudication symptoms.

Often some degree of reduction is already achieved by the prone position and subsequent exposure of the spine in adult spondylolisthesis in situ fixation is a proven surgical method. In high-grade slips in the adult, in situ fixation with or without decompression, depending on the neurologic status, is a proven surgical method, especially when intervertebral body space has markedly diminished. Partial reduction of the slip angle should be attempted if significant malalignment and foraminal stenosis is present. The aim is to decompress neural structures, decrease the lumbosacral kyphosis and facilitate fusion. In cases where partial reduction has been achieved, anterior structural support should be added to hold the reduction in place.

Spondylolisthesis is perse a spinal instability and good postoperative stability is needed to avoid non-union or implant breakage. Interbody fusion is recommended when reduction and/or distraction is performed.

The fusion techniques can be divided into those that Achieve posterior column stability, Anterior column stability and Combined approaches that achieve both. In cases where the spinal canal has to be decompressed and instrumentation is planned, a posterior lumbar interbody fusion (PLIF) is required. Anterior interbody fusion in anterior techniques in spine fusion allow for a complete discectomy and very precise placement of an interbody implant or graft. Larger structural grafts can be placed without the danger of Dural sheath damage or nerve root injury.

In the lumbar spine the anterior technique usually involves a retroperitoneal approach, with its complications such as possibility of vascular injury, damage of the sympathetic plexus with subsequent retrograde ejaculation in males, as well as damage to retro- and intraperitoneal structures. Combined approaches can be either posterior or transforaminal interbody fusion (PLIF or TLIF) or anterior lumbar interbody fusion (ALIF) with posterolateral intertransverse fusion (PLF). Due to the high degree of primary stability achieved with the 360 treatment of the spine, fusion rates are highly reliable. Despite these good results, the technique of 360 instrumentation is technically more demanding than ALIF or PLF alone.

Posterolateral or intertransverse fusion, Cleveland, Bosworth, and Thompson described a technique for repair of pseudarthrosis after spinal fusion in which grafts are placed posteriorly on one side over the laminae, lateral margins of the articular facets, and base of the transverse processes. The intertransverse fusion allows placement of the graft in closer proximity to the center of vertebral rotation than the midline fusion, thus reducing the tensile loads experienced by the graft and decreasing the risk of graft migration.

Both factors increase the probability of obtaining a solid fusion. Although aggressive removal of the facet cartilage does reduce the inherent stability of the motion segment, the increased surface area for fusion and close apposition of the facet joint surfaces is facilitate the rate of fusion.

Posterior instrumentation usually reduces the risk of graft displacement by decreasing displacement and the loads through the graft during the healing process. Watkins described as the lumbar and lumbosacral spine in which the facets, pars interarticularis, and basis of the transverse process are fused with the chip grafts, and a large

graft is placed posteriorly on transverse processes [4].When the lumbosacral joint is included, the grafts extend to the posterior aspect of the first sacral segment it maybe unilateral or bilateral. Wiltse et al. splits the sacrospinalis muscle longitudinally and included the laminae and the articular facets and transverse process in the fusion [4].

Some combine posterolateral fusion using a midline approach with a modified Hibbs-type fusion in routine lumbar and lumbosacral fusions. They add autologous grafts obtained from the ilium.DePalma and Prabhakar also combined posterior and posterolateral fusions [5]. Indications for posterolateral fusion are Primary lumbar and lumbosacral fusions, pseudarthrosis, Congenital or surgical laminar defects, Spondylolisthesis with chronic pain from instability, Low risk of injury to the neural elements, Less risk of iatrogenic spinal stenosis (graft is placing away from midline), less operative time procedure of choice for elders.

A method of achieving an anterior arthrodesis with posterior stabilization in a single surgical approach.Through the posterior approach anterior column support is provided and the disc height is restored in order to open the neural foramen. Best suited for grade I or II displacement. Advances in instrumentation and techniques have resulted in an increased use of the posterior lumbar interbody fusion technique with interbody fusion cages. Cages may be allograft bone, metal, or carbon fibre devices filled with bone graft. Different devices available are allograft spacers or cages. Stabilization is necessary if implants are used posteriorly. Best provided by pedicle screw.

Historically, ALIF has been reserved as a salvage procedure for patients failing multiple posterior procedures.More recently, increased ease of access and concerns over extensor muscle retraction in a relatively young patient population have renewed interest in this approach.Indirect spinal decompression is provided by Eradication of the disc, Restoration of disc height, and Ligamentotaxis by placement of structural bone graft or cage after distraction of the disc space. Tensioning of the posterior ligamentous structures [6-7]

Titanium Syncage or FRA spacer used to restore lordosis and disc height. Syncage denticulated surface increase initial stability. The large implant surface reduces risk of subsidence and the open implant structure facilitates bone ingrowth. In the treatment of spondylolisthesis pedicle screws allow easy manipulation and reduction of displaced vertebra, even if the posterior elements are not intact. Their use facilitates decompression of neural elements by distraction. Avoiding need for laminectomy and permits stabilization of the segments without the requirement to extend fixation much beyond the displaced vertebra.

Moss Miami system acts as posterior tension band based on intact anterior and posterior spinal segments and intact facet joints acting as fulcrum in cases of burst fractures.Since anterior spinal instrumentation such as Kaneda system involves more risk to the patient, the posterior stabilization has become more popular as it involves indirect reduction and maintenance of stability of spine.

We had much favorable results using pedicle screw fixation. Symptomatic improvement of back pain and activity restriction are assessed based on clinical results criteria, KIM-KIM criteria. Neurological improvement of sensory deficits and motor power were assessed based on ASIA scoring.60% of the patients had sensory deficits in L5, S1 dermatomal distribution preoperatively and there was improvement in sensation from 6 weeks to 3 months post operatively, and 10% patients did not have recovery.60% of the patients had motor power weakness of ankle and EHL weakness. Post operatively motor power improved in 50% patients from average of 3 months to 1 year period. 10% had no improvement during study period and follow up period was only 3 months.

A strict comparison of results is, however, difficult because of differences in surgical procedures, types of bone grafts, choice of instrumentation, postoperative protocol, rehabilitation, smoking and analyzing score. The clinical outcome is assessed based on Kim and Kim criteria, in our observation showed satisfactory results (65% including excellent and good) and compared with other studies [8].

Table-6: Comparison of clinical results based on Kim’s criteria

| Kim criteria | My study (n=24) | | Mohammed et al ⁹ (n=40) | | BJ Shin et al ¹⁰ (n=12) | | JC Lee et al ¹¹ (n=12) | |
|------------------|-----------------|------|------------------------------------|-------|------------------------------------|-------|-----------------------------------|-------|
| Excellent | 3 | 15% | 8 | 20% | 1 | 8.3% | 8 | 66.7% |
| Good | 10 | 50% | 18 | 45% | 7 | 58.3% | 2 | 16.7% |
| Fair | 6 | 30% | 5 | 12.5% | 2 | 16.7% | 1 | 8.3% |
| Poor | 1 | 5% | 9 | 22.5% | 2 | 16.7% | 1 | 8.3% |
| Total | 20 | 100% | 40 | 100% | 12 | 100% | 12 | 100% |

The results are nearly similar to other studies i.e., in our study satisfactory (including excellent and good) results 65%, Mohammed et al 65%, BJ Shin et al 66.6%, JC Lee et al 83.4%.Reduction of listhesis of grades I and II is not necessary for better pain relief. But the listhesis is reduced, the tension on the roots disappears, and the transverse processes come to the same level to put the intertransverse graft. It arrests deformity progression, postoperative pain is decreased, fusion length becomes limited, body posture and mechanics are restored and improves appearance. Insitu fusion can be attempted in these cases while reduction and fusion in the rescued position should be attempted in cases of severe spondylolisthesis.

Reduction of spondylolisthesis is not required in most cases of low-grade isthmic spondylolisthesis to affect a better outcome, short segment posterior stabilization (in situ fusion and fixation) is associated with a measurable reduction when used as the sole treatment. Kim et al[7] reported an overall correction of 35% in anterior displacement without any attempt at reduction. Mohammed et al[9], reposed an average correction of anterior displacement of 35% was seen in the early postoperative period, though no separate attempt to reduce the slip was made. An average loss of correction of 105 was noted subsequently[10-11]. In our study, correction of anterior displacement by one grade in 60% and by two grades in 20% was seen in the early postoperative period and in 20% no reduction

achieved. Kyung soo et al[12] showed that for relatively older less active patients, posterior instrumentation with posterolateral fusion is better due to simple and easy procedure.

Conclusion

L5 – S1 spondylolisthesis is common in females, and the common age group is between 20 and 50 years.Most common cause is spondylolysis at L5 vertebra.Symptomatic low grade (1 and 2) patients are treated conservatively initially with analgesics, muscle relaxants, lumbo sacral corset and physiotherapy. High grade slips (3 and 4) and patients with low grade slip (1 and 2) who failed to respond to conservative treatment are fixed with posterior pedicle screws and rods.For low grades slips reduction per se is not necessary, insitu fixation of L5 and S1 with posterior pedicle screws and rods suffice.

This prevents progression of further slip and gives symptomatic relief, regains activity. For high grade slips, aim for reduction and posterior instrumented fusion. If decompressive laminectomy is done, it causes additional instability and therefore posterior fixation is always needed to prevent further slip. Decompressive laminectomy is not need in all cases, distraction and reduction of slip leads to certain extent of decompression. Symptomatic relief and clinical results are evaluated based on KIM-KIM criteria, which is a reliable and easily assessed

criteria. Our case study clinical results based on KIM-KIM criteria are comparable to international studies in literature.

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