ORIGINAL ARTICLE

Transforaminal Lumbar Interbody Fusion Versus Posterolateral Fusion for Surgical Treatment of Segmental Lumbar Spinal Instability

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Abstract

Background data: **The rationale behind lumbar fusion surgery is to eliminate pathologic segmental motion and its accompanying symptoms, especially low back pain. Posterolateral fusion (PLF) using pedicle screw fixation has been one of the most popular procedures among the posterior lumbar reconstruction techniques. Lumbar interbody fusion is a recognized surgical technique in treating chronic low back pain in segmental instability.**

Purpose: **The purpose of this study was to compare the clinical and radiological outcomes of stabilizing the lumbar spine using transforaminal lumbar interbody fusion (TLIF) versus PLF for lumbar segmental instability.**

Study design: **A prospective, nonrandomized clinical controlled trial was performed.**

Patients and methods: **A total of 40 patients with segmental lumbar instability were divided into two groups (TLIF and PLF groups), with 20 patients each. Top-loaded pedicle screw construct was used with both groups. The mean age of the patients was 48.35 years in the TLIF group and 45.3 years in the PLF group. Sex distribution was six males and 14 females in the TLIF group and seven males and 13 females in the PLF group. Mechanical low back pain was the chief complaint in all patients. Sciatica was a complaint in 12 (60%) patients of the TLIF group and 13 (65%) patients of the PLF group. Patients were evaluated preoperatively and postoperatively by visual analog scale (VAS), Oswestry disability index, and radiographs.**

Results: **The average operative time was 214.5 min in the TLIF group and 192.5 min in the PLF group. The mean estimated blood loss was 278 ml in the TLIF group and 259 ml in the PLF group. The average length of hospital stay was 3.85 days in the TLIF group and 3.8 days in the PLF group. Patients progressively improved regarding VAS and Oswestry disability index in both groups, with no statistically significant difference, except for VAS for back pain, where the TLIF group gave better results. However, the TLIF group gave better results in patients with postlaminectomy instability than the PLF group. Solid fusion occurred in 17 (85%) patients of the TLIF group and 16 (80%) patients of the PLF group, with no statistical difference.**

Conclusion: **Both TLIF and PLF are effective and safe options for treating segmental lumbar instability. However, interbody fusion yields superior results in patients with postlaminectomy instability (2021ESJ253).**

Keywords: Interbody, Lumbar fusion, segmental instability, Transforaminal lumbar interbody fusion

Introduction

Frymoyer described a classification system for degenerative segmental instability into primary and secondary instabilities. Primary instabilities include axial rotational, translational, retrolithetic instability, degenerative scoliosis, and internal disc disruption. Secondary instability may follow discectomy, laminectomy, or spinal fusion [1,2]. Clinical findings indicating instability have been proposed, but their validity remains largely unreported [3]. Some have recommended palpation for

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the presence of a 'step-off' between adjacent spinous processes, aberrant motions such as an 'instability catch,' or increased mobility with passive intervertebral motion testing [4,5].

An anterior slip of 5 mm or more in the lumbar spine or a difference in the angular motion of two adjacent motion segments more than 11° from L1 to L5 and motion greater than 15° at L5−S1 compared with L4−L5 are indicative of lumbar segmental instability [6].

Instrumented posterolateral fusion (PLF) has been a popular procedure among the posterior lumbar fusion techniques [7]. The pedicle screws increase initial stability and the fusion rate, as compared with conventional techniques such as non-instrumentation or hook systems. However, some clinical investigations have shown a considerable rate of instrumentation failure, loss of segmental lordosis, and pseudoarthrosis with PLF [8].

Lumbar interbody fusion is a well-known surgical technique in treating chronic low back pain with segmental instability. The aim is to achieve bony fusion between two vertebral bodies, decompression of neural structures, restoration of disc space height, and sagittal plane alignment [7].

Instrumented interbody fusion has several advantages over PLF and has been advocated to improve fusion rates and clinical outcomes. It places the bone graft in the load-bearing position of the anterior and middle spinal columns, thereby enhancing the potential for fusion. In addition, the interbody space has more vascularity than the posterolateral space, increasing the potential for a solid fusion. Furthermore, interbody fusion helps to restore disc space height, lumbar lordosis, and coronal and sagittal balance of the spine, whereas a PLF has limited potential to do this [9].

Transforaminal lumbar interbody fusion (TLIF), introduced by Harms and Rolinger in 1982, has several advantages over ALIF and PLIF as it can be accomplished without exposing more than the ipsilateral foramen, and exposure and retraction on the thecal sac are minimal compared with PLIF. Consequently, TLIF can be performed safely above L3 with less risk of conus medullaris retraction and injury and is better suited for revision cases with significant epidural fibrosis. Because TLIF does not require anterior abdominal exposure, it avoids all the vascular, abdominal wall, and autonomic complications of ALIF. It is a single-stage procedure, unlike ALIF, which requires posterior fusion. Moreover, the pedicle screw construct can be used to restore lumbar lordosis while maintaining disc height with the interbody cage [10,11].

The purpose of this study was to compare the clinical and radiological outcomes of stabilizing the lumbar spine using TLIF versus PLF for lumbar segmental instability.

Patients and methods

This prospective study was conducted from January 2017 to June 2018 at Zagazig University Hospital, in which 40 patients with segmental lumbar spinal instability underwent spinal fusion. They were divided into two groups, with 20 patients in each group. In group A, patients were treated by TLIF, whereas patients were treated by PLF in group B. Patients' allocation for either group was nonrandomized and according to the surgeon's preference. We followed the World Medical Association Declaration of Helsinki, as a statement for ethical principles for research involving human patients. All patients consented to the surgical intervention along with research consent to publish the medical data. The study was approved by the IRB.

Inclusion criteria for this study were patients with single-level degenerative or lytic grade I spondylolisthesis and postlaminectomy instability (patients who had a single-level discectomy with hemilaminectomy or decompressive total laminectomy showing clinical findings and radiological signs of instability). Patients with severe osteoporosis, infection, or malignancy at the affected segment, those on corticosteroid therapy, morbidly obese, and with general contraindication, and patients who were lost to follow-up were excluded from the study.

Preoperative assessment

Demographic data from all the patients, including age, sex, occupation, and smoking, were documented. Each patient underwent a detailed clinical examination. The clinical criteria of instability were instability catch, which was present in all cases (100%) and defined as a sudden onset of pain or painful snap when the patient extends from a forward bent position into the upright position.

Patients were functionally evaluated according to Oswestry disability index (ODI) and visual analog scale (VAS) for back and leg pain before surgery.

Radiological evaluation

Plain radiographs (static and dynamic), MRI, and dual-energy radiograph absorptiometry were done preoperatively for all the patients in the study. Instability is defined as 4-mm translation of vertebrae at level L1−L5 and 5-mm translation at the L5−S1 level, or angulation more than 11° from L1−L5 levels or more than 15° at L5−S1 level [12].

Surgical technique

In both groups, all patients had general anesthesia and were positioned in a prone position on a special four-poster frame to allow the abdomen to hang free and reduce epidural venous pressure. A midline subperiosteal approach was made opposite the affected level after being identified by fluoroscopy.

In PLF, pedicle screws were inserted according to anatomical landmarks, followed by laminectomy, medial facetectomy, and foraminotomy. After adequate decompression, the bed for graft was prepared. Subperiosteal dissection was performed between the transverse processes and lateral aspects of the facet joints. Autograft was placed in this bed after stabilization with pedicle screws and rods (Fig. 1).

In the TLIF group, a transforaminal approach to the disc was used in which facetectomy was performed, and nerve roots were retracted, creating a working window into the disc space. An incision was made over the disc. The disc nucleus was removed as much as possible, and endplates were curetted to the bleeding cancellous bone. Autograft was inserted into the disc space, followed by a bullet-shaped polyetheretherketone cage filled with bone graft. The pedicle screws and rods were inserted as described for the PLF group (Fig. 2).

Follow-up

All patients were followed up for 12 months. The follow-up was performed clinically using the ODI and the VAS score for back and leg pain. Follow-up visits were conducted at 3, 6, and 12 months. The radiographic follow-up, including anteroposterior and lateral radiograph, was conducted at the same time to detect union. A computed tomography scan was done for all patients at the last follow-up visit. The modified Bridwell et al. [13] fusion criteria for the lumbar spine were used to assess fusion on computed tomography scans, and grades I and II were considered satisfactory fusion.

Statistical analysis

The data were collected, presented, and analyzed using SPSS-PC (version 10) software (SPSS, IBM, Armonk, Newyork, USA). Comparisons between measures (mean ± SD) of two groups were made using Student's t test for unpaired data and using paired t test for paired data, whereas comparisons between measures (mean ± SD) between multiple groups were made using the one-way analysis of variance (ANOVA) test, and then the difference between the two groups was determined using the LSD post-hoc test. Moreover, qualitative categories were expressed in the form of frequency and percentage, and comparisons between qualitative categories were made using the χ^2 test. On the contrary, Fisher's exact test was used for an observed cell less than 5. The test results were considered significant when the P value less than 0.05, whereas the test results were considered nonsignificant when P value more than 0.05.

Results

Demographic data and clinical evaluation

The study included 40 patients divided into two groups: group A (TLIF) included six (30%) male patients and 14 (70%) female patients with a mean age of 48.35 years (37–63 years) and group B (PLF)

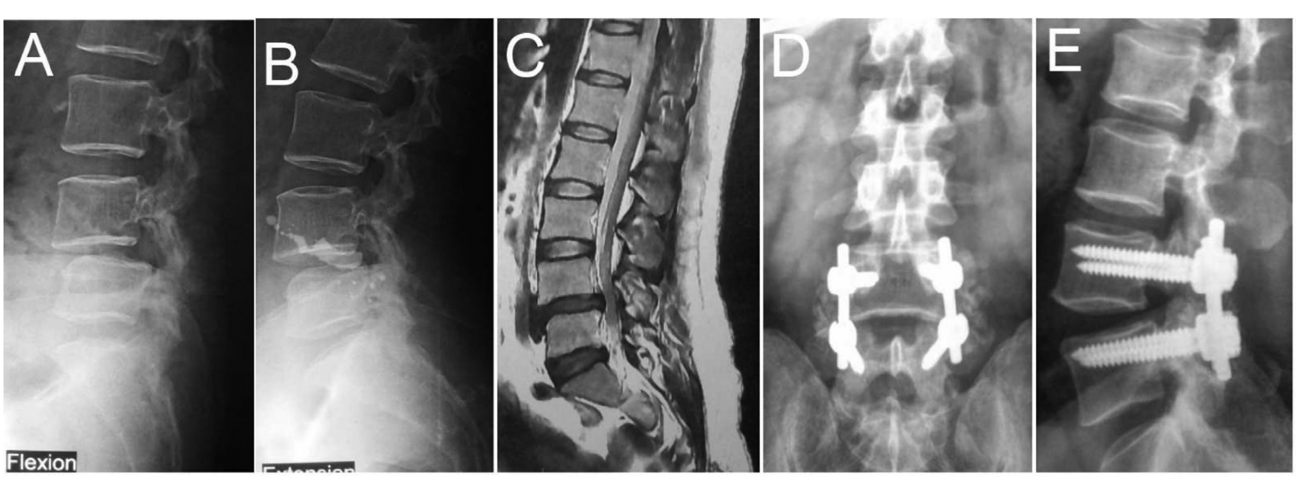

Fig. 1. A 45-year-old female patient with degenerative spondylolisthesis L4/L5: (A) preoperative radiograph; flexion radiograph; (B) extension radiograph; (C) sagittal MRI; (D, E) postoperative anteroposterior and lateral views (PLF). PLF, posterolateral fusion.

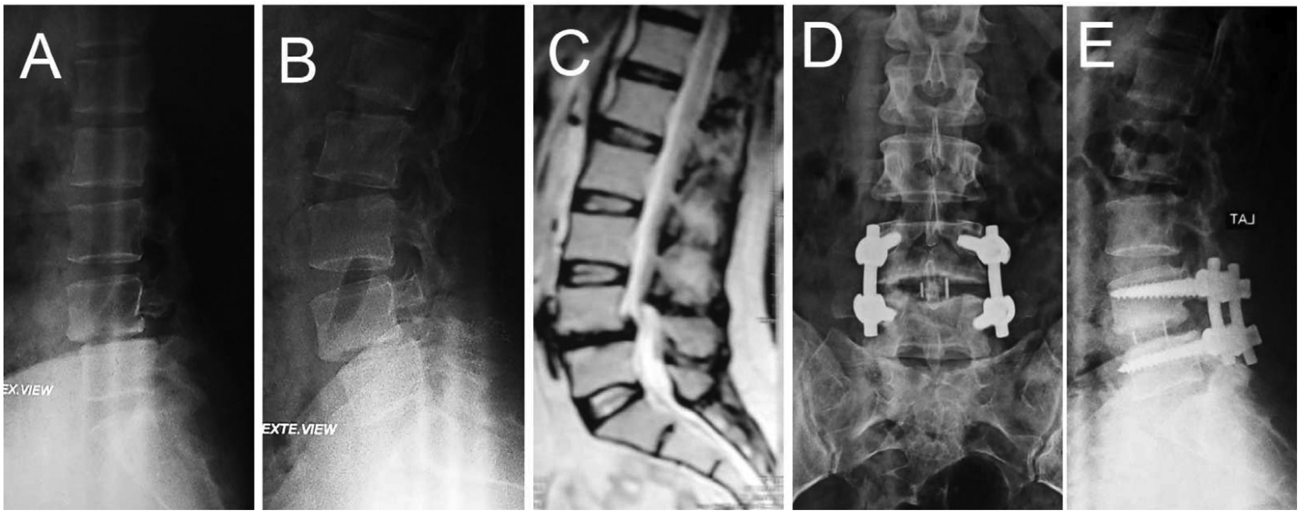

Fig. 2. A 30-year-old female patient with lytic spondylolisthesis at L4/L5 level: (A) preoperative radiograph; flexion radiograph; (B) extension radiograph; (C) sagittal MRI; (D, E) postoperative, anteroposterior and lateral views after 6 months; sagittal CT showing fusion at the last follow-up visit (TLIF). CT, computed tomography; TLIF, transforaminal lumbar interbody fusion.

included seven (35%) male patients and 13 (65%) female patients, with a mean age of 45.3 years (34–55 years) (Table 1).

All of the patients in the study complained of mechanical back pain more than lower limb radicular pain. Back pain was the only manifestation in eight (40%) cases of group A (TLIF), whereas back pain and sciatica were present in 12 (60%) cases, with a mean duration of back pain of 4.5 years (±1.4 years) and a mean duration of sciatica of 9.8 weeks (±2.9 weeks). In group B (PLF), back pain was the only manifestation in seven (35%) cases, whereas back pain and sciatica were present in 13 (65%) cases, with a mean duration of back pain of 3.7 years (±1.1 years) and a mean duration of sciatica of 8.4 weeks (±2.3 weeks).

The most common causes of instability in group A (TLIF) were degenerative spondylolisthesis in 10 (50%) cases, lytic spondylolisthesis in four (20%) cases, and postlaminectomy instability in six (30%)

Table 1. Demographic and preoperative clinical data of the two groups.

Parameters	Group A ($N = 20$)	Group A ($N = 20$)	Significant test*	P value
Age/years (Student test)	48.35 ± 5.9 (37–63)	45.3 ± 5.6 (34–55)	2.92	0.095
Sex				
Male [n (%)]	6 (30)	7 (35)	0.736	0.5
Female [n (%)]	14 (70)	13 (65)		
Male/female ratio	1/2.3	1/1.86		
Compliant characteristics [n (%)]				
Back pain	8 (40)	7 (35)	0.744	0.5
Back and leg pain	12 (60)	13 (65)	–	–
Right sciatica	4 (20)	5 (25)	–	–
Left sciatica	8 (40)	8 (40)	0.677	0.5
Duration of sciatica (weeks)	9.8 (+2.9)	8.4 (+2.3)	0.527	0.601
Duration of back pain (years)	4.5 (+1.4)	3.7 (+1.1)	1.55	0.129
Pathology [n (%)]				
Degenerative spondylolisthesis	10 (50)	7 (35)	2.54	0.467
Lytic spondylolisthesis	4 (20)	6 (30)		
Postlaminectomy instability	6 (30)	7 (35)		
Type of instability [n (%)]				
Primary	14 (70)	13 (65)	0.736	0.5
Secondary	6 (40)	7 (35)		
Spinal level				
L4–L5	12	14	1.31	0.859
L5–S1	8	6		

*P value at a 95% confidence interval is less than 0.05, statistically significant.

cases (two cases discectomy with hemilaminectomy and four cases decompressive total laminectomy). The most common causes of instability in group B (PLF) were degenerative spondylolisthesis and postlaminectomy instability (three cases discectomy with hemilaminectomy and four cases decompressive total laminectomy) in seven (35%) cases each and lytic spondylolisthesis in six (30%) cases. There is no statistically significant difference between both groups regarding pathology.

Group A (TLIF) had 14 (70%) patients with primary instability and six (30%) patients with postlaminectomy instability, whereas group B (PLF) had 13 (65%) patients with primary instability and seven (35%) patients with postlaminectomy instability.

In group A (TLIF), 12 cases showed instability at L4–L5 motion segments, eight cases at the L5–S1 levels. On the contrary, in group B (PLF), 14 cases were at the L4–L5 levels and six cases at the L5–S1 motion segment. There were no statistically significant differences regarding demographic and complaint criteria and level of pathology between both groups (Table 1).

Operative data

The mean operative time in group A (TLIF) was 214.5 ± 26.1 min, whereas in group B (PLF), the mean operative time was 192.5 ± 28.8 min. This was found to be a highly significant difference between the two groups. The mean estimated blood loss in group A (TLIF) was 278 ± 76.9 ml, whereas in group B (PLF), it was 259 ± 74.1 ml. The mean length of hospital stay in group A (TLIF) was 3.85 ± 1.2 days, whereas in group B (PLF), it was 3.8 ± 11 days. There was no statistically significant difference regarding these parameters (Table 2).

Clinical outcome results

In both groups, patients progressively improved with a highly statistically significant difference between preoperative and follow-up assessments for VAS for back pain, VAS for leg pain, and ODI. In group A (TLIF), the average Oswestry score decreased from 64.7% preoperatively to 34.4% at 3 months, 21.2% at 6 months, and 15.3% after 1 year ($P < 0.001$). In group B (PLF), the average Oswestry score decreased from 55.3% preoperatively to 30.1% at 3 months, 19.4% at 6 months, and 14.6% after 1 year ($P < 0.001$).

In comparison between the two groups for the change in VAS and ODI, group A (TLIF) gave a significant difference regarding the change in VAS for back pain than group B (PLF). However, the change in VAS for leg pain and ODI was not statistically significant (Table 3).

In patients with postlaminectomy instability, group A (TLIF) gave better results than group B (PLF). There was a statistically significant difference between the two groups in the reduction of VAS for leg pain, VAS for back pain, and ODI before surgery and 1 year postoperatively among patients with postlaminectomy instability ($P = 0.041$, 0.032, and

Table 2. Operative data, complications, patient satisfaction, and radiological union.

Parameters	Group A ($N = 20$)	Group B ($N = 20$)	Significant test*	P value
Operation time (min)	214.5 ± 26.1	192.5 ± 28.8	6.43	0.015
Estimated blood loss (ml)	278 ± 76.9	259 ± 74.1	0.796	0.431
Hospital stay (days)	3.85 ± 1.2	3.8 ± 1.1	0.138	0.891
Complication [n (%)]				
Dural tear	1 (5)	–	1.026	0.311
Pedicle screw malposition	2 (10)	1 (5)	0.36	0.548
Transient radicular symptoms	3 (15)	2 (10)	0.229	0.633
Partial foot drop	1 (5)	–	1.026	0.311
Infection	1 (5)	–	1.026	0.311
Postoperative radiograph				
Solid fusion	17 (85)	16 (80)	2.105*	0.173
Pseudoarthrosis	3 (15)	4 (20)		

*P value at a 95% confidence interval is less than 0.05, statistically significant.

Table 3. Change in leg and back pain visual analog scale and Oswestry disability index before and 1 year after surgery.

Characteristics	Group A	Group B	Student t test	P value
Change in VAS for back pain	64.41 ± 5.95	57.83 ± 6.12	11.91	0.001*
Change in VAS for leg pain	26.16 ± 7.4	23.35 ± 7.45	2.15	0.149
Change in ODI	47.68 ± 6.4	41.95 ± 3.7	3.47	0.072

*P value at a 95% confidence interval is less than 0.05, statistically significant.
ODI, Oswestry disability index; VAS, visual analog scale.

Table 4. Change in visual analog scale for leg pain, visual analog scale for back pain, and Oswestry disability index before and 1 year after surgery among primary and secondary instability.

Parameters	Group A	Group B	Student *t* test	*P* value
Primary instability				
Change in back pain VAS	63.5 ± 5.41	58.1 ± 5.99	4.01	0.055
Change in leg pain VAS	34.23 ± 8.65	32.57 ± 6.45	0.33	0.570
Change in ODI	46.28 ± 7.1	43.47 ± 1.62	1.41	0.258
Postlaminectomy instability				
Change in back pain VAS	65.32 ± 5.36	57.64 ± 6.96	4.99	0.041[a]
Change in leg pain VAS	18.1 ± 3.31	14.13 ± 2.65	5.58	0.032[a]
Change in ODI	49.08 ± 6.12	40.43 ± 4.27	8.46	0.012[a]

ODI, Oswestry disability index; VAS, visual analog scale.
[a] A statistically significant difference.

0.012, respectively), whereas the difference was not significant among those with primary instability (e.g. degenerative spondylolisthesis) ($P = 0.055$, 0.57, and 0.258, respectively) (Table 4).

Radiologically solid fusion occurred in 17 (85%) patients of group A (TLIF) and 16 (80%) patients of the PLF group with no statistical difference (Table 2).

Complications

Operative complications in the form of dural tear occurred in one (5%) case in group A (TLIF), followed by pseudomeningocele formation. The patient was admitted for meningocele excision with the repair of the dural tear with an improvement of patient symptoms. Pedicle screw malposition occurred in two (10%) patients of group A (TLIF); both were medial pedicular: one at the L4 level and the other at the L5 level breaches. On the contrary, one (5%) patient of group B (PLF) had a laterally malpositioned screw at the L5 level. None of them was associated with significant radicular compromise and required no further management.

Postoperative complications in the form of infection occurred in one (5%) patient of group A (TLIF); the patient was admitted a second time 3 weeks postoperatively, where the wound was opened, debridement and lavage were done, and screws were found stable and were not removed. Transient radicular manifestations occurred in three (15%) patients of group A (TLIF) and two (10%) patients of group B (PLF). This improved gradually within 3 months of medical treatment. Partial foot drop occurred in one (5%) patient of group A (TLIF); the patient regained full function 4 months postoperatively (Table 2).

Discussion

Lumbar spine fusion has become a commonly performed surgery and is used to treat low back pain resulting from degenerative lumbar spondylosis, such as degenerative disc disease, failed disc surgery, spondylosis, spondylolisthesis, and spinal stenosis [7]. In this present study, 40 patients were divided into two groups, with 20 patients each. Group A underwent TLIF and group B underwent PLF.

Epidemiologic findings

In our study, the number of patients was less than those in Wang et al. [14] (52 patients), Yan et al. [11] (96 patients), Zhou et al. [15] (76 patients), and Mura et al. [16] (100 patients) but comparable to Ould-Slimane et al. [17] (45 patients) and Chen et al. [18] (43 patients). The mean age at presentation in group A (TLIF) was 48.35 ± 5.9 (range, 37–63 years) and in group B (PLF) was 43.5 ± 5.6 (range, 34–55 years). There was no significant difference between the two groups regarding the age of presentation. Age was younger in this series than that in other studies [11,14–17] owing to the presence of patients with postlaminectomy instability who presented at a younger age.

The number of female patients was slightly larger than that of male patients. The female patients represented 70 and 65% of studied patients in groups A (TLIF) and B (PLF), respectively. Most studies investigating the prevalence of degenerative spondylolisthesis and canal stenosis showed female predominance. Jacobsen et al. [19] reported that the prevalence of degenerative lumbar spinal stenosis was 2.7% for males and 8.4% for females, with a female: male ratio of 6.4 : 1. Wang et al. [7] showed that the prevalence of degenerative lumbar spondylolisthesis is quite sex specific and age specific. Few women and men have degenerative lumbar spondylolisthesis before the sixth decade, and after the age of 50 years, both sexes start to develop degenerative changes, especially in the lumbar spine. Patients' demographic criteria in both groups were comparable regarding age and sex, with no statistically significant difference (P = 0.095 and 0.5, respectively).

Preoperative evaluation

Mechanical low back pain was the chief complaint in all patients. Sciatica was present in 12 (60%) patients of group A (TLIF) and 13 (65%) patients of group B (PLF). This was comparable to Zhou et al. [15]. The mean duration of back pain was 4.5 ± 1.4 years in group A (TLIF) and 3.7 ± 1.1 years in group B (PLF). The mean duration of sciatica was 9.8 ± 2.9 weeks in group A (TLIF) and 8.4 ± 2.3 weeks in group B (PLF). Complaint criteria were comparable between both groups regarding distribution and duration of back pain and sciatica, with no statistically significant difference ($P = 0.5$, 0.601, and 0.129, respectively). All patients in the present study were subjected to functional evaluation by the ODI, VAS for leg pain, and VAS for back pain, with no significant difference between the two groups in their preoperative value ($P = 0.88$).

Radiological imaging of the studied patients revealed that group A (TLIF) comprised 14 (70%) patients with primary instability in the form of degenerative or lytic spondylolisthesis and six (30%) patients with postlaminectomy instability. Group B (PLF) had 13 (65%) patients with primary instability and seven (35%) patients with postlaminectomy instability. Although all patients of Yan et al. [11] had degenerative spondylolisthesis, all patients of Wang et al. [14] had revision surgery after decompression and Zhou et al. [15] had degenerative disc disease, isthmic or degenerative spondylolisthesis, and recurrent disc herniation. There was no statistically significant difference between the two groups regarding the type of instability distribution ($P = 0.5$).

Operative data

In this study, the mean operative time was longer in group A (TLIF) (214.5 ± 26.1 min) than that in group B (PLF) (192.5 ± 28.8 min), and the difference was highly statistically significant ($P = 0.015$). The operative time was longer in group A (TLIF) because of the time needed for decompression, preparation of the endplates, and insertion of the cage. However, the mean operative time was comparable to Fessler [10], who had a mean operative time of 246 min (4.1 h) in patients having TLIF procedure. However, compared with other studies, Zhou et al. [15] reported an operative time of 135 ± 42.5 min, Wang et al. [14] reported an operative time of 143 ± 35 min, and Ould-Slimane et al. [17] reported an operative time of 124 ± 37. Sajay et al. [20] also reported a slightly longer operative time in the TLIF group (133 ± 6.02 min) than that in the PLF group (90.71 ± 6.3 min). According to a systematic review and meta-analysis by Jay et al. [12], operative times were shorter in the PLF group.

The mean intraoperative blood loss was slightly higher in group A (TLIF) (278 ± 76.9 ml) than that in group B (PLF) (259 ± 74.1 ml), and this difference was not statistically significant ($P = 0.431$). Similarly, Challier et al. [21], in their randomized controlled trial, showed higher mean blood loss in the TLIF group (364 ml) compared with the PLF group (271 ml) but less than that in the study by Ould-Slimane et al. [17], who reported mean blood loss of 570 ± 360 ml, and Zhou et al. [15], who reported blood loss of 320 ± 142.3 ml. Sajay et al. [20] also reported a slightly higher intraoperative blood loss in the TLIF group (319.69 ± 53.8 ml) than that in the instrumented PLF group (261.19 ± 34.9). This can be explained by the excessive use of NSAID drugs preoperatively by the patients. The intraoperative blood loss can be reduced by stopping NSAID 2 weeks before surgery and by maintaining hypotensive anesthesia during the operation.

The mean hospital stay was 3.85 ± 1.2 days in group A (TLIF) (3.85 ± 1.2 days), which was not much different from that of group B (PLF) (3.8 ± 1.1 days), with no statistical significance ($P = 0.891$). The hospital stay was comparable to that of Fessler [10], who reported a hospital stay of 84 ± 36 h.

Clinical and functional outcomes

Comparing the clinical outcomes of the two groups, we found that the reduction of VAS for back pain, VAS for leg pain, and ODI was statistically highly significant in group A (TLIF) ($P < 0.001$) using one-way ANOVA test (353.3, 52.94, and 164.2, respectively). ODI improved to 15.3 ± 4.6 at 1 year, which is comparable to the results of Zhou et al. [15], who reported an ODI of 16.9 ± 5.6 at the final follow-up, and Wang et al. [14], who reported a final ODI of 11.5 ± 4.2.

Outcomes significantly improved after 3 months, and further improvement occurred at 6 and 12 months but with a lower rate. This was comparable to the results of Fessler [10], who reported improvement of VAS scores at 3 months that continued up to 2 years and improvement of ODI scale up to the seventh month. Although patients in group B (PLF) achieved comparable clinical results, the reduction of VAS for back pain, VAS for leg pain, and ODI were highly significant using the one-way ANOVA test (331.2, 57.61, and 107.3, respectively; $P < 0.001$).

In comparing clinical results between two groups, it was found that the reduction of VAS for back pain after 1 year was better in group A (TLIF) and gave a statistically significant difference ($P = 0.001$), whereas the difference between preoperative and final results for VAS for leg pain and ODI was not statistically significant ($P = 0.149$ and 0.072, respectively).

Radiological outcome

In the present study, radiographic fusion was achieved in 85% of cases treated in group A (TLIF), which was less than that reported by Wang et al. [14] (98%) and Yan et al. [11] (100%). This can be attributed to inadequate bed preparation in early cases. In contrast, radiographic fusion was achieved in 80% of cases in group B (PLF), which is less than that reported by Zdeblick [22] (95%) but comparable to results reported by Fischgrund et al. [23] (82%). These results were also comparable to the results reported by Sajay et al. [20], who reported a fusion rate of 87.5% in the TLIF group and 81% in the instrumented PLF group. Jay et al. [12], in their systematic review and meta-analysis, reported a 94.3% fusion rate in the TLIF group and 84.7% in the PLF group.

In comparison between the two groups, it was found that group A (TLIF) achieved better clinical and radiographic outcomes than group B (PLF) in patients with postlaminectomy instability, where changes of VAS for back pain, VAS for leg pain, and ODI were more in group A (TLIF) with statistically significant difference ($P = 0.041$, 0.032, and 0.012, respectively). However, the changes were statistically insignificant between both groups in patients with primary instability (e.g. degenerative spondylolisthesis) ($P = 0.055$, 0.57, and 0.258, respectively).

This can be attributed to the need for a better and wider surface area for bone fusion in patients with postlaminectomy instability, which can be provided in group A (TLIF) by thorough preparation of endplates and applying adequate bone graft within the cage. TLIF also allows for better restoration of the disc and foraminal height, allowing for better decompression of neural elements. It places the bone graft within the cage under compressive forces in the anterior and middle elements, increasing the chances of spinal fusion.

Complications

A low complication rate was reported in this study. One patient in group A (TLIF) had a dural tear that was repaired intraoperative, but it was followed by pseudomeningocele formation, and the patient needed a second operation for meningocele excision. Rosenberg and Mummaneni [24] reported a dural tear in one patient, which was repaired but followed by a cerebrospinal fluid leak that needed a second operation for dural repair and reinforcement by fibrin glue. Zhou et al. [15] reported two cases of dural tear that needed no further surgery after repair. Ould-Slimane et al. [17] reported three (7%) cases of dural tears. Wang et al. [14] reported five cases of dural tears. McAfee et al. [25] reported seven dural tears (of 120 patients) during cage insertion and nerve root decompression.

Malposition of pedicle screws was found in three cases: two in group A (TLIF) and one in group B (PLF). No revision was needed for screw placement. Yan et al. [11] reported screw loosening in one case, and removal of screw was done after 18 months. Mura et al. [16] reported five cases of L5 root irritation due to screw malposition, which were operated within a few days for proper placement of screws.

Infection occurred in one patient of group A (TLIF); a second operation 3 weeks postoperatively was needed for wound lavage and debridement, screws were found stable and not removed, and the patient improved gradually. Rosenberg and Mummaneni [24] reported two cases of postoperative infection, both treated by antibiotics only and improved after 6–12 months. No infection was reported in Wang and colleagues and Ould-Slimane et al. [17].

Transient tingling and numbness occurred in five patients: three in group A (TLIF), and two in group B (PLF). Symptoms resolved within 3 months. Partial foot drop occurred in one patient of group A; the patient showed gradual improvement of motor function till fourth month. Rosenberg and Mummaneni [24] reported one case of postoperative L5 motor weakness that resolved spontaneously within 6 months. Yan et al. [11] reported two cases of radiculitis, and computed tomography myelography revealed normal radiological findings. Chen et al. [18] reported three cases of transient radiculopathy that resolved spontaneously.

No complications related to patient positioning were reported in this study. Rosenberg and Mummaneni [24] reported one case of postoperative brachial neuralgia secondary to improper arm positioning that resolved spontaneously. No cage migration was reported in this study. McAfee et al. [25] reported posterior migration of the cage into the spinal canal 6 months after the operation; the patient was hit in a car accident and required revision surgery to replace the cage.

The main limitations of this study are the small number of patients, the short-term follow-up period, and the lack of spinopelvic parameters and sagittal balance assessment. Future studies should take into consideration the effect of the two procedures on spinopelvic parameters and sagittal balance and their correlation to the functional outcomes.

Conclusion

Both TLIF and PLF are effective and safe options for treating segmental lumbar instability. However, interbody fusion yielded superior results in patients with postlaminectomy instability.

Conflict of interest

There are no conflicts of interest.

Abbreviation list

ALIF	Anterior lumbar interbody fusion
DEXA	Dual-energy X-ray absorptiometry
LBP	Low back pain
NSAIDs	Nonsteroidal anti-inflammatory drugs
ODI	Oswestry disability index
PEEK	Polyetheretherketone
PLIF	Posterior lumbar interbody fusion
PLF	Posterolateral fusion
PSF	Pedicle screw fixation
TLIF	Transforaminal lumbar interbody fusion
VAS	Visual analogue scale

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الملخص العربي

الالتحام الفقاري الامامي من خلال مخارج الاعصاب مقابل الالتحام الفقاري الخلفي الجانبي كعلاج جراحي لعدم الاستقرار الجزئي للفقرات القطنيه

البيانات الخلفيه الأساس المنطقي وراء جراحات دمج الفقرات القطنيه هو القضاء على الحركة الجزئيه المرضية والأعراض المصاحبة لها، وخاصة ألم اسفل الظهر. يعد الالتحام الفقاري الخلفي الجانبي باستخدام المسامير الجذعيه من أحد أكثر الطرق شيوعا بين أساليب إعادة بناء الفقرات القطنيه ن الخلف. يعتبر الالتحام الفقاري الامامي من خلال مخارج الاعصاب أسلوب جراحي معروف في علاج ألم اسفل الظهر المزمنه الناتجه عن عدم الاستقرار الجزئي للفقرات القطنيه.

الغرض. هو تقييم نتائج الالتحام الفقاري الامامي من خلال مخارج الاعصاب مقابل الالتحام الفقاري الخلفي الجانبي كعلاج جراحي لعدم الاستقرار الجزئي للفقرات القطنيه

تصميم الدراسه. تجربه سريريه مستقبليه غير معشاه ذات شواهد

المرضي والطرق هذه الدراسه اجريت علي المرضى الذين يعانون من عدم استقرار جزئي للفقرات القطنيه والذين خضعوا لتثبيت الفقرات القطنيه مع عمل اما الالتحام الفقاري الامامي من خلال مخارج الاعصاب مقابل الالتحام الفقاري الخلفي الجانبي خلال الفتره من يناير 2017 وحتي يونيه 2018. تم تقسيم اربعون مريضا يعانون من عدم استقرار للفقرات القطنيه الي مجموعتين: مجموعة الالتحام الفقاري الامامي من خلال مخارج الاعصاب ومجموعة الالتحام الفقاري الخلفي الجانبي ؛ عشرون مريضا في كل مجموعه. تم استخدام مسامير جذعيه محمله من الاعلي في المجموعتين. كان متوسط عمر المرضي في المجموعة الاولي 48,35 سنه و 45,3 سنه في المجموعه الثانيه. كانت الام اسفل الظهر الميكانيكيه هي الشكوي الرئيسيه في جميع المرضي بينما كانت الام عصب النسا شكوي في 13 مريضا (65%) في المجموعه الاولي و12 مريضا (60%) في المجموعه الثانيه. وقد تم تقييم المرضي قبل وبعد الجراحه عن طريق قياس شدة الالم وفق المقياس البصري لشدة الالم وباستخدام مؤشر لتحديد النشاط الوظيفي ودرجة العجز وكذلك تم التقييم الرضي باستخدام التصوير الاشعاعي.

النتائج كل من الطريقتين ادي الي تحسن الالم والنشاط الوظيفي ولكن اظهر البحث ان الالتحام الفقاري الامامي من خلال مخارج الاعصاب ادي الي نتائج افضل من حيث تحسن الم اسفل الظهر وفق المقياس البصري لشدة الالم كما اثبتت البحث ان هذه الطريقه اعطت نتائج افضل عدم الاستقرار الجزئي للفقرات القطنيه الثانوي.

الخلاصه يعد كلا من الالتحام الفقاري الامامي من خلال مخارج الاعصاب و الالتحام الفقاري الخلفي الجانبي خيارا جيدا لعلاج عدم الاستقرار الجزئي للفقرات القطنيه. مع ذلك فان الالتحام الفقاري الامامي من خلال مخارج الاعصاب يعطي نتائج ممتازه للمرضي الذين يعانون من عدم الاستقرار الجزئي للفقرات القطنيه الثانوي.