Clinical and Radiological Outcomes Between Anterior Lumbar Interbody Fusion with Percutaneous Pedicle Screw Fixation and Transforaminal Lumbar Interbody Fusion in the Treatment of High-Grade Isthmic Spondylolisthesis

Neil Patel, Daniel Coban, Stuart Changoor, George Abdelmalek, Harjot Uppal, Nikhil Sahai, Kumar Gautam Sinha, Ki S Hwang, Arash Emami

INTRODUCTION: Isthmic spondylolisthesis (IS) is characterized by anterior translation of the vertebral body due to a defect in the pars interarticularis. Surgical intervention, such as anterior lumbar interbody fusion with percutaneous pedicle screw fixation (ALIF PPF) or transforaminal lumbar interbody fusion (TLIF), is often required when conservative management fails. While outcomes of these procedures are well documented in low-grade IS, there is limited data comparing ALIF and TLIF in the treatment of intermediate to high-grade IS. This study evaluates and compares the clinical and radiographic outcomes of ALIF PPF and TLIF in this patient population.

METHODS: A retrospective review was conducted on patients treated for IS with either ALIF PPF or TLIF at a single institution between 2012 and 2020. Patients were included if they were ≥18 years of age, had at least two years of follow-up, underwent one- or two-level fusion between L4–S1, and had Meyerding grade II or higher IS. Radiographic evaluation included slip angle, PI-LL mismatch, pelvic tilt, sacral slope, and lumbar lordosis. Functional outcomes were assessed using the Oswestry Disability Index (ODI) and Visual Analog Scale for back and leg pain (VAS-b, VAS-l). Statistical comparisons were performed using chi-square, Fisher's exact, and independent t-tests, with significance set at $p<0.05$.

RESULTS: Fifty-two patients were included (32 ALIF, 20 TLIF). Groups were similar in age, BMI, sex, smoking status, and follow-up duration. The fusion rate was significantly higher in the ALIF group (100%) compared to the TLIF group (85%, $p=0.024$). Revision rates were lower in the ALIF group (6.25%) versus TLIF (20%, $p=0.131$), with a longer mean time to revision in ALIF (25.5 vs. 10.5 months, $p=0.044$). Pseudarthrosis accounted for 50% of revisions in the TLIF group and none in the ALIF group. One vascular complication occurred in the ALIF cohort. Radiographic parameters, including PI-LL mismatch, pelvic tilt, sacral slope, lumbar lordosis, and slip angle, showed no significant differences between groups pre- or postoperatively. Functional outcomes (ODI, VAS-b, VAS-l) improved significantly from baseline in both groups ($p<0.001$), with no significant differences in the degree of improvement between cohorts.

DISCUSSION AND CONCLUSION: Both ALIF PPF and TLIF provide significant clinical and radiological improvements in patients with intermediate to high-grade IS. ALIF was associated with a significantly higher fusion rate and longer time to revision, with lower rates of pseudarthrosis compared to TLIF. These findings suggest ALIF may offer biomechanical advantages in fusion integrity. Larger prospective studies are warranted to validate these results and further guide surgical decision-making in this complex patient population.