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A Study Of Functional Outcome Of Lumbo-Sacral Spondylolisthesis Treated By Posterior Stabilisation With Pedicle Screw With Tranforaminal Lumbar Interbody Fusion With Cage Fixation

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Abstract

Introduction: Spondylolisthesis is derived from the Greek words – spondyl (vertebra) and olisthesis (to slip). The prevalence of spondylolisthesis in general population is approximately 5% and is about equal in men and women. Spondylolysis is a descriptive term referring to a defect in the pars interarticularis. Few studies have investigated the long term effect with transforaminal lumbar interbody fusion with cage on functional outcome.

Objectives : Objectives of the study are to evaluate the safety, efficacy and functional outcome of surgical management of spondylolisthesis with posterior stabilization with pedicle screw with transforaminal lumbar interbody fusion with cage fixation were evaluated based on VAS and modified ODI score**.**

Methodology : From October 2019 to May 2021, a total of 25 patients operated posterior stabilization with pedicle screw with transforaminal lumbar interbody fusion with cage fixation were followed up and evaluated based on VAS and modified ODI score.

Results : There were 25 patients with spondylolisthesis at L3-L4 ,L4-L5 and L5-S1 who were managed with posterior spinal decompression and transforaminal interbody fusion with fixation with pedicle screw with cage . 70% of patients had spondylolisthesis at L5 – S1. Most of the patients were in 4th and 5th decade of life, with a female predominance of 20 cases (80%). In this study 76% of patients had Grade I listhesis and 24% had Grade II listhesis. Bony fusion was achieved for 92% patients. In this study 19 (76%) patients had excellent, 6 (24%) had good outcome based on modified ODI scoring.

Conclusion: Surgical fixation of spondylolisthesis using posterior stabilization with pedicle screw with transforaminal lumbar interbody fusion and cage fixation is still a safe, promising and appealing technique in low and high grade listhesis.

Keywords: Spondylolistheis, Transforaminal interbody fusion,Lumbar lordosis, Functional outcome, modified oswestary index

Introduction

The term spondylolisthesis is derived from Greek word spondylos – vertebra, olisthesis – to slip or slide down a slippery path. It is defined as anterior or posterior slipping of cephalad vertebra over the caudal vetebra[1] "Spondylolisthesis" term was first coined by Killian[2].

Spinal instability caused by lumbar spondylolisthesis can lead to intermittent neurogenic claudication, lumbar radiculopathy and low back pain. If conservative measurements fail or if patients develop neurological deficits, surgical treatment by decompression and instrumented spinal fusion is more frequently considered: in the US, the national bill for instrumented spinal fusion increased 7.9 fold between 1998 and 2008[3].

Classically, posterolateral fusion with pedicle screw fixation is performed, combined with interbody fusion surgery. The rationale for adding lumbar interbody fusion surgery is to improve fusion[(4,5)], thereby restoring balance and redeeming stability[6]. Different fusion techniques have been developed, including transforaminal lumbar interbody fusion (TLIF) and posterior lumbar interbody fusion (PLIF)[(7,8)]. Most spine surgeons are familiar with both and technical difficulty is similar. The unilateral approach to the intervertebral disc is a theoretical advantage of TLIF, based on a number of items[8]. First of all, the a priori chance of damaging nerve or dural sac is 50% less in TLIF. Secondly, in TLIF one facet joint remains unaffected while in PLIF both facet joints are involved in decompression necessary to place interbody cages. Thirdly, TLIF may affect the musculoligamentous complex of the lumbar spine to a lesser extent. Data from retrospective patient series suggest that TLIF may require less surgical time and is associated with less blood loss and fewer complications[(9-11)].

Methods

During the period October 2019 to May 2021, 25 cases diagnosed with lumbosacral spondylolisthesis which was surgically treated at our institution. This is a prospective analysis of the 25 consecutively treated cases with 6 months of minimum follow up. All patients provided written & informed consent prior to procedure, and every clinical test and surgeries were directed by the standards of the Declaration of Helsinki. There were 5 male and 20 female patients. The ages of the patients ranged from 32 to 59 years (average 48 years). All patients had classically described symptoms that are attributed to spondylolisthesis, which include lower back claudication pain and radiation along the posterior aspect of the legs (25) and weakness of muscle groups (12).The modified Oswestry Disability Index (ODI) and visual analog scale (VAS) were used to grade the symptoms. Radiological observations are summarized in Table 1. All patients were investigated both before and after surgery with plain radiographs and MRI. Patients in whom there was radiographic and clinical evidence that suggested infection, tumour were excluded. Injectable antibiotics were continued for 5 days and then changed to oral with adequate analgesia given. Drain tube were removed usually after 48 hours and patient is allowed to turn in bed. Sutures removal was done on 14th day. Patients were allowed to ambulate after drain removal with a lumbosacral belt. Patient is then discharged with lumbosacral belt which is gradually withdrawn after 6 months.

Table 1: Radiological features in 25 cases of Spondylolisthesis

Distribution of levels of Spondylolisthesis among study patients			
Variable	Category	n	%
Level	L3-L4	1	4%
	L4-L5	8	32%
	L5-S1	16	64%

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Figure 1

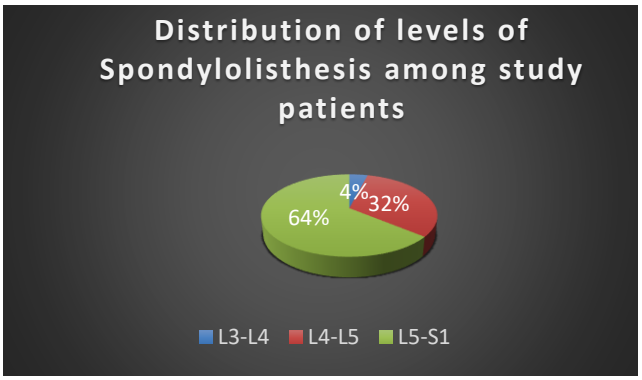

Table 2:Distribution of grade of Spondylolisthesis

Distribution of Grade of Spondylolisthesis among study patients			
Variable	**Category**	**n**	**%**
Grade	**Grade 1**	**19**	**76%**
	Grade 2	**6**	**24%**

Surgical Procedure

After palpating the spinous processes ,a line is drawn between the highest points on the iliac crest is in the L4-5 interspace. The line is a rough guide, however the best means of determining the exact level is either to insert a small needle into the spinous process under the C – Arm guidance and carry the dissection distally and identify the sacrum. A midline skin incision relative to the disc space and over the marked spinous process. On furthur incision through fat and fascia in line with the skin incision until the spinous process itself is reached. Detach the paraspinal muscles subperiosteally as one unit from the bone, using a dissector, such as a Cobb elevator, or with cautery. Dissect down the spinous process and along the lamina to the facet joint. The lamina with spinous process was removed which was used for bone graft. The loose listhetic segment was identified and discectomy with decompression of nerve root was done . The fibrocartilagenous tissue strangulating the nerve root was completely removed and the loose neural arch became mobile. After removing the adhesion, the posterior disc space was removed and the end plate was scraped with angular scoop and trial disc was done with introduction of fenestrated kidney cage with bone graft with the introducer after Pedicle screw instrumentation. Initially the cage was placed 25 degrees oblique which later made horizontally and distraction of vertebra was loosened making the cage compressing between the vertebrae decreasing the chance of displacement. The self tapping polyaxial and reduction screws of 5.5mm were used. The patients were mobilized as soon as possible, but were advised to use lumbar spinal belt and to restrict activities for a period of 6 months. The patients were then advised to engage in normal physical activity after confirmation of the status of screws. Postoperative imaging was done in the immediate postoperative phase and at follow up examination.

CASE 1

PREOP XRAYS AND MRI

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FIGURE 2

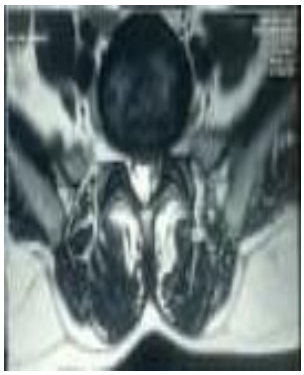


FIGURE 3

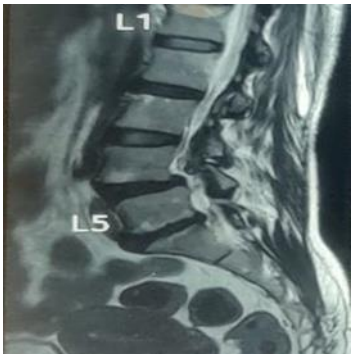
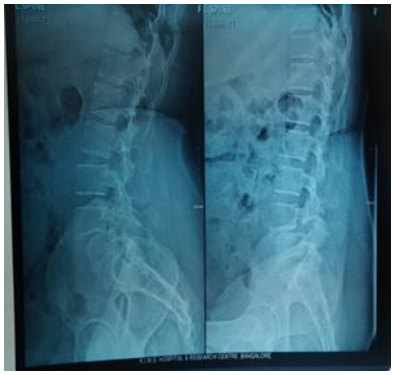


FIGURE 4



CLINICAL PHOTOS OF PRE OP

FIGURE 5

FIGURE 6

FIGURE 7

FIGURE 8

FIGURE 9

CASE 2

PREOP XRAY AND MRI

FIGURE 10

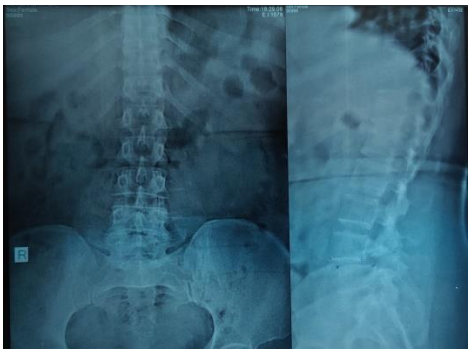


FIGURE 11

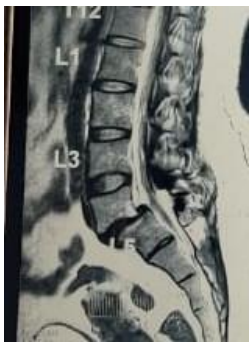


FIGURE 12

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CLINICAL PHOTOS OF PREOP

FIGURE 13

FIGURE 14

FIGURE 15

FIGURE 16

FIGURE 17

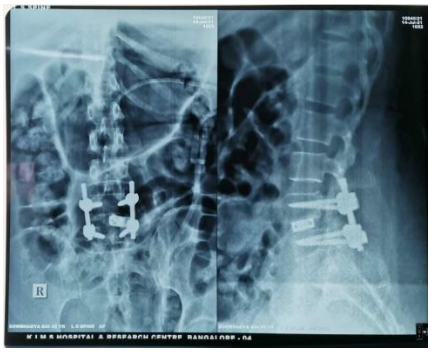
Results

The follow-up duration ranged from 6 months till 1 year. The Chief surgeon himself and the subordinates did clinical assessment and radiological interpretations. All patients symptoms improved in the immediate postoperative period to varying degrees, mostly favourable. VAS and ODI scales were compared both pre and post operative. Apart from these measures, a patient satisfaction in the local vernacular language assessed the status of clinical recovery. No recurrence of symptoms in any case was noted in the minimum follow up period of 6 months. Arthrodesis of the treated spinal segments was considered to be successful when at the minimum follow-up of 6 months the screw position remained in place, bony fusion across the facets was observed, and no relative movement of any vertebral component observed on dynamic imaging. With these minimum parameters, successful segmental arthrodesis was achieved in all cases. All the patients were satisfied with the clinical outcome and are professionally active. The operation was not repeated in any of the cases nor any additional surgical maneuver done on the same level or at any other spinal level.

CASE 1 :

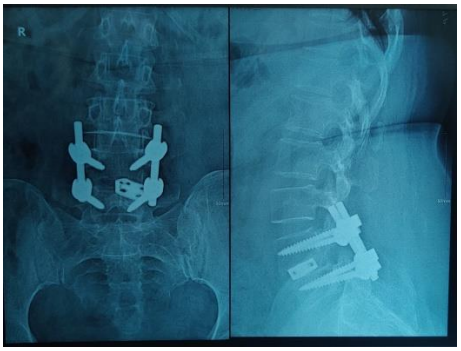
IMMEDIATE POST OP

FIGURE 18



POST OP XRAY AFTER 24 WEEKS

FIGURE 19



CLINICAL PHOTOS POST OP

FIGURE 20

FIGURE 21

FIGURE 22

FIGURE 23

FIGURE 24

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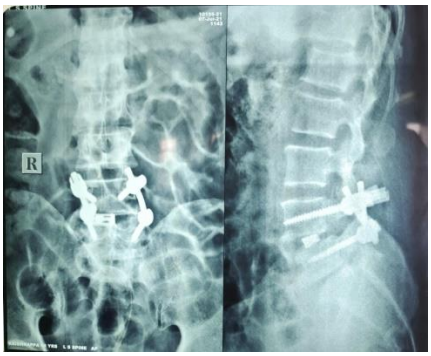
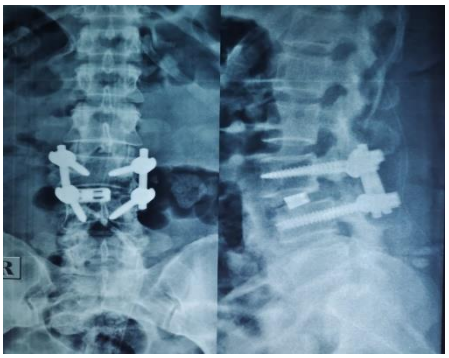
CASE 2:

IMMEDIATE POST OP **POST OP XRAY AFTER 24 WEEKS**

FIGURE 25 **FIGURE 26**

CLINICAL PHOTOS POST OP

FIGURE 27 **FIGURE 28** **FIGURE 29** **FIGURE 30** **FIGURE 31**





Table 3: Comparison of mean ODI score pre and post operatively

Comparison of mean ODI values between Pre & Post-Operative treatment among study patients using Wilcoxon Signed Rank Test							
Time	N	Mean	SD	Min	Max	Mean Diff	P-Value
Pre OP	25	43.92	3.81	52	30	28.16	<0.001*
Post OP	25	15.76	4.45	24	10		

Figure 32

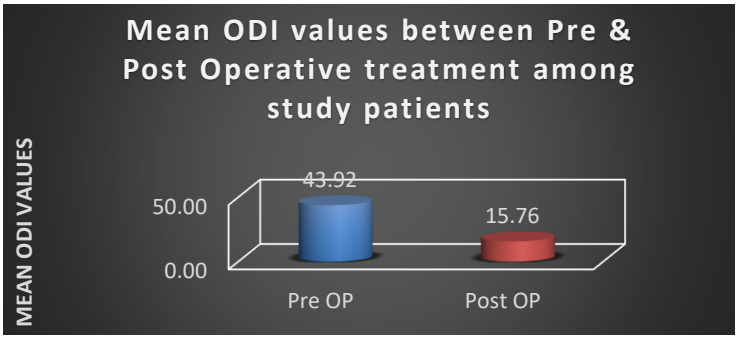


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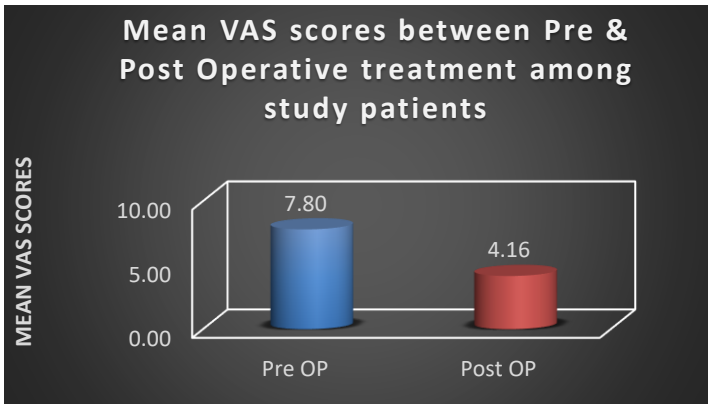
Table 4:Comparison of mean vas scores pre and post operatively

Comparison of mean VAS scores between Pre & Post-Operative treatment among study patients using Wilcoxon Signed Rank Test							
Time	N	Mean	SD	Min	Max	Mean Diff	P-Value
Pre OP	25	7.80	0.71	9	7	3.64	<0.001*
Post OP	25	4.16	1.03	6	2		

FIGURE 33



Discussion

In our study, transpedicular instrumentation with interbody cage was performed at lumbosacral level Meyerding grade I , II,III and IV spondylolisthesis. Our experience with the TLIF procedure confirms the findings of prior studies in that it produces good clinical outcomes, 92% fusion rate without intra-operative complication. It provides circumferential fusion via a posterior approach and, thus, avoids the need for a separate anterior surgery that would entail additional risk of retrograde ejaculation or injury to abdominal viscera or vascular structures. In addition, TLIF avoids the need for dural retraction present when performing a PLIF, which may increase the potential for complications such as neurapraxic injury and dural laceration. Our results are similar to recent studies in terms of surgical data and hospital stay[12,13] . The complication rate in this study was low. There were no intra-operative complications and specifically no dural tear which is common in PLIF. This is reflected in similar studies[13,14] .In a recent MRC study[15] a peri -operative complication rate of up to 36% is reported. Transient neuritis due to excessive nerve root retraction has been reported to be as high as 7%; however, this has not been our experience. There have been reports of vascular injuries to the great vessels during decompression[16] or cage placement. Complications reported in ALIF include great vessel injury (1.7%) with venous injury as high as 15.6%[8] , retroperitoneal damage resulting in dyspareunia in female patients and retrograde ejaculation in male patients. These complications place TLIF as a favourable alternative option to a circumferential fusion. The debate whether clinical outcome and fusion rate correlate has been raging in the literature for years[17-20] . Our patients were operated for spondylolisthesis and our clinical outcomes can be regarded excellent with significant improvement in VAS and modified ODI score. If one considers that our union rate was 92% it is clear that clinical results correlate with the fusion rate. In our study majority of the patients were female 20 (80%) out of 30 patients while only 5 (20%) were male patients. In degenerative spondylolisthesis, the female gender is shown to be predominant[21] . Hackenberg in their study reported the results of TLIF with a minimum follow up of 3 years[22] . In their study, along with low grade Spondylolisthesis, they included patients with disc degeneration disease in whom TLIF was performed. But like our study, their main focus was on the functional outcome and

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the tool was ODI scoring like in our study. Their mean ODI scoring preoperative was 41.6% and 31.6% at latest follow up. Butterman G et al. in their study reported improvement in mean ODI from 63% to 33% 3 years after fusion surgery for Spondylolisthesis[23] . Like these studies, our mean preoperative ODI was 43.92, while postoperatively it was 15.76. Our follow-up was short compared to them. We found statistically significant improvement in pain scores (VAS and ODI) and significant improvement in SLR test postoperatively at 3 months and 6 months follow-up as compared with pre-operative scores. The improvement was significant when a comparison was made between 3 months and 12 months results. We believe that the initial relief in the symptoms may be due to the stabilization effect of the internal fixation device, and permanent relief can be related to attainment of satisfactory fusion, and resorption of the osteocartilaginous mass may also contribute to the clinical improvement. A fusion rate of 68–100% has been reported with posterolateral fusion in low grade spondylolisthesis. We used radiographic criteria for fusion assessment and our fusion rate was 92%. Adding pedicle screw fixation to fusion has been reported to increase the rate of arthrodesis for low grade spondylolisthesis[24] , and also to improve clinical outcome[25] . A direct relationship between failure to achieve arthrodesis and unsatisfactory pain outcome was reported in a prospective study[26] . Some other studies have also reported a direct relationship between failure to achieve a satisfactory arthrodesis and an unsatisfactory outcome[27] . On the other hand, Schnee et al.[28] reported good clinical results in only 60% of cases, though a 90% fusion rate had been achieved. They concluded that factors other than preoperative symptoms and radiographic fusion significantly influenced results. In this study, we found that good radiological fusion correlated with better clinical and functional outcome. analysing the radiological fusion with clinical scores, good radiological fusion grades correlated with lower VAS scores for pain ($p < 0.01$). Objective assessment of clinical status in non-traumatic lumbar disorders remains elusive[29] . We used VAS score and ODI for a final as- sessment of results because we found it to be simple and it had been used in a study comparing results of transforaminal lumbar interbody fusion; our results showed a 92% satisfactory outcome and it is comparable to the 60–98% reported in the literature[30] . A strict comparison of results is, however, difficult because of differences in surgical procedures, types of bone grafts, choice of instrumentation, postoperative immobilization, rehabilitation and smoking. The results of our study showed a close relation between satisfactory clinical outcome (90%) and solid fusion (92%). They claim that in situ fixation has good comparable results with a low rate of complications[31] . The distraction of a lumbar disc space serves to increase the cross-sectional area of the neural foramen and has been assumed to be of clinical value in relieving neural compression[32] . Although the importance of restoration of disc space height (DSH) and segmental lordosis has been emphasized in numerous works, there are limited experimental data to validate these concepts in clinical practice[33] . In our study, we demonstrated excellent clinical outcomes with a significant increase in DSH with cage fixation. A possible explanation for this might be that the elimination of segmental motion could stop irritation of a nerve root and result in symptomatic improvement with an increase in the dimensions of the neural foramen. Cheng et al. demonstrated that whole LL was improved after TLIF as a result of the spontaneous restoration of lordosis at the unfused lumbar levels in lumbar spondylolisthesis[34]. Jagannathan et al. found post- operative increased segmental and Global LL in their study. We found the same finding in our study with TLIF[35] . TLIF patients spent less days in hospital than PLIF patients in one study[6]. Also it is hypothesized that TLIF increases the approximate biomechanical stability more compared to PLIF and reduces stress at the cage-endplate interface better thereby maintaining spinal alignment[36,37], which could influence long term outcome.

Conclusion

Low back ache is one of the common conditions that is seen in Orthopaedic practice. With spondylolisthesis being a common condition and is found in about 5% to 7% of the population.

In the earlier stages , the patient can be managed by nonoperative methods like rest, traction, lumbosacral corset, NSAID's, physiotherapy and exercises.When these methods do not bear the expected results and when the other indications for the surgery as

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mentioned earlier are met, then the option of surgery must be given to the patient.

The goals of surgical management are as follows:

1. Reduction of back and leg pain.
2. Stabilization of unstable segment.
3. Restoration of normal spine mechanisms, posture and gait.
4. Reversal of neurological deficits.

Reduction of listhesis of grade I and II is necessary for better relief. After the listhesis is reduced, the tension of the roots does disappear, and the transverse processes come into same level to put the interbody graft. It arrests deformity progression, post-operative pain is decreased, fusion length becomes limited, body posture and mechanics are restored and it improves appearance and self-image. In situ fusion can be attempted in these cases while reduction and fusion in the reduced positions should be attempted in cases of severe spondylolisthesis. Surgical fixation of spondylolisthesis using posterior stabilization with pedicle screw fixation with transforaminal lumbar interbody fusion with cage is a safe, promising and appealing technique especially in low grade and high grade listhesis because

1. It provides mechanical support and helps in biological bony fusion with placement of fenestrated kidney cage and maintaining the disc height across the segment
2. With the help of TLIF the body weight is transferred across rod cage system making it more stable with minimal stress across the implant
3. Implant failure rate was observed to be nil with this procedure as noted in our study because the body weight is passing through cage instead of the screws and rods making the implant more stable.

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