



Results of Transforaminal Lumbar Interbody Fusion (TLIF) for Unstable Degenerative Lumbar Spondylolisthesis (UDLS) in elderly patients: 5-year experience

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Abstract: *Background:* Degenerative Lumbar Spondylolisthesis (DLS) may present with significant disability due to instability. Interbody fusion (IBF) is advocated to achieve the highest possible functional recovery. *Objective:* To assess the clinical-radiological outcomes and perioperative complications of conventional open Transforaminal Lumbar Interbody Fusion (TLIF) in elderly (age >65 years) patients with single-segment unstable DLS (UDLS). *Methods:* Between March 2015 and October 2023, records of 79 patients, 22 men and 57 women, aged 65 to 75 years who underwent single-level TLIF for UDLS were reviewed. The patient's Body Mass Index (BMI) and co-morbidity status were recorded. The study sample was divided into Group A (Male) and Group B (Female). Perioperative clinical outcome was assessed by Visual Analogue Score (VAS) and Oswestry Disability Index (ODI). Radiological fusion was assessed by Brantigan and Steffee criteria and the overall outcome by Wang-Bohlman criteria. Perioperative complications were recorded and analyzed concerning age, sex, and co-morbidities. Statistical analysis was performed using SPSS. *Results:* Female patients of 65-70 years presented late and had significantly higher BMI, and medical co-morbidities. In both groups, the Mean VAS score [Group-A, 7.9±1.5 to 1.1±1.8; Group B, 7.8±1.7 to 1.3±1.6] and ODI score, [Group-A, 78.5±6.5 to 11.5±7.2; Group B, 76.5±7.5 to 13.6±9.3] had highly significant improvement at last post-operative follow-up. The Mean Operative time, intraoperative blood loss, and postoperative complications had no significant difference between the groups and were not statistically associated with age, sex, or BMI. In both groups, fusion [Group-A, (n=20, 90.91%); Group-B, (n=54, 94.74%) and the overall outcome was satisfactory [Group-A, n=19(86.37%), Group-B, n= 53(92.98%)]. *Conclusion:* Transforaminal Lumbar Interbody Fusion (TLIF) for single-segment Unstable Degenerative Lumbar Spondylolisthesis (UDLS) can provide satisfactory and favorable outcomes in carefully selected elderly and results in minimum complication.

Original Researcher Article

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Article at a glance:

Study Purpose: To assess the clinical-radiological outcomes and perioperative complications of conventional open TLIF for the elderly with UDLS.

Key findings: Elderly females (65-70 years) had higher BMI and medical co-morbidities but showed significant improvements in pain, function post-surgery, with no age-related outcome differences or complications.

Newer findings: TLIF effectively improves pain, disability in elderly UDLS patients with satisfactory outcomes (91.14%), despite late presentation and co-morbidities.

Abbreviations: Degenerative Lumbar Spondylolisthesis (DLS), Interbody fusion (IBF), unstable Degenerative Lumbar Spondylolisthesis (UDLS), Body Mass Index (BMI), Visual Analogue Score (VAS), Oswestry Disability Index (ODI)..



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INTRODUCTION

Spondylolisthesis is a common disorder of old age (> 65 years) and is defined as the forward

slip of the spinal column.¹ Despite mostly being stable, it may present with significant disability while associated with instability.^{2,3} Simple

decompression and stabilization may provide some relief, but interbody fusion (IBF) procedures are advocated to achieve the highest possible functional recovery.⁴ IBF procedures are highly rewarding for their achievement of solid union, balance restoration, enhancing stability, and load-bearing capacity.⁵ Moreover, fusion provides anterior spinal column support through which 80% of compression, torsion, and distractive loads are transmitted and neutralized.⁶ Out of different IBF techniques, Transforaminal Lumbar Interbody Fusion (TLIF) has passed the test of time due to its safety, wide range of applicability, and minimal neural issues.⁷

Nevertheless, the safety of these procedures has been occasionally depicted as uncertain in the elderly age group and has been associated with conflicting results worldwide.^{8,10} Moreover, the effect of age on TLIF and perioperative complications has not been studied in elaboration. Considering all these facts we intended to assess the clinical-radiological outcomes and perioperative complications of conventional open TLIF in elderly (age >65 years) patients with single-segment UDLS and to evaluate the effect of age and co-morbidities on clinical outcome and complications.

METHODS

Between March 2015 and October 2023, records of 79 patients, 22 men and 57 women, aged 65 to 75 years (mean 69, SD 5.7) who underwent single-level TLIF for UDLS according to Posner¹¹ and S-DSIC¹² criteria were reviewed retrospectively. All the surgeries were performed by the same surgeon with a minimum of 3 years completed follow-ups. Patients with UDLS with i) progressive neurological deterioration, ii) progressive disability, iii) uni/bilateral radiculopathy who failed adequate conservative therapy were included but the patients with i) Stable DLS; ii) 2 or more level UDLS iii) Previous history of discectomy or any other spine surgery; iv) spondylitis or Spondylo-discitis and v) Medically unfit were excluded. A total of 59 cases were involved at L4-5 and 20 cases at L5-S1 level. All the patients were divided into Males (Group A) and Females (Group B) for further statistical evaluation.

All the patient's Body Mass Index (BMI) was recorded and underwent preoperative medical assessment for co-morbidities [Hypertension (HTN), Ischemic Heart Disease (IHD), Chronic Kidney Disease (CKD)] and Triple Radiological Assessment (TRA) was done by X-ray L/S spine A/P, lateral and dynamic films (for instability¹³ and MRI of the L/S spine (T2 weighted film)¹² [Table-I]. The operative time, intra-operative bleeding and complications, and improvement of clinical (e.g., motor, sensory, reflex) and functional status (e.g., pain, disability, stability) were recorded. Perioperative pain status was recorded by self-evaluated Visual Analogue Score (VAS)¹³, and disability by Oswestry Disability Index (ODI).¹⁴ The overall clinical outcome was determined by Wang Bohlman Criteria,¹⁵ where excellent and good grades were considered satisfactory. Follow-up was done at 6 weeks, 3 months, 6 months, 1 year, and then yearly¹⁶ for 3 consecutive years by TRA. Radiological fusion was assessed using the Brantigan Steffee method.¹⁶

Surgical technique- All the patients were positioned prone under general anesthesia. After proper positioning and strapping, the target level was marked and reconfirmed by the image intensifier (II). The posterior lumbar midline incision was used to dissect and retract the paraspinal muscles. The facet capsule and the transverse process guided the entry point for the Titanium pedicle screws (TPS). The superior facet joint was preserved, the pedicle eye was punctured and the ball-tipped tracker probe (BTTP) was introduced to measure the length and assess the pedicular walls. The TPS of appropriate length and diameter were introduced after tapping and checking it with the II. We preferred the more symptomatic side for instrumentation and decompression by doing ipsilateral inferior facetectomy, Inferior laminectomy, and superior articular process-ectomy. A contralateral procedure was repeated after ipsilateral discectomy, interbody bone grafting, and interbody fusion cage (IBFC) placement with graft. After completing the contralateral side, the rods were placed and compressed. II was used again for final confirmation and the wound was closed in layers with keeping a drain in situ. All the patients were mobilized on the second postoperative day, and the

next day, all the channels and drains were removed followed by a radiological assessment was done.

On successive follow-ups, The TRA was taken at 6 weeks, 6 months, 1 year, and yearly thereafter for 3 consecutive years. All radiographs were examined by two separate radiologists for loss of correction, nonunion, adjacent segment disease, and screw loosening or fracture. The presence of 1 mm or more radiolucent area on the screw bone

interface was considered screw loosening. The clinical and radiological parameters were measured by the same assessor and the statistical analysis was established using the SPSS statistical software IBM SPSS software ver. 19.0 (IBM Corp., Armonk, NY, USA) where results were achieved from the chi-square test, t-test, and z-test where applicable with p-value <0.05 considered significant.

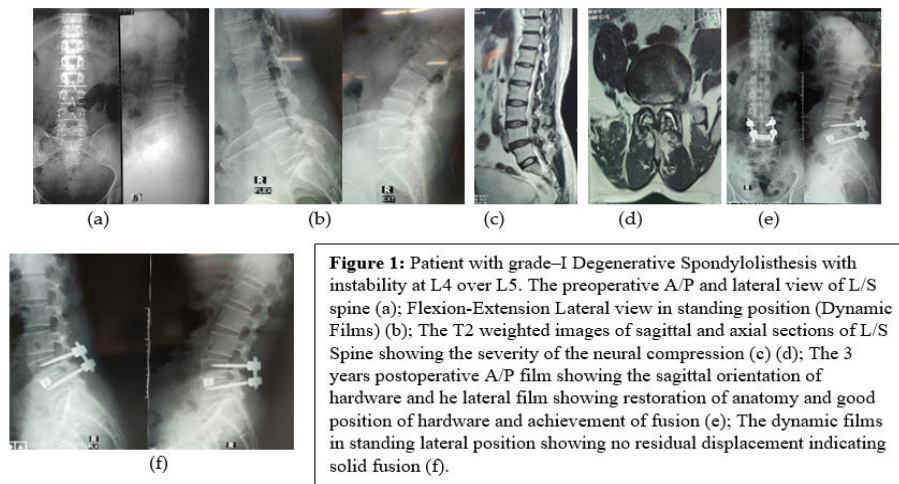


Figure 1: Patient with grade-I Degenerative Spondylolisthesis with instability at L4 over L5. The preoperative A/P and lateral view of L/S spine (a); Flexion-Extension Lateral view in standing position (Dynamic Films) (b); The T2 weighted images of sagittal and axial sections of L/S Spine showing the severity of the neural compression (c) (d); The 3 years postoperative A/P film showing the sagittal orientation of hardware and he lateral film showing restoration of anatomy and good position of hardware and achievement of fusion (e); The dynamic films in standing lateral position showing no residual displacement indicating solid fusion (f).

RESULTS

Table 1: Patient Demographics

		Group-A (n=22)	Group B (n=57)	Total (n=79)
Age	65-70 years	14(63.63%)	39(68.42%)	53(68.08%)
	70-75 years	18(81.81%)	18(31.58%)	36(45.57%)
	25.0-29.9	12(54.54%)	4(07.02%)	16(20.25%)
BMI	30.0-34.9	9(40.91%)	36(63.16%)	45(56.96%)
	35.0-39.9	1(04.54%)	17(29.82%)	18(22.78%)
Co-Morbidity	Single	15(68.18%)	19(33.33%)	34(43.04%)
	Multiple	7(31.81%)	38(66.66%)	45(56.96%)

Table 1, summarizes the demographic data of the study population. Both Group A (n=22) and Group B (n=57) were subdivided into 65-70 years and 70-75 years age groups. The mean age in Group A was 70.8±5.5 years (range, 65–73 years), and in

Group B, 67.3±9.7 years (range, 65–75 years). Female patients of 65-70 years and their association with higher BMI and multiple medical comorbidities were significant (z-test, p<0.05).

Table 2: Clinical data of the study

		Group-A (n=22)	Group B (n=57)	Total (n=79)
Duration of symptoms	1-2 years	16(72.72%)	17(29.82%)	33(41.77%)
	2-5 years	6(27.27%)	40(70.17%)	46(58.23%)
VAS	Pre-operative	7.9±1.5	7.8±1.7	
	Post-operative	1.1±1.8	1.3±1.6	
ODI	Pre-operative	78.5±6.5	76.5±7.5	
	Post-operative	11.5±7.2	13.6±9.3	

All patients in this study had neurogenic claudication as the presenting symptom with radiculopathy. In Group A, the mean symptom duration was 9.5±8.2 months (range, 12–24 months), whereas, the other group presented significantly late at 15.6±9.5 months (range, 12–34 months) [z test, p<0.05]. The preoperative mean VAS score, [Group A, 7.9±1.5 (range, 6–10) and Group B, 7.8±1.7 (range, 4–9)] and mean ODI score,

[Group A 78.5±6.5 (range, 66–87). and Group B 76.5±7.5 (range, 56–84)] had highly significant improvement (chi-square test, p<0.01) at 3 years follow up, the VAS score, [Group A, 1.1±1.8 (range, 6–10) and Group B, 1.3±1.6] and ODI score, [Group A 11.5±7.2 and Group B 13.6±9.3]. However, there was no significant difference in terms of perioperative VAS and ODI between the groups (chi-square test, p>0.05).

Table 3: Surgical data of the study

		Group-A (n=22)	Group B (n=57)	Total (n=79)
Levels of Fusion	L4-5	18(81.81%)	41(71.93%)	59(74.68%)
	L5-S1	4(18.18%)	16(28.07%)	20(25.32%)
Surgical Time (minutes)	L4-5	141±21min	153±33min	
	L5-S1	157±31min	164±36min	
Intra-Operative Blood Loss (ml)		175±35ml	195±42ml	
Hospital Stay (Days)	3-5 days	11(50%)	18(31.58%)	29(36.71%)
	5-7 days	11(50%)	39(68.42%)	50(63.29%)

In both groups, L4/5 Level was mostly operated [Group-A, 18(81.81%), Group-B 41(71.93%)] with a mean operative time of 154±29 minutes (range, 170–215 minutes) in group A and

158±35 minutes (range, 175–230 minutes) in group B. The mean operative blood loss [Group A (165±15 ml), Group B (185±31 ml)] was also indifferent (p>0.05).

Table 4: Post-Operative Complications

Category	Complications	Group-A (n=22)	Group-B (n=57)	Total (n=79)
General	Superficial Surgical Site Infection (SSSI)	3(13.63%)	7(12.28%)	10(12.66%)
	Deep Surgical Site Infection (DSSI)	1(4.54%)	2(3.51%)	3(3.79%)
	Post-operative pyrexia (POP)	4(18.18%)	7(12.28%)	11(13.92%)
	Transient Paresthesia	4(18.18%)	5(8.77%)	9(11.39%)
	Dural puncture	3(13.63%)	7(12.28%)	10(12.66%)
Neurological	Dural Tear	2(22.72%)	3(5.26%)	5(6.33%)
	Root Injury	1(4.54%)	2(3.51%)	3(3.79%)
	Bladder Dysfunction	1(4.54%)	1(1.75%)	2(2.53%)
Cardio-Pulmonary	Post-operative pneumonia (POPn)	3(13.63%)	7(12.28%)	10(12.66%)
	Acute Respiratory Distress Syndrome (ARDS)	1(4.54%)	1(1.75%)	2(2.53%)
	Ischemic Heart Disease (IHD)	1(4.54%)	2(3.51%)	3(3.79%)
Vascular	Pulmonary Embolism (PE)	1(4.54%)	1(1.75%)	2(2.53%)
	Deep Vein Thrombosis (DVT)	1(4.54%)	0(0.0%)	1(1.26%)
	Urinary Tract Infection (UTI)	3(13.63%)	8(14.03%)	11(13.92%)
Urinary Tract	Acute Renal Failure (ARF)	1(4.54%)	1(1.75%)	2(2.53%)
	Progressive Renal Insufficiency (PRI)	0(0.0%)	1(1.75%)	1(1.26%)

Table 3 summarizes the postoperative complications (POC) [Group-A (n=30), Group-B (n=55)]. There was no significant difference between the groups (chi-squared test p<0.05). Radiological data analysis showed a satisfactory fusion rate, [Group-A (n=20, 90.91%), Group-B

(n=54, 94.74%]. Screw loosening, cage intrusion, and cage displacement were found once in each group [Group-A (n=1, 4.54%), Group-B (n=1, 1.75%]. There was no incidence of implant failure, Adjacent Segment Dysfunction, or revision surgery.

Table 5: Overall outcome status of the patients (n=79)

Comprehensive outcome according to Wang-Bohlman criteria							
	Group-A (n=22)	Group-B (n=57)	Total (n=79)		Group-A (n=22)	Group-B (n=57)	Total (n=79)
Excellent	10(45.45%)	30(52.63%)	46(58.23%)	Satisfactory	19(86.37%)	53(92.98%)	72(91.14%)
Good	9(40.91%)	23(40.35%)	26(32.91%))))
Fair	3(13.63%)	4(7.02%)	7(8.86%)	Unsatisfactory	3(13.63%)	4(7.02%)	7(8.86%)
Poor	0(0.0%)	0(0.0%)	0(0.0%)				

The table-5 shows the overall improvement was significant (chi-squared test, $p < 0.05$) at 3 years in both groups, [Group A $n=19(86.37\%)$, Group B

$n=53(92.98\%)$] with no difference between the groups (chi-squared test, $p > 0.05$).

DISCUSSION

The present-day advancement, technical innovation, and instrumentation have made TLIF a choice for populations at an increased surgical risk (elderly and those with significant comorbidities).¹⁷ It had not been studied widely with a prevailing thought of increased cost and incidence of complications.¹⁸ Many authors have reported similar favorable outcomes in comparison to the younger age group.^{11,12,19} However, reports of increased risk of complications are noteworthy,¹⁰ but the improvement of quality of life (QOL) had been the target to achieve.^{20,21} Okuda et al., analyzed a cohort of 101 patients of DLS at L4–L5 and found similar results to ours in terms of QOL improvement of elderly patients. The overall outcome of our study is comparable to that of Patel.^{15,22} There are studies where comorbidity is associated with increased morbidity and mortality in lumbar fusion surgery;^{18,23} However, in the present series, the incidence of complications regardless of medical co-morbidity was insignificant. Despite increased co-morbidity in the elderly (>65 years), complications were not significantly different.²⁴ These suggest that age may not be an independent risk factor for TLIF-related complications. Although some clinical studies indicated a slightly higher risk in the elderly.^{2,3}

had ended in wound dehiscence and required delayed wound closure. Patients with POP [Group A ($n=4$, 18.18%), Group B ($n=7$, 12.28%)] were managed conservatively with antibiotics as discussed in different series.^{15,20,22} The total intra and postoperative persistent neurological issues were insignificant [Group A ($n=3$, 13.63%), Group B ($n=6$, 10.52%)]. Minor dural punctures were managed with gelfoam, and watertight fascia closure, with no postoperative dural puncture-related complications. Primary closure was done in a total of 5 cases. Patients with transient paresthesia [Group A ($n=4$, 18.18%), Group B ($n=9$, 15.79%)] were improved at 9 months except in 3 cases, which had persistent residual deficits associated with peripheral neuropathy. These results are also comparable to other reports.^{15,20,22}

Life-threatening complications were reported in different works of literature,²³⁻²⁵ contrary to ours. Both groups had one case of IHD, ARDS, PE, and ARF, all were managed in the high-dependency unit and recovered well. Additionally, urinary tract infections (UTI) [Group-A ($n=3$, 13.63%), Group-B ($n=8$, 18.03%)] were managed with oral antibiotics without additional hospital stay [Table II]. Out of 2 patients with ARDS; one required prolonged ventilator support. This study had no peri-operative mortality, even after 3 years, which mostly attributed to the fact that we dealt with ambulatory degenerative patients; generally healthy except for reduced reserves due to age and medical co-morbidities. With strict preoperative optimization on co-morbidities and judicious patient selection, TLIF-related mortality in the elderly age group can be brought down.²⁵ This study is not beyond limitations, the sample size was small with

Among the POC, patients with SSSI [Group A ($n=3$, 13.63%), Group B ($n=7$, 12.28%)] (due to uncontrolled diabetes) and delayed wound healing, were managed conservatively with antibiotics and alternate day dressing. patients with DSSI [Group A ($n=1$, 4.54%), Group B ($n=2$, 3.51%)] could be managed conservatively using antibiotics through both parenteral and enteral route except one which

a retrospective design. Moreover, it requires a larger sample size to increase the power of the study. However, the quality of the evidence would be further strengthened by future randomized controlled trials or well-controlled prospective cohorts. Finally, surgeries limited to single-level TLIF may not necessarily apply to multi-level cases. However, a midterm follow-up of 3 years may not allow us to know whether differences will appear over a longer period.

CONCLUSION

Transforaminal Lumbar Interbody Fusion (TLIF) for single-segment Unstable Degenerative Lumbar Spondylolisthesis (UDLS) can provide a favorable outcome in carefully selected elderly patients with minimum complication.

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Authors contributions:

NS: Concept and design, data acquisition and interpretation, drafting, and final approval.
MMT: Data acquisition, drafting, analysis.

Declarations

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Consent for publication: Had been taken.

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