



2023

Evaluation of Transpedicular Screws Fixation with Posterior Interbody Fusion by Cage in Management of Lumbar Spondylolisthesis

Ibrahim Gamil Ewiss

Department of Neurosurgery, Faculty of medicine for boys, Al-Azhar University, Cairo, Egypt

Ahmed Ibrahim Rewehy

Department of Neurosurgery, Faculty of medicine for boys, Al-Azhar University, Cairo, Egypt

Kamal Abdul-Malik Ali Mohamed

Department of Neurosurgery, Faculty of medicine for boys, Al-Azhar University, Cairo, Egypt,
elqurmakamal@gmail.com

Follow this and additional works at: <https://aimj.researchcommons.org/journal>



Part of the [Medical Sciences Commons](#), [Obstetrics and Gynecology Commons](#), and the [Surgery Commons](#)

How to Cite This Article

Ewiss, Ibrahim Gamil; Rewehy, Ahmed Ibrahim; and Mohamed, Kamal Abdul-Malik Ali (2023) "Evaluation of Transpedicular Screws Fixation with Posterior Interbody Fusion by Cage in Management of Lumbar Spondylolisthesis," *Al-Azhar International Medical Journal*: Vol. 4: Iss. 3, Article 16.

DOI: <https://doi.org/10.58675/2682-339X.1693>

This Original Article is brought to you for free and open access by Al-Azhar International Medical Journal. It has been accepted for inclusion in Al-Azhar International Medical Journal by an authorized editor of Al-Azhar International Medical Journal. For more information, please contact dryasserhelmy@gmail.com.

Evaluation of Transpedicular Screws Fixation With Posterior Interbody Fusion by Cage in Management of Lumbar Spondylolisthesis

Ibrahim Gamil Ewiss, Ahmed Ibrahim Rewehy, Kamal Abdul-Malik Ali Mohamed*

Department of Neurosurgery, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Abstract

Background: Lumbosacral spondylolisthesis is a common pathology characterized by single or multi-level slippage of lumbar vertebra over the other and may be associated with spinal canal stenosis and neural foramina compromise and may be presented by lower back pain, radicular pain, or neurogenic claudication pain. For the management of lumbar spondylolisthesis, a number of surgical techniques have been suggested, however there is still debate about the best surgical approach.

Aim and objectives: To evaluate the effectiveness of posterior interbody fusion by cage with transpedicular screws fixation in the treatment of lumbar spondylolisthesis.

Subjects and methods: This was Prospective and Retrospective study, conducted on 25 cases with lumbar spondylolisthesis at Al-Azhar University hospitals and Damanhur Medical Institute hospital. All cases were subjected to: History and clinical examination, Investigation by X-ray dynamic study, MRI lumbosacral Spain study, and Surgical techniques.

Results: There was statistically significant improvement in post-operative pain (after 1 week and after 6 months) of visual analog scale score compared to preoperative visual analog scale.

Conclusion: Spondylolisthesis is managed mainly surgical in case of failure of conservative treatment. *Trans*-pedicular fixation with inter-body fusion is an efficient method for the treatment of spondylolisthesis. Partial reposition of spondylolisthesis with neural decompression makes it possible to avoid neurological complications.

Keywords: Lumbar interbody cage, Posterior lumbar interbody fusion, Spondylolisthesis

1. Introduction

A posterior deficiency in the vertebral body at the pars inter articularis is referred to as spondylolisthesis. Spondylolisthesis has taken place if this instability causes the vertebral body to translate.¹

The subluxation of one vertebral body over another in the sagittal plane is known as spondylolisthesis. It stands for a specific and often occurring mechanism of intervertebral instability. Herbiniaux, an obstetrician, first recorded a case of lumbosacral spondylolisthesis in 1772. He observed a bony protrusion anterior to the sacrum that

narrowed the pelvic outlet as a result of the forward slide of L5 on the sacrum, making delivery difficult.²

Spondylolisthesis, a condition that may result in low back discomfort, is the anterior or forward displacement of one vertebra with respect to the next lower vertebra. Congenital, isthmic, degenerative, traumatic, pathologic, and postoperative types of spondylolistheses include the displacement of one vertebra from its neighboring lower vertebra. Congenital, isthmic, degenerative, traumatic, pathologic, and postoperative spondylolisthesis are some of the many types.³

About 5% of children in the pediatric population have spondylolisthesis, with L5-S1 being the most

Accepted 5 October 2022.
Available online 12 June 2023

* Corresponding author at: Department of Neurosurgery, Faculty of Medicine for Boys, Al-Azhar University, Resident of Neurosurgery at Damanhour Educational Hospital, Cairo, Egypt. Fax: +20 2 25914742.
E-mail address: elqurmakamal@gmail.com (K.A.-M.A. Mohamed).

<https://doi.org/10.58675/2682-339X.1693>

2682-339X/© 2023 The author. Published by Al-Azhar University, Faculty of Medicine. This is an open access article under the CC BY-SA 4.0 license (<https://creativecommons.org/licenses/by-sa/4.0/>).

often affected region. Regarding adult lumbar, 5% of men and 10% of women are found to have spondylolisthesis without a pars deformity.⁴

Spondylolisthesis patients often complain of low back discomfort, neurological problems, and/or radicular symptoms. Most of the vertebrae in the L3-S1 area are affected.⁵

Spondylolisthesis patients report pain that begins as incidental and becomes worse with activities. Repetitive extension, rotation, and return from a flexed posture all aggravate pain; resting alleviates it. The patient can mention radicular symptoms.⁶

Bilateral transverse processes are now fused during posterior and posterolateral lumbar arthrodesis. Modern bilateral posterolateral fusion (PLF) has a reported fusion rate of 81–100% and a clinical success rate of 60–98%.⁷

The purpose of the research was to evaluate the effectiveness of lumbar and lumbosacral spondylolisthesis treatment using transpedicular screws fixing and posterior interbody fusion via cage.

2. Materials and methods

Prospective and Retrospective research on 25 cases with lumbar spondylolisthesis at Al-Azhar University hospitals and Damanhur Medical Institute hospital.

2.1. Inclusion criteria

Patients diagnosed with spondylolisthesis above within the age range of 20–5 years, both sexes, patients with extreme low back pain or severe symptoms of root compaction who did not have relief from symptoms with conservative methods, and patients diagnosed with both spondylolisthesis with unsuccessful conservative therapy, consented to surgery.

2.2. Exclusion criteria

Age under 20, low back pain lasting less than three months, spondylolisthesis with no apparent symptoms, grade 5 spondylolisthesis, and congenital spinal abnormalities are all risk factors.

All cases are subjected to:

2.3. History taking

Personal history: Name, age, sex, occupation. History of presenting condition: Onset of the illness: (Acute - Gradual), course of the illness: Remission and exacerbation and unremitting course: Stationary Progressive, duration of illness (months),

neurological deficit (back pain, motor deficits, sensory deficits and sphincteric troubles).

Assessment of patient clinical improvement in relation to pre-operative assessment with visual analog scale (VAS) and Oswestry disability index (ODI) for pain and disability.

Visual Analog Scale (VAS): Pain intensity is measured by the VAS. It is a continuous scale with horizontal (referred to as the horizontal VAS) and vertical (referred to as the vertical VAS) dimensions that are typically 10 cm or 100 mm in length (Both gradations are employed). The most popular anchors for the pain intensity scale are 'no pain' (score of 0) and 'worst pain conceivable' (score of 10) (Fig. 1).

Typically, respondents are asked to indicate their present level of pain or their level of pain in the last 24 h. For this research, a new visual analog scale (VAS, 0–10 cm) was created to offer a thorough assessment of low back pain. In a recently developed detailed VAS, low back pain is separately assessed while the patient is in three distinct postural states: moving, standing, and sitting.

2.4. Oswestry disability index (ODI)

Researchers and disability assessors utilize the ODI (also known as the Oswestry Low Back Pain Impairment Questionnaire) as a very crucial instrument to assess a patient's long-term functional disability. The evaluation is regarded as the 'gold standard' for measuring low back functional outcome.

2.5. Scoring instructions

The maximum score for each section is 5. If the first sentence is marked, the section score is 0, and if the final statement is marked, the section score is 5. Following is how the score is determined if all 10 parts are completed: example: If one component is missing or is not relevant, the score is computed as follows: 16 (total scored), 50 (total potential score) x

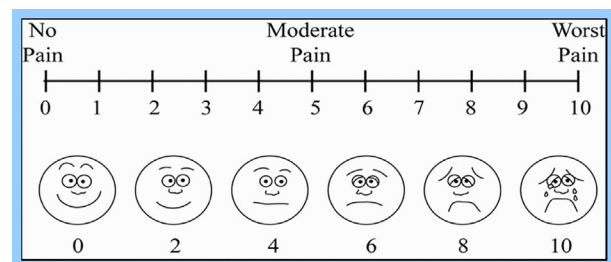


Fig. 1. Visual Analog Scale (V.A.S) and Faces rating scale (FRS).

100 = 32%; otherwise, it is 16 (total scored), 45 (total possible score) \times 100 = 35.5%. 10% points is the smallest observable change (90% confidence). (A change of less than this could be the result of measurement mistake).

2.6. Walking distance

The patients were asked about the walking distance, how far were they able to walk in meters before and after surgery.

2.7. Examination

General examinations to detect any associated injury and assess fitness for surgery. Neurological examination to evaluate the neurological status of the patient as: Assessment of consciousness. Motor system examination [muscle power in both right and left sides using Medical Research Council scale (MRC)]: Grade 0: absolute paralysis, Grade 1: tangible or visible constriction, Grade 2: moving actively, removing gravity, Grade 3: Active defiance of gravity, Grade 4: acting actively against opposition and Grade 5: moving actively when facing stiff opposition. Examination of sphincters including the control of voiding urine. Examination of sensory system including superficial and deep sensation. Examination of the spine 'back' for: signs of trauma, tenderness, spasm, gap, kyphotic or scoliotic deformities and limited movement. Sciatica clinical examinations include: 1- SLR test (straight leg raise) The patient will be laying on his or her back for this examination, elevating one leg at a time while keeping the other flat or bent at the knee. Sciatica is often diagnosed when the afflicted leg hurts when it is lifted. 2- The patient will be tested while sitting straight and placing her hands behind her back. The patient's hips sag forward (bends). One leg is stretched as far as it can be and the neck is bowed down with the chin touching the chest. Sciatica may be present if this posture causes discomfort.

2.8. Investigations

Routine laboratory investigations: During preoperative preparation of the patients, all cases were subjected to:

Complete blood picture, blood glucose, and liver and kidney functions.

Bleeding and clotting profiles, ECG and chest X-ray.

2.8.1. Imaging investigations

Plain X-ray of the lumbosacral spine anterior-posterior & lateral views, flexion & extension.

Computed tomography lumbosacral spine gives information about the bony part of the spine. Magnetic resonance imaging of the lumbosacral spine is very useful for evaluation of the spinal cord, intervertebral discs and ligamentous state. DEXA scan for evaluation of spine bone density.

2.8.2. Anesthesia

General anesthesia in all of cases, Intravenous antibiotics should be given 30 min prior to incision.

2.8.3. Position

The patient is lying on their back with their abdomen free, and their spine is bent to allow for the opening of their interlaminar gaps.

2.9. Procedures

2.9.1. Bilateral laminectomy and discectomy

The incision is made longitudinally midline over the spinous processes. The dissection was carried down with electro cautery through the subcutaneous tissue until the thick white lumbosacral fascia was reached. Electro cautery was used to expose the posterior tip of the spinous process bilaterally. A Kerrison punch was used to remove the inferior one third of the lamina above from medial to lateral. Curretting disc material and cartilage from the vertebral endplate, final disc material is removed and endplates prepared. All nuclear disc material is removed to ensure good bone graft to vertebral bone contact.

2.9.2. Pedicle screw fixation

1. ENTRY via the lateral side of the superior facet at the base of the transverse process, where the rostral-caudal axis of the transverse process meets the sagittal plane. The position of the pedicle is confirmed by palpation utilizing a probe inserted into the spinal canal if a laminectomy has been done at that level; otherwise, fluoroscopy is utilized. 2. TRAJECTORY a) For each level from L1 to L5, the lumbar vertebral number multiplied by 5° determines the approximate mediolateral trajectory. Fluoroscopy is used to assess the angle of the screw in the rostral-caudal direction, ensuring that its path remains parallel to the vertebral endplate (for a 'straight-ahead' trajectory). Image-guided navigation may be used. b) S1 cranio-caudal trajectory: aim for the sacral promontory (the anterior superior edge of S1) 3. SCREWS major screw diameter = 70–80% of pedicle diameter. Length should put tip 2/3 of the way across the VB (typical screw lengths: 40–55 mm) except for S1, which are usually only 35–40 mm long. To lessen the danger

of harming the major vessels or abdominal viscera, bicortical purchase or anterior VB penetrating should be prevented (save for S1).4. ROD Typically 5–6.5 mm diameter.

2.9.3. Lumbar interbody fusion

By conducting a broad laminectomy and bilateral partial facetectomies, the intervertebral disc may be seen and removed using the PLIF approach.

2.9.4. Follow up the patient

In this research, we assessed clinical and radiological findings in our patients immediately following surgery, one week later, and six months later. We assessed clinical examination (by evaluating subjective symptoms like low back pain and radicular pain), clinical signs, outcome scores like the VAS, Oswestry disability index, walking distance, and length of postoperative hospital stay, as well as postoperative X-ray imaging after surgery.

2.10. Statistical analysis

Employing Microsoft Excel 2016 for Windows, part of the Microsoft Office suite, 2016 of Microsoft Corporation, United States, data was gathered, coded, and then input as a spread sheet. IBM's Statistical Package for Social Sciences (SPSS) was employed to examine the data (Version 26.0 of IBM SPSS Statistics for Windows. Armonk: IBM Corp). The normality of the distribution was examined using the Kolmogorov-Smirnov test. While categorical data was reported as numbers and percentages, continuous data was expressed as mean \pm standard deviation, median, and IQR. Substantial statistical values were defined as < 0.05 .

3. Results

This prospective and retrospective study was done among 25 cases with lumbar spondylolisthesis at Al-Azhar University hospitals and Damanhur Medical Institute hospital (Table 1).

Fig. 2.

The preoperative radiographic evaluation was done for all patients and including: Regular static and dynamic plain lumbosacral spine X-rays are taken in the lateral view to check the spine for anatomical variations and preoperative instability. All patients will have a DEXA scan, C.T. lumbosacral spine, and measurement of the fracture pars interarticularis, pedicle diameter, and canal diameter at the stenotic level. For all individuals exhibiting further signs of neural compression, a lumbosacral spine MRI is recommended. The

Table 1. Distribution of studied patients regarding demographic data.

Pre-operative demographic data	Studied patients (n = 25) No. (%)
Age (years):	
Range	26.0–65.0
Mean \pm SD	43.92 \pm 9.94
Median	40.0
Age groups:	
18–40 years	13 (52.0%)
41–60 years	10 (40.0%)
≥ 60 years	2 (8.0%)
Gender:	
Males	10 (40.0%)
Females	15 (60.0%)

majority of patients (76%) with spondylolisthesis at the level of L4-L5 were identified by the imaging data (Fig. 3).

Lumbosacral spine X-ray was done to control the location of the fusion cage and the positioning of the transpedicular screws. The results showed that the level of interbody fusion by Cage was L4-L5 in 64% patients, at L5-S1 in 12% patients, L3-L4, L3-L4/L4-L5 and L4-L5/L5-S1 in 8% in each respectively (Table 2).

Pre-operative pain on VAS score ranged from 7 to 9 point with median value of (7.64 \pm 0.569), after one week post-operative it was ranged from 2 to 7 with mean value of (3.52 \pm 0.918). While post-operative pain on VAS score ranged from 1 to 7 point with mean value of (2.32 \pm 1.314) with mean difference was 5.32 \pm 1.345. Post-operatively (after 1 week and after 6 months), there was statistically substantial increase in pain of VAS score compared to preoperative VAS (Table 3).

The results showed that the level of fixation was at L4-L5 in 64% patients, at L3-L4-L5 in 12% patients, L4-L5-S1 in 8%, at L3- L4 in 4% patients and at L5-S1 in 12% patients. The mean operation time was 95.59 \pm 2.97 min and ranged from 85 to 120 min The mean hospital stay was 2.37 \pm 0.98 days and ranged from 1 to 10 days (Table 4).

Pre-operative disability on Oswestry Disability Index (ODI) ranged from 40% to 72% with mean value of (52.16 \pm 8.20), while after six months post-operative it was ranged from 6% to 28% with mean value of 13.92 \pm 5.21) with mean difference was 38.28 \pm 6.16%. After 6 months Post-operatively, there was statistically substantial increase in disability on ODI ($P < 0.001$) (Table 5).

Pre-operative Young adult T-score index ranged from -0.9 to 1.2 with median value of (0.4 \pm 0.69) while after six months post-operative it was ranged from -0.9 to 1.2 with mean value of (0.4 \pm 0.69). After 6 months post-operatively, there was

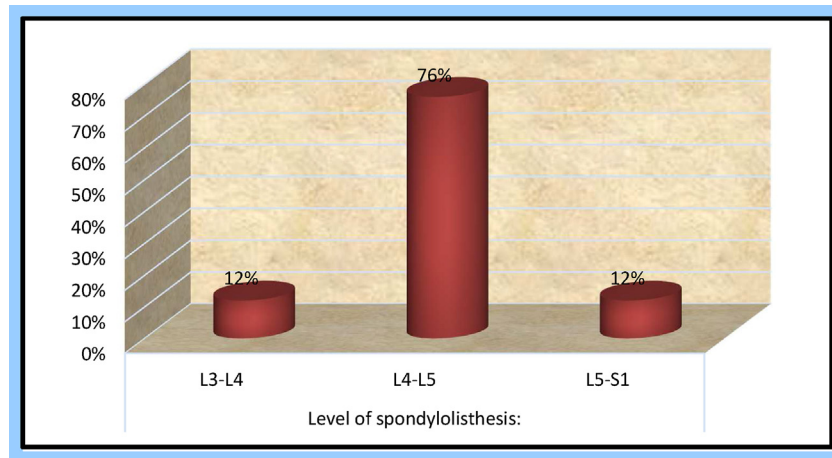


Fig. 2. Distribution of patients according to level of spondylolisthesis.

no statistically substantial variation in Young adult-score index compared to preoperative score (Table 6).

The most of patients (92%) had no complications. One case (4%) suffered from CSF leak and one (4%) patient suffered from superficial wound infection (Table 7).

The mean blood loss was 480.0 ± 87.8 cc and ranged from 300 to 700 cc (Table 8).

Regarding improvement of radiculopathy, 9 (36%) patients had good improvement, 8 (32%) patients showed fair improvement, 7 (28%) patients had Great improvement and only one patient had no improvement.

3.1. Case 1

A 65 year old female patient, Complain: back pain and bilateral sciatica more than one year ago with failure of conservative measures more than 6 months.

Pre-operative: MRI L.S.S, Dynamic X-ray L.S.S, DEXA SCAN and routine lab are done. Finding: showing L3- L4-L5 spondylolisthesis. Operation: The patient underwent laminectomy of partial L3 and complete L4-L5 laminectomy and discectomy of L3-4 and L4-5, pedicle screw fixation between L3-L4-L5 and interbody fusion by a cage. The operation was done by PLIF approach. Post-operative: The patient improved clinically ODI and VAS for back and leg pain. Post-operative x rays of lumbar spine were done showing rods and screws and cage in the proper site with no post-operative instability (Fig. 4).

Fig. 5.

Fig. 6.

Fig. 7.

4. Discussion

Most cases with spondylolisthesis are asymptomatic. Although the various types of spondylolisthesis

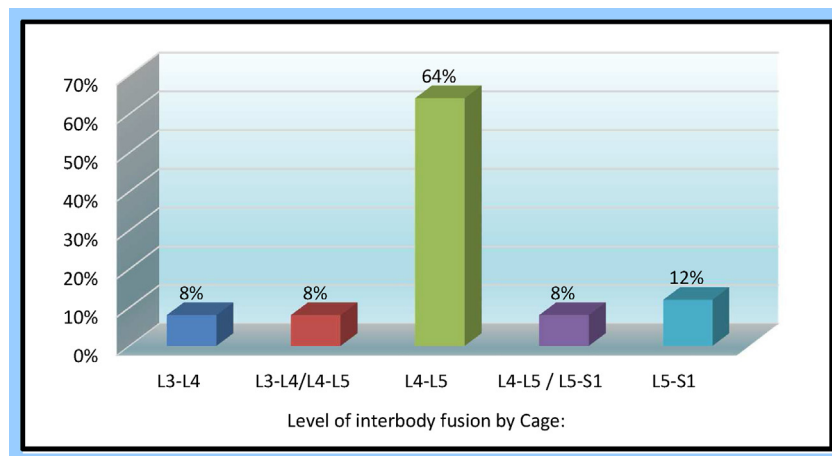


Fig. 3. Distribution of patients according to of interbody fusion by Cage.

Table 2. Comparison between pre-operative and post-operative pain in VAS score.

Pain (VAS score)	Range	Mean \pm SD	Median	Friedman's ANOVA test	
				F	P value
Pain (VAS score)					
Preoperative	7.0–9.0	7.64 \pm 0.569	8.0	45.9	<0.001**P1 = 0.001P2<0.001 P3 = 0.022
Postoperative (After 1 week)	2.0–7.0	3.52 \pm 0.918	3.0		
Postoperative (After 6 months)	1.0–7.0	2.32 \pm 1.314	2.0		
Difference	0.0–7.0	5.32 \pm 1.345	6.0		

$P \leq 0.05$ substantial, $P \leq 0.01$ is highly statistically substantial.

P1: comparison between preoperative VAS and 1week postoperative VAS, P2: comparison between preoperative VAS and 6months postoperative VAS, P3: comparison between 6months postoperative VAS and 1 week postoperative VAS.

differ as regard to cause, age, sex and pathology, several clinical presentations are common to all types including back pain, radicular pain, neuro-claudication pain, deformity kyphosis or scoliosis and gait disturbance.⁸

The purpose of this research was to evaluate the effectiveness of posterior inter-body fusion by cage with transpedicular screws fixation in the treatment of lumbar and lumbosacral spondylolisthesis.

This retrospective study was done among 25 cases with lumbar spondylolisthesis at Al-Azhar University hospitals and Damanhur Medical Institute hospital.

An analysis of our results showed that age of the patients ranging from 26 to 65 years with median age was 43.92 \pm 9.94 years. The most common age group was age group between 18 and 40 years representing 52% of studied cases. There was predominance of female sex among studied cases (60%) while there were 10 (40%) females with male to female ratio was 0.67: 1.

Come in comparison with our findings, the research of mowafy *et al.*,⁹ included 40 subjects with various degrees of Spondylolisthesis; They were split into 2 main groups: group A: TPF (Transpedicular fixation) and group B: TPIF (Transpedicular with interbody fusion). The median age of

group A was 57.85 \pm 5.49 years ranging between 46 and 60 years. However, the mean age of group B was 56.55 \pm 6.63 years, ranging from 44 to 67 years. Out of 20 patients in group A, 14 (70%) patients were females, and the others were males. While in group B there were 13 (65%) females, and the others were males.

Ghogawala *et al.*,¹⁰ reported in his study female ratio (68%) and male ratio (32%) which is near to our study results.

In another trial of Moussa *et al.*,¹¹ comprised 20 participants with varying degrees of spondylolisthesis, 13 of them (65.0%) were females, demonstrating a preponderance of women among the population. Their ages varied from 29 to 59 years, with 50.0% of them falling into the older age group (40–50 years).

Benguluri and Kumar,¹² performed research on 86 patients, with a median age of 43 years (58 females and 28 men). additionally, Madan and Boeree¹³, showed 44.4 years as median age, while Kim and Kim,¹⁴ patients with an average age of 41.3 years were included.

In the current study, the weight of the patients ranged from 70 to 95 Kg with median age was 81.88 \pm 6.39 Kg. The height of the patients ranged from 160 to 175 cm with mean age was 166.84 \pm 3.29 cm. The BMI of the patients ranged from 24.51 to 36.33 kg/m² with mean BMI was 29.44 \pm 2.50 kg/m².

In the study of Tedyanto¹⁵, There were no patients included in the BMI underweight and obese category, as is well known. A total of 59 patients (81.9%) were included in the normal group, with the remaining 13 patients (18.1%) being part of the overweight group.

In the current study, we found that all patients (100%) complained from lower back pain. Less than half of patients (48%) complained from bilateral radicular pain, right pain in 7 (28%) patients and left pain in 6 (24%) patients.

The findings of this study are consistent with those of Agabegi and Fischgrund,¹⁶ who noted that

Table 3. Distribution of patients regarding operative data.

Operative data	Studied patients (n = 25) No. (%)
Levels of fixation	
L3-L4	1 (4.0%)
L3-L4-L5	3 (12.0%)
L4-L5-S1	2 (8.0%)
L4-L5	16 (64.0%)
L5-S1	3 (12.0%)
Operation time (minutes)	
Range	85.0–120.0
Mean \pm SD	95.59 \pm 2.97
Median	95.0
Hospital stay (day):	
Range	2.37 \pm 0.98
Mean \pm SD	4.0
Median	1.0–10.0

Table 4. Comparison between pre-operative and post-operative pain (after 6 months) in Oswestry disability index (ODI).

Oswestry Disability Index (ODI)	Range	Mean \pm SD	Median	Wilcoxon Signed Ranks Test	
				Z	P value
ODI (%)					
Preoperative	40.0–72.0	52.16 \pm 8.20	52.0	4.383	<0.001**
Postoperative	6.0–28.0	13.92 \pm 5.21	14.0		
Difference	20.0–48.0	38.28 \pm 6.16	40.0		

$P \leq 0.05$ substantial, $P \leq 0.01$ is highly statistically substantial.

spondylolisthesis in their study was either of isthmic or degenerative kinds, with radicular signs and low back pain as the primary symptoms.

In the current study, preoperative radiographic evaluation was done for all patients and including: Regular static and dynamic plain lumbosacral spine X-rays are taken in the lateral view to check the spine for anatomical variations and preoperative instability. All patients will have a DEXA scan, C.T. lumbosacral spine, and measurement of the fracture pars interarticularis, pedicle diameter, and canal diameter at the stenotic level. For all individuals exhibiting further signs of neural compression, a lumbosacral spine MRI is recommended. The imaging data showed that most patients (76%) had spondylolisthesis at the level of L4-L5. lumbosacral spine X-ray was done to control the location of the fusion cage and the positioning of the transpedicular screws. The results showed that the level of interbody fusion by Cage was L4-L5 in 64% patients, at L5-S1 in 12% patients, L3-L4 8%, L3-L4/L4-L5 8% and L4-L5/S1 8%.

In the study on our hands, we found that the level of fixation was at L4-L5 in 64% patients, at L3-L4-L5 in 12% patients, L4-L5-S1 in 8% in each respectively, at L5-S1 in 12% patients and at L3-L4 in 4% patients. The mean operation time was 95.59 \pm 2.97 min and ranged from 85 to 120 min The mean hospital stay was 2.37 \pm 0.98 days and ranged from 1 to 10 days.

In comparison with our findings, the research of mowafy *et al.*,⁹ reported that only one patient in their study had two levels of spondylolisthesis in group A. while all patients in group B had only one

level of listhesis. In group A only two patients had Grade II listhesis, and the others had Grade I listhesis. While in group B only one patient has Grade II listhesis and other patients had Grade I listhesis.

Furthermore, the current research's findings support Benguluri,¹² who revealed that, L4-L5 was the level most often impacted (55 instances), then L5-S1 (31 patients). On the other side, Dantas *et al.*,¹⁷ revealed the same number (45%) of patients with L4-L5 and L5-S1 level involvement. Otherwise, Ganju *et al.*,¹⁸ revealed impacted rates for L4-L5 of 47.72% and L5-S1 of 52.27%.

In the study on our hands, we found that the level of fixation was at L4-L5 in 52% patients, at L3-L4-L5 in 16% patients, L4-L5 and L5-S1 in 12% in each respectively, at L4-L5-S1 in 8% patients and at L3-L4 in 4% patients. The mean operation time was 95.59 \pm 2.97 min and ranged from 85 to 120 min The mean hospital stay was 2.37 \pm 0.98 days and ranged from 1 to 10 days.

In the study of Elsayed *et al.*,¹⁹ reported that PLIF group the operative time ranged between 180 and 260 min and the mean was 223.2 \pm 24.7 min while in TLIF group the operative time range was 120–220 min and the mean was 150 \pm 33.6 min, there was statistical significance between these groups and P value = 0.001.

Inamdar,²⁰ reported on operative time in their comparative study between PLIF and PLF that the average operating time for patients with PLIF was 4 h, compared to 3 h for patients with PLF. The PLIF technique time was longer than PLF as discectomy steps and their complication were cancelled.

In the present study; Pre-operative pain on VAS score ranged from 7 to 9 point with median value of (7.64 \pm 0.569), after one-week post-operative it was

Table 5. Comparison between pre-operative and post-operative pain in Young adult T-score index of DEXA scan.

Young adult- score index	Range	Mean \pm SD	Median	Paired T Test	
				T	P value
Young adult T- score index					
Preoperative	–0.9–1.2	0.4 \pm 0.69	0.5	0.0	1.00
Postoperative	–0.9–1.3	0.4 \pm 0.69	0.50		

$P \leq 0.05$ substantial, $P \leq 0.01$ is highly statistically substantial.

Table 6. Distribution of patients regarding post-operative complications.

Post-operative complications	Studied patients (n = 25) No. (%)
No	23 (92.0%)
CSF leak	1 (4.0%)
Superficial wound infection	1 (4.0%)

Table 7. Distribution of patients regarding blood loss.

Operative data	Studied patients (n = 25)
Blood loss (cc):	
Range	300.0–700.0
Mean ± SD	500.0
Median	480.0 ± 87.8

Table 8. Distribution of patients regarding improvement of radiculopathy.

Improvement of radiculopathy	Studied patients (n = 25) No. (%)
Great	7 (28.0%)
Good	9 (36.0%)
Fair	8 (32.0%)
No improvement	1 (4.0%)

ranged from 2 to 7 with mean value of (3.52 ± 0.918) . While post-operative pain on VAS score ranged from 1 to 7 point with mean value of (2.32 ± 1.314) with mean difference was 5.32 ± 1.345 . Post-operatively (after 1 week and after 6 months), Compared to preoperative VAS, there was statistically substantial increase in the pain VAS score.

Abou-Madawi *et al.*,²¹ reported that In group I, the preoperative VAS of back pain decreased from 8 ± 3.1 to 4.5 ± 2.8 at 3 months, 3.5 ± 2.5 at 6 months, and 3.4 ± 2.9 at the most recent follow-up, while group II's preoperative VAS of back pain decreased from 8 ± 3.2 to 4.6 ± 2.7 at 3 months, 3.8 ± 3 , and 3.6 ± 2.6 at the most recent follow-up. While the study of Moussa *et al.*,¹¹ demonstrated a statistically substantial reduction in VAS score, which dropped from 7.75 ± 0.72 before surgery to 1.35 ± 0.59 after six months. These findings concur with those of El-Sayed *et al.* (19), who found a considerable reduction in pain after Spodylolythesis surgery.

In addition to above findings; we found that Pre-operative disability on Oswestry Disability Index (ODI) ranged from 40% to 72% with mean value of (52.16 ± 8.20) , while after six months post-operative it was ranged from 6% to 28% with mean value of 13.92 ± 5.21 with mean difference was $38.28 \pm 6.16\%$. After 6 months Post-operatively, there was statistically substantial improvements in disability on ODI ($P < 0.001$).

In mowafy *et al.*,⁹ study; the mean preoperative Oswestry Disability Index scores (ODI) of the studied patients in group A was 72.4 while in group B it was 78.7 with high significant difference comparing both groups. This is slightly more Delawi *et al.*,²² results which were 65. This is going in agreement with Rezk *et al.*,²³ study which reported the mean preoperative ODI 75.

As opposed to that; Abou-Madawi *et al.*,²¹ revealed that Preoperative ODI in group I increased from 41.4 ± 8 to 18 ± 8 at 3 months, to 12.6 ± 6 at 6 months, and to 12.3 ± 7 at the last follow-up, whereas the preoperative ODI in group II improved from 39 ± 9 to 17 ± 7 at 3 months, to 13.4 ± 4 at 6 months, and to 13 ± 8 at the last follow-up. According to the subjective 5-point outcome score, 83.3% of patients in group I had excellent or good outcomes, whereas 87% of patients in group II had the same.

In the study on our hands; we found that Pre-operative Young adult T-score index ranged from -0.9 to 1.2 with median value of (0.4 ± 0.69) while after six months post-operative it was ranged from -0.9 to 1.2 with mean value of (0.4 ± 0.69) . After 6 months post-operatively, there was no statistically substantial variation in Young adult-score index compared to preoperative score.



Fig. 4. MRI t2 sagittal view LSS pre-operative show L3-L4 disc prolapse and L4-5 disc prolapse with spondylolisthesis.

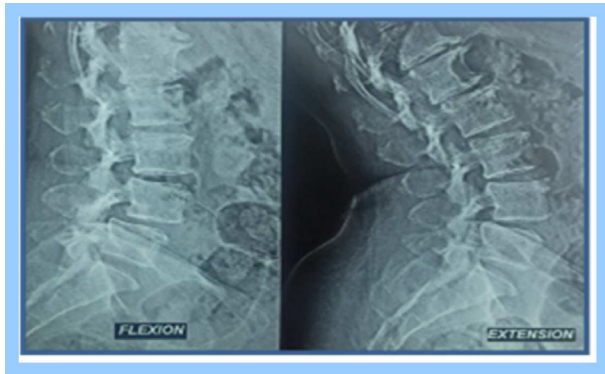


Fig. 5. X ray pre-operative lateral flexion and extension show L4-5 spondylolisthesis.

Furthermore; Bao *et al.*,²⁴ reported that Patients with vertebral compression fracture and degenerative scoliosis had substantially greater rates of osteoporosis than those without (70.5% vs. 39.4%, $P < 0.001$) and lower rates of osteoporosis than those without (47.8% vs. 38.2%, $P = 0.002$), respectively, of the 1041 patients who had lumbar fusion surgery for LDD.

In the present study; we revealed that the most of patients (92%) had no complications. One case (4%) suffered from CSF leak and one (4%) patient suffered from superficial wound infection.

Nearly similar to our findings, Moussa *et al.*,¹¹ The majority of the analyzed groups (75%) had no issues, whereas there were two occurrences of C.S.F. leaks, according to the study's analysis of complication rates across the groups. Rezk *et al.*,²³ produced a 17.1% complication rate. CSF leaks might develop as a result of spinal trauma or surgical procedure. These leaks are a serious issue since they are linked to ongoing headaches and are contagious (e.g., meningitis). Re-intervention by surgery is

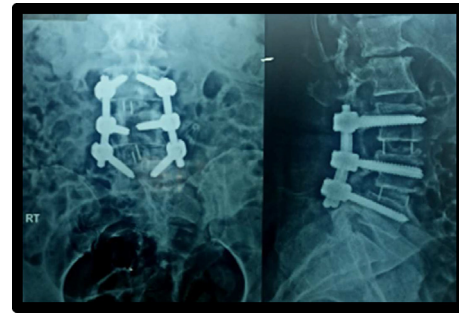


Fig. 7. X-ray LSS post-operative show L3-4/L4-5 TPF 6 screws + PLIF by 2 cage one cage in every level.

often necessary, as it is complete direct dura closure. If not, a fascial graft for closure is required.

Moreover, in the current study, the mean blood loss was 480.0 ± 87.8 cc and ranged from 300 to 700 cc.

In mowafy *et al.*,⁹ study the mean intraoperative blood loss of the studied patients in group A (operated by posterior lumbar decompression, transpedicular screw fixation and postero-lateral inter-transverse bony fusion) was found to be 567 ml, while in group B (operated by posterior decompression, *trans*-pedicular screw, posterolateral inter-bony fusion by insertion of inter-body cages) was found to be 800 ml. McAfee *et al.*,²⁵ reported that, the median blood loss in PLF was 280 ml compared to 450 ml blood losses in inter-body fusion group.

Finally; in our study; regarding improvement of radiculopathy, 9 (36%) patients had good improvement, 8 (32%) patients showed fair improvement, 7 (28%) patients had excellent improvement and only one patient had no improvement.

In mowafy *et al.*,⁹ study, 70% of group attained grade II fusion, however the remaining 30% patients



Fig. 6. Intra-operative TPF+ 2 level PLIF by cage.

attained grade III and no patients attained grade I. On the other hand, 45% patients in group B attained grade I and 55% patients attained grade III.

Rao *et al.*,²⁶ agreed with our study as he found that with the use of pedicle screws for fixation, the inter-body fusion was more effective in increasing the fusion rate than posterior lateral screw fusion alone. This led to early stability and a high rate of fusion after PLIF.

4.1. Conclusion

Spondylolisthesis is managed mainly surgical in case of failure of conservative treatment. Transpedicular fixation with inter-body fusion is an efficient method for the treatment of spondylolisthesis. Partial reposition of spondylolisthesis with neural decompression makes it possible to avoid neurological complications. Future research should include more multicenter trials with long-term follow-up and large sample sizes.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

Conflict of interest

There are no conflicts of interest.

References

1. Fredrickson B, Baker D, McHolick WJ. The natural history of spondylolysis and spondylolisthesis. *J Bone Joint Surg Am.* 1984;66:699–707, 5.
2. Herbinaux G. *Traite sur divers. Accouchement laborieu et sur les polipe de la matrice.* Brussels. J.L. De Boubers; 1782.
3. Majid K, Fischgrund JS. Degenerative lumbar spondylolisthesis: trends in management. *J Am Acad Orthop Surg.* 2008;16:208–215.
4. Mostofi K, Gharai Moghaddam B, Karimi Khouzan R, Daryabin M. The reliability of LERI's sign in L4 and L3 radiculalgia. *J Clin Neurosci.* 2018;50:102–104. <https://doi.org/10.1016/j.jocn.2018.01.025>.
5. Kalichman L, Kim DH, Li L. *Spondylolysis and spondylolisthesis: prevalence and association with low back pain in the adult community-based population.* 2009:199–205.
6. Garry J, McShane J. Lumbar spondylolysis in adolescent athletes. *Spine.* 1988;47:145–149.
7. Jacobs WC, Vreeling A, De Kleuver M. Fusion for low grade adult isthmic spondylolisthesis: a systematic review of the literature. *Eur Spine J.* 2006;15:391–402.
8. Crawford EJ, Ravinsky RA, Coyte PC, Rampersaud YR. Life-time incremental cost-utility ratios for minimally invasive surgery for degenerative lumbar spondylolisthesis relative to failed medical management compared with total hip and knee arthroplasty for osteoarthritis. *Can J Surg.* 2021;64:E391–E402. <https://doi.org/10.1503/cjs.015719>. PMID: 34296707; PMCID: PMC8410474.
9. mowafy O, gameel I, El-Zayat T, Abo El Khir M. Comparative study between transpedicular screws fixation with and without interbody fusion using cages in lumbar spondylolisthesis. *Al-Azhar Int Med J.* 2022;3:35–39. <https://doi.org/10.21608/aimj.2022.106779.1666>.
10. Ghogawala Z, Dziura J, Butler WE. Laminectomy plus fusion versus laminectomy alone for lumbar spondylolisthesis. *N Engl Med.* 2016;374:1424–1434.
11. Moussa AA, Ali MS, Galal M. Outcome of transpedicular screw fixation with posterior interbody fusion in management of spondylolisthesis. *Int J Med Arts.* 2020;2:358–364.
12. Benguluri R, Kumar CS. Surgical management of spondylolisthesis by pedicular screw rod system and postero-lateral fusion. *IOSR J Dent Med Sci.* 2018;17:61–70. <https://doi.org/10.9790/0853-1704056170>.
13. Madan S, Boeree NR. Outcome of posterior lumbar interbody fusion versus posterolateral fusion for spondylolytic spondylolisthesis. *Spine.* 2002;27:1536–1542.
14. Kim EH, Kim HT. En bloc partial laminectomy and posterior lumbar interbody fusion in foraminal spinal stenosis. *Asian Spine J.* 2009;3:66–72. <https://doi.org/10.4184/asj.2009.3.2.66>.
15. Tedyanto EH. Relationship between body mass index and radiological features of spondylolisthesis. *Int J Sci Res.* February 2020;9(2):1204–1206. <https://doi.org/10.21275/SR20215210921>.
16. Agabegi SS, Fischgrund JS. Contemporary management of isthmic Spondylolisthesis: pediatric and adult. *Spine J.* 2010;10:530–543. <https://doi.org/10.1016/j.spinee.2010.02.023>.
17. Dantas FL, Prandini MN, Ferreira MA. Comparison between posterior lumbar fusion with pedicle screws and posterior lumbar interbody fusion with pedicle screws in adult spondylolisthesis. *Arq Neuro Psiquiatr.* 2007;65:764–770. <https://doi.org/10.1590/s0004-282x2007000500006>.
18. Ganju A. *Isthmic Spondylolisthesis.* *Neurosurg Focus.* 2002;13:E1. <https://doi.org/10.3171/foc.2002.13.1.2>.
19. Elsayed A, Alqazaz M, Mohamed K, Shater M. Evaluation of transforaminal lumbar interbody fusion versus posterior lumbar interbody fusion in patients of lumbar instability submitted to transpedicular screws fixation. *Med J Cairo Univ.* 2012;80:185–192.
20. Inamdar D, Alagappan M, Shyam L. Posterior lumbar interbody fusion versus intertransverse fusion in the treatment of lumbar spondylolisthesis. *J Orthop Surg.* 2006;14:21–26.
21. Abou-Madawi A, Sherif H. *Local Autograft versus Iliac Crest Bone Graft PSF-Augmented TLIF in Low-Grade Isthmic and Degenerative Lumbar Spondylolisthesis.* 2020. <https://doi.org/10.1177/2192568220946319>. Published online.
22. Delawi D, Dhert WJ, Castelein RM. The incidence of donor site pain after bone graft harvesting from the posterior iliac crest may be overestimated 2007: a study on spine fracture patients. *Spine.* 2007 Aug;32:1865–1868.
23. Rezk EMA, Elkholy AR, Shamhoo EA. Transforaminal lumbar interbody fusion (TLIF) versus posterior lumbar interbody fusion (PLIF) in the treatment of single-level lumbar Spondylolisthesis. *Egypt J Neurosurg.* 2019;34:6. <https://doi.org/10.1186/s41984-019-0052-9>.
24. Bao J, Zou D, Li W. Characteristics of the dxa measurements in patients undergoing lumbar fusion for lumbar degenerative diseases: a retrospective analysis of over 1000 patients. *Clin Interv Aging.* 2021;16:1131–1137. <https://doi.org/10.2147/CIA.S300873>.
25. McAfee P, DeVine J, Chaput C, Prybis B. The indications for interbody fusion cages in the treatment of spondylolisthesis: analysis of 120 cases. *Spine.* 2005;6:60–65.
26. Rao G, Abdul Azeez Q, Kumar S. Evaluation of the clinico-radiological outcome of lumbar interbody fusion using cage and local bone graft in management of lumbar spondylolisthesis. *Int J Orthop Sci.* 2018;4:814–822.