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ORIGINAL ARTICLE

Evaluation of Outcomes of Posterior lumbar Interbody Fusion for Management of Segmental Degenerative Lumbar Canal Stenosis

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Abstract

Background: ***Lumbar degenerative disorders, such as lumbar spinal stenosis, lumbar disc herniation & lumbar degenerative instability, are prevalent crippling illnesses that occur in the elderly population.***

Objectives: ***To analyze the safety and efficacy of posterior lumbar interbody fusion (PLIF) in managing segmental degenerative lumbar canal stenosis.***

Patients and methods: ***Retrospective and prospective study on 25 cases with segmental degenerative lumbar canal stenosis. Individuals with segmental degenerative lumbar canal stenosis. This study was conducted at Al-Azhar University Hospitals and Damanhur Medical Institute Hospital.***

Results: ***Our findings showed that regarding the relation between different improvements and each other's, there were no significant variations between the three groups concerning Age, Height (cm), Weight (kg), B.M.I., L.B.P., Radicular Pain, Level of Interbody Fusion by Cage, No Post O.P. Complication, and Blood Loss (CC). There was a significant distinction amongst the three groups regarding Sex, with a significant disparity between Excellent and Good: p<0.00001, and Fair vs Good: p<0.00001. Three subjects (12%) have interbody fusion at L3-L4, 17 subjects (68%) have interbody fusion at L4-L5, and five subjects (20%) have interbody fusion at L5-S1.***

Conclusion: ***Posterior lumbar interbody fusion (PLIF) can be recommended for mono-segmental spinal stenosis, with or without segmental instability. The most notable finding in this study was that males showed significant positive correlations, and overweight showed significant negative correlations with good improvement; L4-L5 was the most common level of fixation among the subjects.***

Keywords: outcomes; lumbar interbody; fusion; Degenerative; Stenosis

1. Introduction

Lumbar degenerative disorders involving lumbar disc herniation, lumbar degenerative instability, or lumbar spinal stenosis are prevalent among the elderly and cause significant disability. [1]

As our population ages, more individuals may be affected by these diseases, which hurt people's quality of life and place a significant strain on the healthcare system. [2]

Conservative techniques are effective against most degenerative disorders of the lumbar spine. However, when non-surgical treatments have failed, surgery may be necessary to reduce symptoms and restore lumbar function.[3]

Lumbar fusion procedures, the backbone of surgical therapies, play a crucial role in the management of lumbar degenerative disease. One of the most popular lumbar fusion procedures is posterior lumbar interbody fusion.[4]

The PLIF technique is a frequent surgical approach for treating lumbar degenerative illnesses; moreover, the efficacy and safety of this technique still need to be determined. [5,7,8]

Our research aimed to evaluate the feasibility and effectiveness of PLIF for treating degenerative lumbar canal stenosis at the segmental level.

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2. Patients and methods

Type of the study: Retrospective and prospective study on 25cases with segmental degenerative lumbar canal stenosis

2.1.Study population: cases with segmental degenerative lumbar canal stenosis.

2.2.Study intervention: PLIF

Place of study: Al-Azhar University Hospital and Damanhur Medical Institute Hospital.

2.3.Inclusion criteria: all patients diagnosed with segmental degenerative lumbar canal stenosis, sexes, age above 40 years old, and evidence of degenerative as (ligamentum hypertrophy, facet hypertrophy, and intervertebral disc herniation)

Exclusion criteria: MRI suggestive of Lumbar Canal stenosis but patient symptomatically normal, Congenital lumbar canal stenosis, cases with other causes need Transpedicular Screws Fixation, e.g. (lumbar vertebral fracture), and Isolated disc intervertebral herniation.

2.4.Sample Size (n):

This study was based on a study carried out by JONKERThe sample size was measured utilizing Epi Info STATCALC, taking into account the following assumptions: The study was done utilizing a 95% two-sided confidence level and a power of 80%, with a margin of error of 5%. The ultimate maximum sample size extracted from the Epi-Info output was 22. Therefore, the sample size was augmented to include 25 cases to account for any dropout throughout the follow-up period. [9]

$$\left(\frac{Z_{a/2} + Z_B}{P_1 - P_2}\right)^2 (p_1q_1 + p_2q_2)$$

Takazawa& Morita. [10]

n = sample size

Z a/2 (The crucial number that demarcates the center 95% of the Z distribution)

ZB (The crucial number that demarcates the center 20% of the Z distribution)

p1 = prevalence in case group

p2 = prevalence in the control group.

q = 1-p

Preoperative clinical evaluation of the patients

Clinical examination and history by Visual analog score for back pain and neurogenic Claudication (VAS back-leg). Visual analog scale (VAS) is a measure of pain intensity. It is a continuous scale comprised of a horizontal (called horizontal visual analog scale) or vertical (called vertical visual analog scale), usually 10 cm or 100 mm in length (both gradations are used. For pain intensity, the scale is most commonly anchored by "no pain "(score of 0) and "worst imaginable pain "(score of 10). Persons enjoying very high HRQL might report scores that do not end with 0 or 5 more than others. The selected personal characteristics likely to affect the reported VAS score were controlled to examine that argument. These characteristics included economic status (a set of 4 dummy variables representing the five categories: excellent, very good, good, fair, and poor).

During preoperative preparation of the patients, all cases were subjected to a complete blood picture, Blood glucose, Liver and kidney functions, bleeding and clotting profiles, ECG, and Chest X-ray.

All patients were investigated with MRI LSS, Dynamic x-ray LSS, or CT. Computed tomography of the lumbosacral spine gives information about the bony part of the spine. Magnetic resonance imaging of the lumbosacral spine is useful for evaluating the spinal cord, intervertebral discs, and ligament.

2.5.Procedure: Posterior decompression laminectomy, foramenotomy, discectomy, and Posterior interbody fusion one level.

The operation was done by PLIF approach as the patient underwent laminectomy of L4&L5 and discectomy of L4-5, pedicle screw fixation between L4-L5, and interbody fusion by a cage.

2.6.Outcome: Early Clinical outcome by Visual analog score (vas), Late clinical outcome. Radiological outcome: All patients were investigated postoperative with x-ray LSS Ap, lateral view. CT LSS MRI LSS is used for selective cases (worsening symptoms, disability). Complications associated with the PLIF procedure are permanent neurological deficit, cerebrospinal fluid leakage, radicular pain, and deep wound infection.

2.7.Statistical analysis

All statistical analyses were performed using the SPSS statistical package for Social Science version 25. Descriptive statistics were Quantitative data, presented as mean and standard deviation (mean ± SD), and Qualitative data, expressed as numbers and percentages. Two independent samples' means were compared using the t-test. The coefficient interval was set to 95%. The significance level was calculated using the following probability (P) values: $P<0.05$ was considered statistically significant.

3. Results

Table 1. Demographic data of included subjects

DEMOGRAPHIC DATA	VALUE
AGE (Y)	
MEAN ± SD	48.96 ± 6.96
MEDIAN (RANGE)	48 (40-65)
BMI (KG/M^2)	
MEAN ± SD	29.53 ± 2.59
MEDIAN (RANGE)	29.41 (24.51-36.33)
HEIGHT (CM)	

MEAN ± SD	166.76 ± 3.31
MEDIAN (RANGE)	167 (160-175)
WEIGHT (KG)	
MEAN ± SD	82.04 ± 6.54
MEDIAN (RANGE)	82 (70-95)

The age distribution of included subjects in this table shows that the mean age of the subjects is 48.96 years with a standard deviation of 6.96. The median age is 48 years, with a range of 40-65 years. The median BMI is 29.41 kg/m^2, with a range of 24.51-36.33 kg/m^2. The median height is 167 cm, with a range of 160-175 cm. The median weight is 82 kg, with a range of 70-95 kg.

Table 2. Level of interbody fusion by cage

LEVEL OF INTERBODY	
L3-L4	3 (12%)
L4-L5	17 (68%)
L5-S1	5 (20%)

The table showed that 3 subjects (12%) have interbody fusion at L3-L4, 17 subjects (68%) have interbody fusion at L4-L5, and 5 subjects (20%) have interbody fusion at L5-S1.

Table 3. VAS score pre and post management

VAS SCORE	PRE-MANAGEMENT	POST-MANAGEMENT	P. VALUE
MEAN ± SD	7.67 ± 0.56	3.17 ± 1.63	<0.0001
MEDIAN (RANGE)	8 (7-9)	3 (1-7)	

The table showed that before management, the mean VAS score was 7.67 with a SD of 0.56, and the median was 8, with a range of 7-9. After management, the mean VAS score was 3.17 with a SD of 1.63, and the median was 3, with a range of 1-7. There was significant decrease in VAS score post-operative.

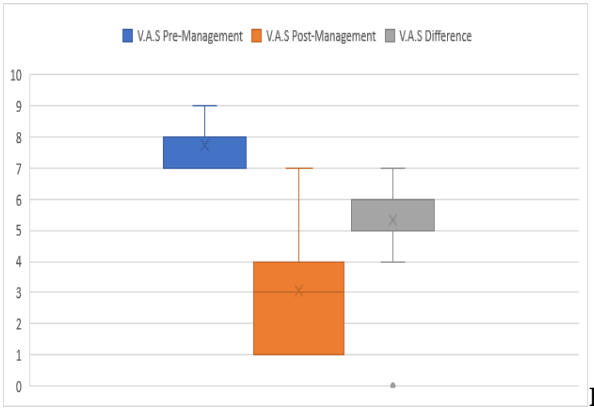

Fig Figure 1. VAS score pre and post management.

Table 4. Post-operative complications

CSF LEAK	1 (4%)
SUPERFICIAL WOUND INFECTION	1 (4%)
NO COMPLICATIONS	23 (92%)

The table shows that 1 subject (4%) experienced a CSF leak and 1 subject (4%) experienced a superficial wound infection. 23 subjects (92%) reported no complications.

Table 5. Improvement of Radiculopathy

IMPROVEMENT OF RADICULOPATHY	
EXCELLENT	8 (32%)
GOOD	12 (48%)
FAIR	4 (16%)
NO IMPROVEMENT	1 (4%)

The table showed that 8 subjects (32%) reported excellent improvement, 12 subjects (48%) reported good improvement, 4 subjects (16%) reported fair improvement, and 1 subject (4%) reported no improvement.

Table 6. Relation between different improvements and each other's

	EXCELLENT (N = 8)	FAIR (N = 4)	GOOD (N = 12)	NO IMPROVMENT (N = 1)	P. VALUE
AGE (Y)	47.75 ± 8. 89	52± 6.58	49.42 ± 6.09		0.6317
• 40-50	6 (75%)	2 (50%)	7 (58%)	0	
• 50-60	1 (12.5%)	2 (50%)	5 (41.5%)	1(100%)	
• 60-70	1 (12.5%)	0	0	0	
SEX					
• MALE	3 (37.5%)	1 (25%)	10 (83.3%)	0	0.0117*
• FEMALE	4 (50%)	3 (75%)	2 (16.6%)	1(100%)	
HEIGHT (CM)	166. 5 ± 3.29	165.75 ± 2.36	167.25 ± 3.84	-	0.7377
WEIGHT (KG)	82.13 ±6.7	77.5 ± 2.38	83.4 ± 7.29	-	0.3206
BMI	28.22 ± 0.89	29.85 ± 2.74	29.68 ± 3.09	-	0.011
• < 28.5	3 (37.5%)	4 (100%)	2 (16.6%)		
• 28.5-30	1 (25%)	2 (50%)	4 (50%)		
• > 30	0 (0%)	2 (16.67%)	2 (25%)		
L.B.P	8 (100%)	4 (100%)	12 (100%)	1(100%)	-
RADICULAR PAIN					
• RIGHT	2 (25%)	1 (25%)	2 (25%)	1(100%)	0.4383
• LEFT	5 (62.5%)	1 (25%)	5 (62.5%)	-	
• BILATERAL	1 (12.5%)	2 (50%)	1 (12.5%)	-	
LEVEL OF INTERBODY FUSION BY CAGE					
• L3-L4	1 (25%)	2 (16.67%)	0 (0%)		0.714
• L4-L5	6 (75%)	2 (50%)	5 (41.6%)	1 (100%)	
• L5-S1	2(25%)	1 (25%)	3 (25%)	0	
NO POST OP COMPLICATION	8 (100%)	4(100%)	11(91.6%)		0.593
BLOOD LOSS (CC)	457.14 ± 44. 98	495.83 ± 83.82	462.5 ± 44.32		0.1583

Regarding Relation among different improvements and each other's, there was no significant disparity between the result and other variant concerning Age, Height (cm), Weight (kg), L.B.P, Radicular Pain, Level of Interbody Fusion by Cage, No Post OP Complication, and Blood Loss (CC), while there was a significant distinction among the result and other variant as regard sex & BMI.

Case: A 45 years old male patient weight95kg, height175cm. Complain: back pain and left sciatica one years ago with failure of conservative measures with history of previous of spine surgery long time ago. Pre-operative: MRI L.S.S, Dynamic X-ray L.S.S and routine lab were done. Finding: L3-4 spondylolisthesis with degeneration of level below. Operation: The individual had an L3-L4 laminectomy, L3-L4 discectomy, L3-L4 pedicle screw fixation, L4-L5 pedicle screw fixation, and L3-L4 interbody fusion with a cage.

Post-operative: The patient's VAS scores for back and leg pain improved clinically. Lumbar spine x-rays taken after surgery confirmed the correct placement of the rods, screws, and cage, as well as the absence of any postoperative instability.

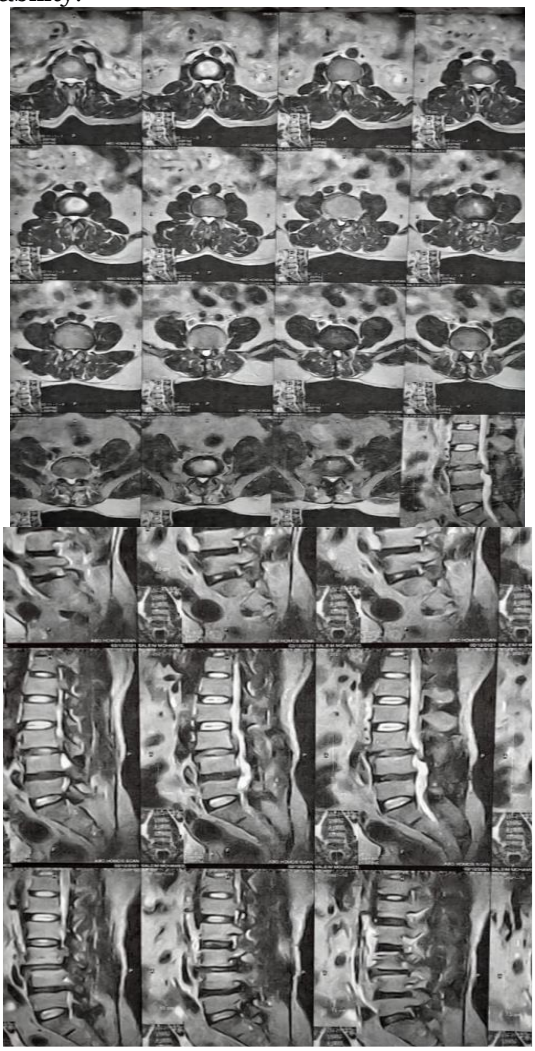

Figure 2. Pre-operative MRI T2 sagittal view show 2 level disc prolapse between L3-4 and L4-5 with L3-4 spondylolisthesis. Pre operative MRI T2 axial view show 2 level disc prolapse between L3-4 and L4-5.

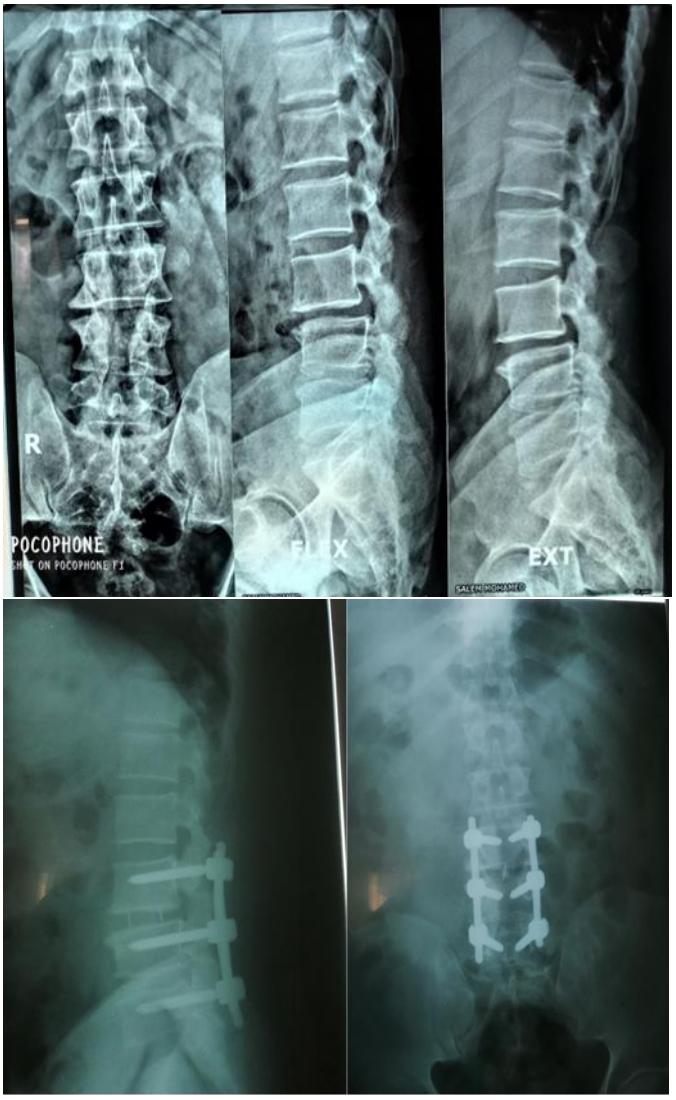

Figure 3. Post-operative x-rays of the lumber spine revealed the cage, fasteners, and rods to be positioned appropriately, with no indication of post-operative instability.

4. Discussion

In the current study, demographic characteristics of the subjects revealed that the mean age of the studied patients was (48.96 ± 6.96) years with a range of 40-65 years, the mean height was 166.76 ± 3.31 cm., the mean weight was 82.04 ± 6.54 kg, the mean B.M.I. was (29.53 ± 2.59) Kg/m2.

In the same study, Farrokhi et al.[8] performed randomized prospective controlled clinical research in which 44 cases were operated on with PLIF with posterior instrumentation. The population consisted of 12 (27.3%) males and 32(72.7%) females, with a mean age of 48.35 ± 9.03 years, a mean weight of 76.12 ± 9.91ka, a mean height of 170.27 ± 5.12, and a mean B.M.I.

ofI. was 29.3 ± 4.4 Kg/m2.

Our results observed that before management, the mean VAS score was 7.67, with a standard deviation of 0.56, and the median was 8, with a range of 7-9. After management, the mean VAS score was 3.17, with an SD of 1.63; the median was 3, with a range of 1-7. There was a significant decrease in VAS score postoperatively. The variance in mean VAS scores was 5.29, with a standard deviation 1.37.

Along with our findings was the result of Farrokhi et al.,[8] who found that before management, the mean VAS score was 8.01, with an SD of 1.56. After management, the mean VAS score was 4.98, with an SD of 1.84. Also, Fan G et al.,[9] found that the mean VAS score was 6.1 before management, with a standard deviation of 1.1. After management, the mean VAS score was 2.9, with an SD of 0.8. There was a significant decrease in VAS score postoperatively.

Zhang et al.,[10] noted that the mean VAS score was 7.1, with a standard deviation of 2.1. After management, the mean VAS score was 1.7, with a standard deviation 0.7.

The present data showed that eight subjects (32%) reported excellent improvement, 12 subjects (48%) reported good improvement, four subjects (16%) reported fair improvement, and one subject (4%) reported no improvement.

In a previous similar study, Farrokhi et al.,[10] showed that 22 subjects (50%) reported good improvement, and ten subjects (22.7%) reported fair improvement.

The mean blood loss was 479.17 cc with an SD of 89.58 cc and a median of 500 cc, with a range of 300-700 cc.

In similar research, Wu et al.,[11] reported that Cases of PLIF were observed for an average of 52.8 months (48-68 months), with operations taking an average of 182.5 minutes (120-300 minutes) and bleeding averaging 470 ml (range, 250-108milliliterses).

In a previous study, Farokhi et al. [8] reported that the mean intraoperative blood loss was 883.05 ± 390.24 mL, and the mean surgical duration was 325± 63.6 min. Also, Fan G et al. [9] found that the mean blood loss was 908.3cc with an S.D. of 242.9cc.

Kim et al.[12] demonstrated that PLIF had a shorter operating time and less blood loss than P.L.F.

Regarding the Relation between different improvements and each other, there were no statistically significant differences between the result and another variant regarding Age, Height (cm), Weight (kg), B.M.I., L.B.P., Radicular Pain, Level of Interbody Fusion by Cage, No Post O.P. Complication, and Blood Loss (CC). At the same time, There was a statistically significant distinction among the three groups regarding Sex, with statistically significant variation between Excellent and Good and fair vs. Good.

Triebel et al. examined[13] Clinical outcomes following lumbar fusion, and the authors aimed to determine if gender had a role. They analyzed the 2-year follow-up data from 4,780 prospectively collected individuals in the Swedish National Spine Register with lumbar degenerative disc degeneration and persistent LBP, and their findings demonstrated that women do not have poorer outcomes than males following spinal fusion surgery. They also found that compared to males, women's pain and function are worse before surgery but better after that. Nath R et al.,[14] demonstrated that comparing preoperative and three-month postoperative of Excellent, Good, and Fair, the P value is <0.001, meaning that outcomes were extremely significant postoperatively. Statistically significant improvement was seen in all variables except running and lifting heavy weights.

On the other hand, Hawker et al.[15] do not observe any gender differences in willingness to undergo surgery but find women to be less risk-averse than men. In a significant study by Balasubramanian,[16] they concluded that there was no statistical correlation between the clinical results and improvement in radiological features. Good improvement in pain scores occurred in their patients despite the reduction in slips.

In the current study, males showed a significant positive correlation with good improvement. Blood loss showed a significant correlation with no improvement. Improvement of radiculopathy was significantly associated with excellent improvement and showed a significant negative correlation with fair and no improvement. Only overweight showed significant negative correlations with good improvement.

Triebel et al.,[13] noted that, at the 2-year follow-up, the logistic regression analysis revealed that age, not working, and prior spine surgery were all associated with attrition. Additionally, smoking and a higher B.M.I. were found to be related to dropout.

In 2016, Pochon and his colleagues examined the impact of gender on preoperative condition and one-year postoperative outcomes in a large cohort of individuals undergoing surgery for various degenerative spinal disorders (including spinal stenosis) revealed that despite presenting with a worse preoperative condition, women and men do not differ significantly in terms of their postoperative outcome. Furthermore, they stated that there should be no gender-based distinction in administering an individual's health, given that men and women can achieve comparable levels of improvement.[17]

A small sample size, a single-center study, and a short follow-up period limited this study.

Future research should include multicenter studies to validate our findings, using well-designed randomized controlled trials or large, comparative observational studies. Studies should also include a representative sample of patients with similar age, gender, and disease severity. To accurately assess long-term outcomes, studies should have a longer follow-up period. The sample size of future studies should be large enough to provide meaningful conclusions and to control for confounding factors. Data collection will be done using standardized tools and protocols at regular intervals postoperatively.

4. Conclusion

In conclusion, Posterior lumbar interbody fusion (PLIF) can be recommended for mono-segmental spinal stenosis, with or without segmental instability. The most notable finding in this study was that males showed significant positive correlations, and overweight showed significant negative correlations with good improvement. L4-L5 was the most common level of fixation among the subjects.

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

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Conflicts of interest

There are no conflicts of interest.

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