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A Case Series of Three Patients with Single-Level Spondylolisthesis: Clinical and Functional Results Following Transforaminal Lumbar Interbody Fusion.

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Abstract

Lumbar spondylolisthesis, characterized by lumbar instability and forward slippage in relation to the underlying vertebrae, is a common condition often accompanied with chronic low back pain, radiculopathy and interfering functionality factors that may necessitate surgical treatment when conservative approaches have been tried. TLIF had emerged as a leading surgical method to achieve both decompression and stabilization through the single posterior approach. In this case series, 3 cases of single level lumbar spondylolisthesis in which TLIF surgery was performed were presented and their clinical evaluation with VAS (Visual Analogue Scale) score, ODI (Oswestry Disability Index) score and radiologically assessed. All patients showed impressive improvement following surgery, as the mean VAS score decreased from 8.0 preoperatively to a corresponding measurement of 1.6 at 6 months post-surgery; similarly, ODI scores improved significantly by reporting a percentage of disability reduction from original states (58%) to stable remote state (18%). Fusion was achieved on radiographs in every case, and there were no major complications. TLIF is a safe and effective surgical modality, with excellent pain relieve, functional improvement and high fusion success in single-level spondylolisthesis as evidenced by these findings.

Keywords: TLIF; Spondylolisthesis; Case series; Lumbar fusion; Functional outcome

Introduction

Spondylolisthesis is defined as forward displacement of one vertebral body over another, with the lumbar spine being the most common location. It is a major source of chronic low back pain and disability, commonly with radiculopathy and neurogenic claudication involvement. The disease mainly affects the lumbosacral junction, and the most commonly affected segments are L4–L5 and L5–S1 levels (1). Meyerding categorized spondylolisthesis into 5 grades, from I (0–25%) to V (>100%), otherwise known as spondyloptosis, based on the amount of vertebral migration (2).

There are various types of spondylolisthesis based on etiology [dysplastic, isthmic, degenerative, traumatic, pathological and iatrogenic] (3). Degenerative and isthmic types are the most frequently seen types clinically, among these. Degenerative spondylolisthesis is most commonly arises in the older adult population, resulting from progressive degeneration of the intervertebral disc, facet joint arthropathy and ligamentous laxity leading to segmental instability (4). On the other hand, isthmic spondylolisthesis typically occurs in a younger population and involves defects of pars interarticularis (5).

The clinical presentation of spondylolisthesis consists of different levels of back pain, radicular signs and functional limitation. In more severe cases, patients may have neurological deficits and gait disturbances. Various factors such as the extent of slip, spinal instability, and concomitant degenerative changes affect how natural history turns out (6). Epidural steroid injections are usually considered as a part of the initial management along with physiotherapy, analgesics and lifestyle modification. However, surgical intervention is required in patients with symptomatic persistence, progressive neurologic deficits, or imaging evidence showing instability (7).

Different surgical techniques are confirmed in lumbar fusion, such as posterolateral fusion (PLF), anterior lumbar interbody fusion (ALIF), posterior lumbar interbody fusion (PLIF) and transforaminal lumber interbody fusion/TLIF. Of these techniques, the TLIF has become most widely used because of its unique advantages. The two-segment long fixation of the rig was sufficient in minimizing the excessive retraction of neural tissues while maintaining spinal stability in a single posterior approach, which could significantly reduce iatrogenic injury, as suggested by previous studies (8).

The TLIF technique entails unilateral facetectomy, discectomy, interbody cage insertion with bone graft placement and posterior stabilization via pedicle screw instrumentation. The circumferential fusion method provides better biomechanical stability and greater rates of fusion. Studies have shown that TLIF achieves fusion scores >90%, with significant pain and functional improvement (9). TLIF also has been linked to reduced operative morbidity relative to other fusion methods and especially PLIF due to less manipulation of the dural and nerve roots (10).

While TLIF has its benefits, it is also not free of complications. Intraoperative and postoperative complications can be dural tears, nerve root injury, surgical site infection, implant failure and pseudoarthrosis (11). Surgical outcomes and the rate of complications can also be influenced by patient-related factors like age, comorbid disease, underlying bone quality and degree of spondylolisthesis. As a result, precise selection of patients and exacting surgical technique are prerequisites for optimal outcomes. Many articles have studied the results of TLIF on a population basis requiring large numbers and statistical evaluations; however, series of case provide better understanding regarding the individual patient outcomes, clinical diversity as well as actual surgical experience. They enable granular assessment of symptom trajectory, surgical response and recovery dynamic that may not always be detectable in larger cohort studies.

Thus, the current case series aims to report the clinical picture, surgical treatment and functional results of three patients with single-level lumbar spondylolisthesis who underwent TLIF. This study aims to solidify TLIF as a highly effective, safe and clinically applicable option for the treatment of symptomatic spondylolisthesis based upon case-specific characteristics and outcomes.

Case Presentation

Case 1

A 47-year-old female visited the outpatient department with complaints framing chronic low back pain since about two years which has worsened during the last six months. The pain appeared to be a steady, aching sensation limited to the lower lumbar area, with subacute radiation to the left lower extremity covering the L5 dermatome. The symptoms were aggravated on standing for long periods, walking and forward bending while there was partial relief with rest and analgesics. However, conservative management with physiotherapy, non-steroidal anti-inflammatory drugs and activity modification did not provide sustained relief over time.

Clinical examination revealed bilateral lumbar paraspinal muscle spasm and restricted range of motion Left lower limb showed positive straight leg raising test at 50 degrees suggesting nerve root irritation. Neurological examination showed a mild sensory deficit over the dorsum of foot (L5 nerve root distribution involvement) but preserved motor function. Reflexes were normal.

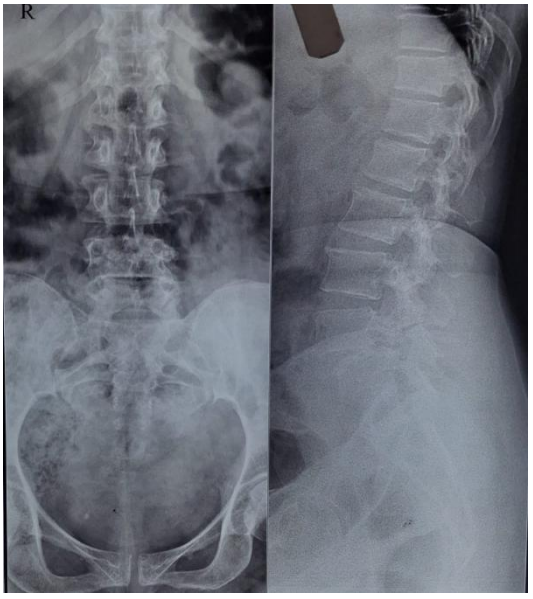

Figure 1: Preoperative X-ray - AP & Lateral view

Plain radiographs (anteroposterior and lateral view) radiological evaluation shows Grade I anterolisthesis at L4–L5 level. MRI of the thoracic spine revealed degenerative changes consistent with disc desiccation, facet joint hypertrophy and bilateral foraminal narrowing with nerve root compression.

Keeping in mind the persistent symptoms and radiological correlation patient was planned for surgical intervention. She was taken for Transforaminal Lumbar Interbody Fusion (TLIF) under GA. A standard posterior midline approach was utilized, with unilateral facetectomy and decompression. L4 and L5 pedicle screws were placed, followed by discectomy. Interbody cage with autologous bone graft was placed, followed by rod fixation and final tightening.

Postoperatively, the patient was mobilized in under 48 hours with adequate pain control. Wound healing was uneventful. At 6-month follow-up, the patient showed considerable clinical improvement—Visual Analogue Scale (VAS) score decreased from 8 preoperatively to 2, and Oswestry Disability Index (ODI) improved from a value of 60% to a value of 20%. Postoperative radiographs confirmed satisfactory interbody implant positioning and suggested interbody fusion. No complications were encountered.

Case 2

A 55-year-old man came with complaints of one year history of radicular low back pain, bilateral lower limb irradiation and neurogenic claudication. The patient complained of difficulty in walking beyond 100–150 meters due to bilateral lower limb pain and heaviness that severely impaired his activities of daily living (ADL) and quality of life (QOL). The patient had received several conservative treatment modalities such as physiotherapy and epidural steroid injections without success.

On examination, the patient had an antalgic gait with a forward stooping posture. Motion of the lumbar spine was painful and limited. Straight leg raising test was bilaterally positive at 40 degrees. Neurological examination showed decreased sensation in the S1 dermatome on both sides and mild weakness of plantar flexion. Deep tendon reflexes were diminished at the ankle jerk.

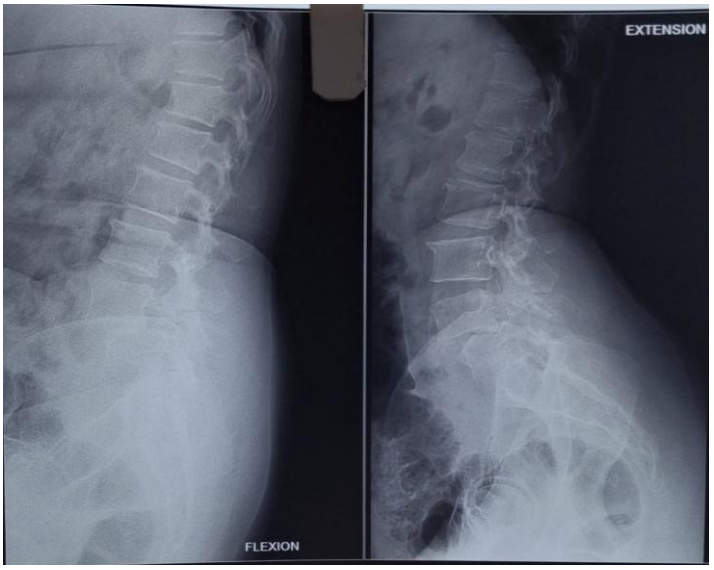

Figure 2: Pre-operative X-ray Lateral _ Flexion & Extension views

Radiological investigations demonstrated Grade II spondylolisthesis at L5–S1 level with spinal canal stenosis. Magnetic resonance imaging demonstrated disc degeneration, ligamentum flavum hypertrophy, and thecal sac compression.

Due to severe symptoms and ineffectiveness of conservative management, surgical intervention was planned. The patient was treated with TLIF, decompression and stabilization. On intraoperative evaluation, there was significant canal stenosis, which was sufficiently decompressed. Pedicle screw fixation at L5 and S1 followed by interbody cage insertion.

Postoperatively, he had an uneventful recovery and was mobilized on the second postoperative day. At follow-up, there was a significant improvement in symptoms. VAS score improved from 9 pre-operatively to 2 at 6 months, and ODI improved from 65% to 22%. The patient also noted that walking distance and daily activities improved significantly. Radiological evaluation confirmed successful fusion. No intraoperative or postoperative complication was observed.

Case 3

A 40-year-old-female patient presented with intermittent low back pain and right-sided radicular symptoms for the past eight months. Initially, mild to moderate in intensity but progressively worsening and interfering with daily activities. The patient also experienced occasional paraesthesia in the right lower limb. Conservative treatment with medications and physiotherapy gave only transient relief.

On clinical examination there was localized tenderness over the lower lumbar spine and mild restriction of the movements. Positive straight leg raising test at 60 degrees on the right. Neurological examination was negative for motor deficit, but mild sensory changes were present.

Figure 3: MRI Image- Sagittal Section

Radiological evaluation demonstrating Grade I spondylolisthesis at L4–L5 level. MRI disc bulge + nerve root compressiono n early degenerative changes. The patient underwent TLIF after conservative therapy failed. The surgery was done with general anesthesia using an ordinary posterior approach. A decompression, discectomy and interbody fusion with cage placement was performed, and pedicle screw fixation was subsequently performed.

The patient achieved satisfactory pain relief postoperatively and was mobilized early. However, she had an atypical superficial surgical site infection on the 7th postoperative day, which was effectively treated with antibiotics and local wound management. Now, no infection — and it can resolve without complications. At 6-month follow-up, the patient displayed a great functional recovery with improvement of VAS point (7 to 1) and ODI points (55% to 12%). Radiographs demonstrated solid fusion and stable instrumentation.

Discussion

This case series illustrates the clinical impact and functional improvements attained with Transforaminal Lumbar Interbody Fusion (TLIF) for single level lumbar spondylolisthesis. All three patients showed considerable progression in pain, functional capacity and radiological fusion reinforcing the role of TLIF as a successful surgical mode. Spondylolisthesis is a common spinal disorder related to mechanical instability, degenerative changes, and neural compression which are associated with chronic pain and disability. Degenerative spondylolisthesis primarily involves the L4–L5 level according to prior studies that have observed this finding in two of our cases (1,2). The pathophysiology includes progressive disc degeneration, facet joint arthropathy and ligamentous laxity resulting in vertebral slippage or compression of nerve roots (3,4).

In our case series, all patients had undergone conservative management prior to surgical intervention; this is concordant with established treatment guidelines that suggest surgery in cases with refractory symptoms or neurological deficit (5). Among various lumbar fusion methods, TLIF has become one of the most common because it can achieve circumferential fusion through a single posterior approach with good neural retraction (6). A major finding of our study was a substantial reduction in pain scores. Demonstrated that the mean VAS score decreased from severe postoperative pain levels to an average of mild pain by 6 months. Roh YH et al (7) and Wang Y et al (8) have reported relatively similar improvements, with TLIF leading to significant pain reduction. This is made possible by appropriate neural element decompression and restoring spinal stabilization.

There was also significant improvement in all cases in the functional outcomes as assessed using the Oswestry Disability Index(ODI). Lower ODI figures denote better mobility, improved daily activities and quality of life. Studies to date have consistently reported ODI improvements of over 70% at TLIF, which is comparable to our results (9,10). Radiologic fusion is an important factor for surgical success. In our case series, all patients achieved successful fusion at 6 months follow-up. Literature cites in excess of 90% fusion rates when using TLIF (11,12). Biomechanical stability is improved, and the risk of further slippage is eliminated by augmenting inter-body cages with pedicle screw fixation promoting fusion. Among the different methods of fusion namely Posterior Lumbar Interbody Fusion (PLIF), Anterior Lumbar Interbody Fusion (ALIF) and TLIF, And TLIF offers certain advantages over others. It prevents neural retraction, spares the dura, and hence provides unilateral approach which leads to reduced surgical morbidity (13,14). The use of minimally invasive TLIF techniques has subsequently been associated with less blood loss, reduced operative time, and shorter hospital stays (15).

Our complication rates were minimal in our study, as superficial surgical site infection occurred once and was treated conservatively. No significant complications like dural tear, nerve root injury or implant failure occurred. This concurs with previous reports noting low complication rates in TLIF (16,17).
An important observation in the current case series is that early mobilization contributes to recovery. All patients were mobilized within 48 hours postoperative mobilization, which was associated with improved functional outcomes and decreased length of stay. Studies demonstrate that early mobilization, including all its rehabilitation elements, can improve circulation and lower complications while increasing patient satisfaction (18).

The close correlation between clinical improvement and radiological fusion demonstrated by this study emphasizes the need to obtain both mechanical stability and neural decompression. However, clinical outcomes do not always correlate directly with radiological findings and patient-reported outcomes are still important (19). Despite the encouraging results of this study, there are limitations. However, this was a case series with small sample size and results cannot be generalized to the larger population. Furthermore, the follow-up also only extended up to 6 months which fails to identify any potential long term complications of DSIS such as adjacent segment disease or implant failure (20).

Summary

In this case series, three patients with single-level lumbar spondylolisthesis who underwent TLIF were evaluated. All patients had chronic low back pain and radiculopathy refractory to conservative treatment. VAS and ODI were used to test whether clinical evaluation is treated postoperatively and whether significant improvement has been made. Radiological evaluation revealed successful fusion in all patients. The procedure had few complications (one case of superficial infection). These results underscore the efficacy of TLIF for pain relief, functional recovery, and spine stability. It supports TLIF as a safe surgical procedure with good clinical and radiological outcomes.

Conclusion

The TLIF approach is a safe, effective, and reliable surgical procedure for the treatment of single-level lumbar spondylolisthesis. This is a procedure that yields a large degree of pain relief, functional improvement and very high rates of radiological fusion with relatively few complications. Was inspired by early mobilization; also, in suitable patients of course will imporve postoperative recovery and outcome. Based upon our findings, we feel that TLIF can be considered a favorable surgical treatment for patients with symptomatic spondylolisthesis who fail conservative management.

Declaration

Consent: Written informed consent was obtained from the patient. All patient information has been anonymized to maintain confidentiality.

Conflict of Interest: Nil

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