

Posterior Lumbar Interbody Fusion in Degenerative Spondylolisthesis

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ABSTRACT

Background: degenerative spondylolisthesis is one of causes of low back pain in older patients and it's referring to a forward slippage of a lumbar, with an intact neural arch. Uncommon before the age of 50 years, it is more common in women and particularly in blacks, with a male: female ratio of 1:6. Posterior lumbar interbody fusion surgery is one of an effective surgery in treatment of patients with degenerative spondylolisthesis and can make significant relief in low back pain and disability. It has amore advantages more than other type of back surgery through restoring of vertebral height and restricts motion of the vertebral segment.

Objective: this study aimed to evaluate the surgical treatment of degenerative spondylolisthesis by Posterior Lumber Interbody Fusion.

Patients and Methods: this was a prospective study carried out at Al-Azhar University Hospitals on 15 patients with degenerative spondylolithesis operated by posterior lumber interbody fusion and assessment pre-operative, one day, three months and six months post-operative by oswestry disability index .also according to visual analogue scale pre and post-operative then assessment of the fusion according to lenke classification.

Results: the mean preoperative ODI was (70.2%±5.5) one day Postoperative ODI was (10.93%±4.76), after 3 months was (10.67±7.97) and 6 months the mean post-operative was (12.76±14.25). According to VAS for back pain pre-operative was (6.9± 0.9) preoperative and show marked improvement and the main postoperative value according to VAS is (1.53±1.126) for leg pain The mean value Pre-operative according to VAS was :(9.06±0.7) and the mean value Post operativeis (2.0±1.41) the mean outcome was 87.24 % ranged from 38% to 94% the main complication noted the adjacent segment degenerative disease and Dural tear.

Conclusion: posterior lumber interbody fusion in degenerative spondylolisthesis is a very good option.

Key word: degenerative spondylolisthesis, interbody fusion

INTRODUCTION

Degenerative spondylolisthesis refers to a forward slippage of a lumbar, with an intact neural arch. Uncommon before the age of 50 years, it is more common in women and particularly in blacks, with a male: female ratio of 1:6⁽¹⁾. L4-L5 is the most commonly affected level and rarely exceeds 30% of the vertebral width. Degenerative spondylolisthesis is usually asymptomatic but may be associated with symptomatic stenosis of the lumbar spinal canal. The canal stenosis is the most common cause of back surgery in adults over 55 years when associated with neurogenic claudication. However, spinal stenosis is usually asymptomatic. Therefore, clinical radiological correlation is essential for making decisions⁽²⁾.

The lesion is due to longstanding intersegmental instability. Remodeling of the articular processes at the level of involvement

results. Farfan believes that in addition to degeneration of the disc there are multiple small stress compression fractures of the inferior articular processes of the olisthetic vertebra. As the slip progresses, the articular processes change directions and become more horizontal. One side nearly always rotates more than the other. This is an integral characteristic of this disease. Farfan believes that the typical hour-glass deformity seen on the myelogram is due to rotation of the upper vertebra with displacement of the pedicle⁽³⁾.

Surgical treatment with spinal decompression and stabilization in degenerative spondylolisthesis is recommended when conservative treatment fails⁽⁴⁾. The surgical treatment of degenerative spondylolisthesis is indicated for cases of neurogenic claudication, intractable radicular pain, severe low back pain,

presence of neurological symptoms, failure of conservative management, radiological instability^(5,6).

Lumbar interbody fusion is the most reliable fusion technique currently available for the lumbar spine as these constructs are biomechanically stronger, provide axial support with less graft subsidence or collapse comparing to those with posterolateral arthrodesis, and produce a better biologic fusion in lordotic alignment^(7,8). In theory interbody fusion provides several advantages when compared with fusion techniques as it immobilizes the painful degenerated spinal segments, decompress the nerve roots, and restores disc height and root canal dimensions, as well as load bearing ability of the anterior structures.⁽⁹⁾

The bilateral posterior lumbar interbody fusion (PLIF) procedure was first introduced by Cloward for lumbar interbody fusion and neural decompression⁽¹⁰⁾.

Aim of the work: This study aims to evaluate the surgical treatment of degenerative spondylolisthesis by Posterior Lumbar Interbody Fusion.

Patient and Methods: This prospective study included fifteen patients; they were operated upon by posterior lumbar interbody fusion and transpedicular fixation for surgical treatment of lumbar degenerative spondylolisthesis to evaluate the effectiveness and safety of the procedure. Duration of symptoms was not less than 6 months to five years. They included 12 female and 3 male patients, with their age ranged from 50 to 70 years and mean of (56.2) years.

Inclusion criteria: Patient didn't respond to conservative treatment, or physical therapy rehabilitation for six months, patient with radiological signs of degeneration without instability in the cranially adjacent segment.

Exclusion criteria: Patients with other types of spondylolisthesis as isthmic, traumatic, **dysplastic and pathologic**, Patients received medical treatment or physical therapy rehabilitation less than six months and Patients with previous osteoporotic fracture, malignancy and infection of lumbar vertebrae.

Ethical issues: all patients participating in our present study was informed clearly and a written informative consent was obtained from all of

them. **The study was approved by the Ethics Board of Al-Azhar University.**

Surgical Technique:

a) After induction of general anesthesia with intubation, the patient was placed in a prone position on operative table. Traditional mid line incision started above the affected vertebra at the mid line above the spinous processes and extended as the situation need, dissection is carried through the subcutaneous tissue to the lumbosacral fascia. This may be done sharply using the scalpel or alternatively with electrocautery. Once the correct levels are identified using intra operative imaging studies, a subperiosteal technique is used to expose the lamina. Above and below the level to be fused laminae are exposed.



Figure 1: posterior midline approach showing the spinous processes

b) Pedicle screw insertion additional exposure of the transverse processes of the levels to be fused is generally performed for appropriate localization of the pedicle and defect in the cortical bone using rangers. Using awel and detect to level and position guided by C-arm anteroposterior and lateral views Pedicle screws are placed. the other screws is putted by the same manner guided by C arm then one rod inserted and distraction of the vertebrae done to visualize the disc space.

c) Removal of Lamina and Facets: The laminectomy; removal of only the laminae and spinous processes adjacent to the level to be fused stating that only a deep notch be made in the laminae and spinous processes rather than a complete laminectomy. Once the bony removal is performed, the dura is retracted medially with

either the use of handheld retractors or a self-retaining retractor standard discectomy.

A variety of instruments used to prepare the vertebral end plates, such as end-plate scrapers, shavers, curettes, or rasps, have been developed (fig.2). After the discectomy is performed and the end plates are adequately prepared using a series of reamers, shavers, rasps, curettes, and other

available instruments, the grafts are ready to be placed. Careful attention should be paid to the insertion depth of all instruments while working within the disc space, however, because the average depth of the disc space often ranges from 25 mm under the facet to 35 mm in the center of the interspace.

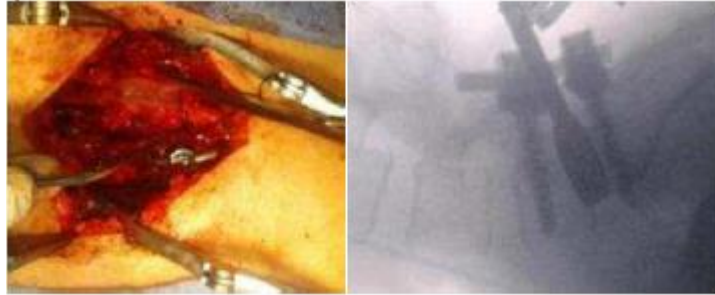


Figure 2: Intra operative Fluoroscopic Images of removal of degenerative disc and curettage of vertebral end plate.

d) Graft placement: The disc space is prepared with the surgeon's choice of instrumentation. The goal is to achieve parallel endplates on each vertebral body to ensure good contact with the graft. Once the disc space is prepared, the surgeon will insert graft with auto graft bone packed between and around them. The auto graft bone is typically local bone removed during the laminectomy. In the type of hard PLIF the surgeon insert the cage after insertion of the auto graft in it then fill the space around it by the bone graft chips collected during laminectomy (fig.3)



Figure 3: The cage and its inserter

e) Rods insertion the other rod inserted the heads of the pedicular screws and relief the distraction of the vertebrae and fixation is completed and tensioned.



Figure 4: X-ray of anteroposterior and lateral views (a-b) showing narrow disc space between l4/5/s1 and slippage of L4 on L5



Figure 5: X-ray flexion and extension lateral views (c-d) show narrow space between L4 and L5 with slippage about 25% of vertebral body of L4.

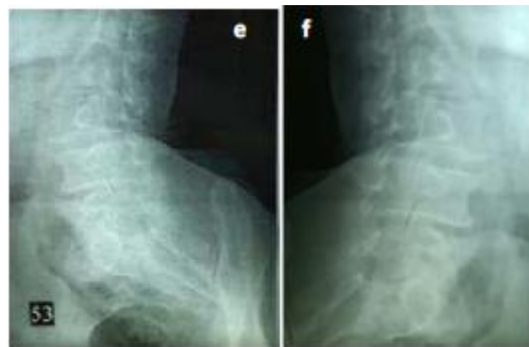


Figure 6: Oblique views (e-f) showing intact neural arch and no fracture of the pars interarticularis.

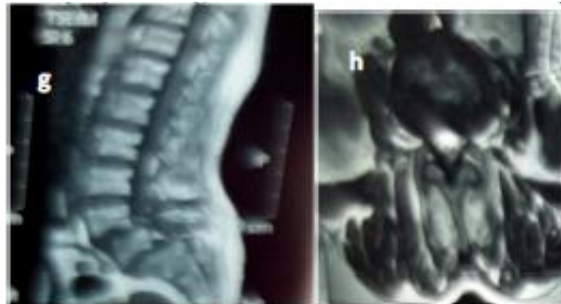


Figure 7: MRI (g-h) show grade 1 spondylogenerative changes of L4/5

Patient underwent a PLIF surgery in Sayed Galal hospital 9 months ago and post-operative X-rays show.



Figure 8: Show post operative anteroposterior and lateral views with good placement of the graft

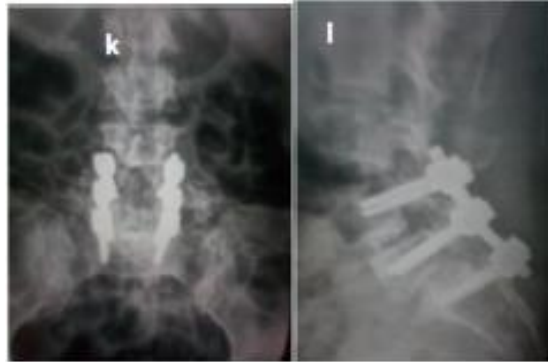


Figure 9: x-rays anteroposterior and lateral views 6 months post-operative showing grade A fusion according to lenke classification of I4/5/S1.

Post-operative Management: After PLIF, patients are allowed to mobilize as soon as their tolerable and level of discomfort will allow, though no later than 24 hours postoperatively. The use of a brace is at the discretion of the surgeon, though a brace not incorporating the thigh will do little to immobilize the L5–S1 segment. Patients are discharged when their wounds are clean and dry, their discomfort is

controlled with oral medications, and they are ambulatory, afebrile, eating, and voiding. Patients follow up at regular intervals with physical examination and static and dynamic radiographs until radiographic evidence of fusion is seen. Bone graft resorption, lucent lines, evidence of hardware loosening or failure, or persistent or recurrent complaints should prompt reevaluation.

Results:

Table (1): Comparison between studied patients as regard ODI (pre-operative, 1 day, 3 months and 6 months post-operative).

	Pre operative (N = 15)	1 day P.O (N = 15)	3 months P.O (N = 15)	6 months P.O (N = 15)	ANOVA p-value
OID					
Mean	70.2	10.93	10.67	12.76	< 0.001*
±SD	5.5	4.76	7.97	14.25	

*: p-value < 0.001 is considered highly significant.

Table (1) shows preoperative assessment by the Oswestry Disability Index as follows: the mean preoperative ODI (70.2%±5.5), one day postoperative ODI was (10.93%±4.76), after 3 months was (10.67±7.97) and 6 months the mean post-operative was (12.76±14.25). Table shows highly statistical significant difference (p-value < 0.001) between studied patients as regard ODI (pre-operative, 1 day, 3 months and 6 months post-operative).

Table (2): Comparison between studied patients as regard VAS for back (pre-operative and post-operative).

		Pre-operative (N = 15)	Post-operative (N = 15)	T-test p-value
VAS	Mean	6.9	1.53	< 0.001*
	±SD	0.9	1.126	

***: p-value < 0.001 is considered highly significant.**

Table (2) shows the assessment of the main value of back pain according to VAS for back pain was (9.6± 0.9) preoperative and show marked improvement and the main postoperative value according to VAS is (1.53±1.126). Table shows highly statistical significant difference (**p-value < 0.001**) between studied patients as regard VAS for back pain (pre & post-operative).

Table (3): Comparison between studied patients as regard VAS for leg (pre-operative and post-operative).

For Leg		Pre-operative (N = 15)	Post-operative (N = 15)	T-test P-value
VAS	Mean	9.06	2.0	< 0.001*
	±SD	0.7	1.41	

***: p-value < 0.001 is considered highly significant.**

The table (3) shows the assessment of leg pain is done by VAS for Leg pain (visual analogue score): and show marked improvement. The mean value Pre-operative is according to VAS: (9.06±0.7) and the mean value Post operatives (2.0±1.14).Table shows highly statistical significant difference (p-value < 0.001) between studied patients as regard VAS for leg pain (pre & post-operative).

Table (4): Description of fusion after 6 months in studied patients.

		Studied patients (N = 15)
Fusion after 6 months	Grade A	7 (46.6%)
	Grade B	6 (40%)
	Grade C	1 (6.6%)
	Grade D	1 (6.6%)

Table(4) shows the description of fusion according to lenke classification of fusion after 6 months in studied patients.7 patient (46.6%) was grade A Definitely solid with bilateral trabeculated stout fusion masses present ,6 patient (40%) was Grade B Possibly solid with a unilateral large fusion mass and a contralateral small fusion mass. ,1 patient (6.6%) was grade C Probably not solid with a small fusion mass bilaterally, 1patients (6.6%) was Grade D Definitely not solid with bone graft resorption or obvious pseudoarthrosis bilaterally

Table (5): Description of complications among studied patients.

		Studied patients (N = 15)
Complications	Non	13 (86.7%)
	ASD	1 (6.7%)
	Dual tear	1 (6.7%)

Table (5) shows the description of complications among studied legs.13 patients had no complication, 1 patient (6.7%) had ASD and 1 patient (6.7%) had dual tear.

Discussion

Between (January 2017 and April 2018), 15 patients were evaluated in this study (12 female

(80%) and 3 male (20%) mean age is 56.2 (from 50 y To 70 y) similar to Rashid Khan study⁽¹¹⁾

which was 55.3 ranged from (20 to 70 years) while the mean age of Sears W study⁽¹²⁾ was 65.1 years ranged from (35 to 82 years) the mean age of Hironobu Hayashi study⁽¹³⁾ . was 61.8 years ranged from (26 to 77 years), the mean age of Okuyama, Koichiro study⁽¹⁴⁾ was 60, The mean age of Hironobu Sakaura study⁽¹⁵⁾ was 68.3 years range from (44 to 79 years).⁽¹³⁾ this study patient age was close to Rashid Khan study and Okuyama, Koichiro study this confirm that degenerative spondylolisthesis is one of the diseases of elderly.

In our study, 15 patients (12 females and 3 males), 53 patients (45 females and 8 males) were in Rashid Khan study⁽¹¹⁾, 37 patients (16 males and 21 females) were in Hironobu Hayashi et al study⁽¹³⁾, 28 patients (10 males and 18 females) were in Okuyama, Koichiro study⁽¹⁴⁾ 20 patients (6 males and 14 females) were in Hironobu Sakaura study⁽¹⁵⁾. so that The reason for higher female to male ratio in our study may be due to the increased incidence of postmenopausal osteoporosis and increased incidence of obesity among elderly females .

In this study the clinical assessment of the patients was according to ODI pre-operative, one day, 3 months and 6 months post-operative and VAS for back and leg pain the mean preoperative ODI (70.2%±5.5) ,one day Postoperative ODI was (10.93%±4.76), after 3 months was (10.67±7.97) and 6 months the mean post operative was (12.76±14.25) . According to VAS for back pain pre operative was (9.6± 0.9) and the main postoperative was (1.53±1.126), Pre operative VAS for leg was (9.06±0.7) and Post operative was (2.0±1.14) with 87,3% from good to excellent outcome.

In Rashid Khan study⁽¹¹⁾ (TLIF for DS) clinical assessment was according to ODI and VAS the mean preoperative Oswestry Disability Index (ODI) Score was 64% range from (56% -74%) which improved to 20% and the mean preoperative Visual analogue score for back pain was 10 which improved to 2 ,the mean preoperative Visual analogue score for Leg pain was 8 which was improved to 1(0-5) while the clinical outcome of Sears W study⁽¹²⁾ (PLIF for DS) was recorded according to Visual Analogue Pain Score (VAS), Low Back Outcome Score (LBOS), Short Form (SF)-12 and patient satisfaction questionnaires Pre- and

postoperative. The Mean preoperative measures of VAS and LBOS of (5.3+/-2.2) and (24.8+/-15.6), respectively, improved to (2.2+/-2.1) and (44.8+/-18.0). (91%) considered their outcome to be good or excellent .While the clinical outcome of Hironobu Sakaura study⁽¹⁵⁾ (PLIF for DS) was according to The JOA score before surgery and at the latest follow-up and the recovery rate were significantly improved from (14.2 ± 4.2) points preoperatively to (22.5 ± 6.2) points at the final follow-up (mean recovery rate 55.3 ± 29.0%). In comparing with the clinical outcome of Farhaan Altaf, et al study⁽¹⁶⁾ (PLF vs PLIF for DS), was according to VAS and ODI and the improvement was 70.1 % for the PLF patients and 77.9% for PLIF patient.

So that there was no significant improvement between the outcome of PLIF for DS and TLIF for DS, there was little difference between the outcome of PLIF and PLF in treatment of DS.

According to complication rate and types in this study, the complication rate was about 13.3% one patient in the form of dural tear for one patient which was surgically sutured during surgery and another patient with adjacent segment disease which needed surgical intervention 9 months later because there was no improvement with conservative treatment. No superficial nor deep implant infection was noted during the follow up in comparison with Rashid Khan study⁽¹¹⁾ whose complication rate was about 15% in the form of Pedicle screw misplacement, other had a minor complication whose included radiculitis and superficial wound infection .While in sear w. study,⁽¹²⁾ the rate of complication was 10.9%. There were no device-related procedural complications. Its complications were in the form of ileitis, deep wound infection which was settled on antibiotics and adjacent segment stenosis. Also Hayashi, H study⁽¹³⁾ the complication rate was 13.5% in the form of Dural tear was observed in 2 patients (5.4%). Reoperation was required in 3 patients (8.1%) due to intolerable symptoms in their lower extremities caused by adjacent segment degeneration. Re operated 76 months later .and in Hironobu Sakaura study⁽¹⁵⁾ the postoperative complications rate was 14.6% in the form of epidural hematoma ,mild deep wound infection and Symptomatic ASD was found patients of the 2-level PLIF .In comparison with Farhaan Altaf

study⁽¹⁶⁾ the complication rate was 8.9% in the form of ASD and superficial wound infection in PLF group and complication rate in PLIF group was 13.8% in the form of deep wound infection, ASD and dural tear.

So that the complication rate of in PLIF surgery is high than PLF surgery and near to TLIF surgery.

In our according to lenke classification of fusion after 6 months (46.6%) was grade A Definitely solid with bilateral trabeculated stout fusion masses present , (40%) was Grade B Possibly solid with a unilateral large fusion mass and a contralateral small fusion mass. , (6.6%) was grade C Probably not solid with a small fusion mass bilaterally and (6.6%) was Grade D Definitely not solid with bone graft resorption or obvious pseudoarthrosis bilaterally .In comparative to Rashid Khan study⁽¹¹⁾ 53 patients (55%) out of 30 patients were grade A(fusion),13 patients (25%) were grade B (probable fusion) other 11 patient grade C (20%) are uncertain. Thus 80% of cases show fusion from grade B to grade A, none of their cases show pseudoarthrosis. The mean time taken for fusion is 5 months. (Range4 months to 8 months) andFarhaan Altaf study⁽¹⁶⁾ 21patients of 28 patient 69% showed fusion from grade B to A for PLF group and 25patients of 31 were show 80.6% fusion FROM grade B to A for PLIF group.

So that the fusion rate of PLIF has an advantages than PLF and minimal advantages than TLIF and this is came back to the removal of intervertebral material and cartilaginous and the great amount of graft in PLIF more than TLIF and PLF

This study has several limitations.

First; we had no control group. Therefore, we could not evaluate the degenerative changes in the discs of nonsurgical patients.

Second ; this study was a small case series.

Third; short term follow up of this study as some of post operative complications needed more time as ASD may appear after long time of operation.

Conclusion: PLIF surgery is one of an effective surgery in treatment of patients with degenerative, spondylolisthesis.

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