

Stand-Alone Lateral Lumbar Interbody Versus Circumferential Fusion in Adult Scoliosis: A Comparative Analysis of Reoperation Risk

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Introduction

Surgical treatment of adult scoliosis requires balancing surgical invasiveness with long-term construct durability. Circumferential (360°) fusion provides robust deformity correction and mechanical stability but is associated with increased perioperative morbidity, whereas stand-alone lateral lumbar interbody fusion (SA-LLIF) has emerged as a less invasive alternative with concerns regarding reduced construct stability. Reoperation represents a clinically meaningful outcome to compare the durability of these surgical strategies.

Materials and Methods

Adult scoliosis patients undergoing surgical treatment with either SA-LLIF or circumferential fusion were retrospectively identified. Reoperation was defined as the primary outcome. Time-to-event analysis was performed using Kaplan–Meier estimates and Cox proportional hazards regression, adjusting for age, Charlson Comorbidity Index, preoperative Cobb angle, and preoperative PI-LL mismatch. Patients were followed for reoperation for up to 5 years postoperatively, with censoring at last clinical follow-up (mean follow-up 3.9 years).

Results

A total of 259 patients were included (SA-LLIF: n = 91; circumferential fusion: n = 168). Median follow-up was 3.5 years (IQR, 2.0–7.0). At 2 years after the surgery, the reoperation-free survival probability for stand-alone group was 87.2% while for circumferential group was 79.3%. Reoperation occurred in 13 patients in the SA-LLIF group and 44 patients in the circumferential group within 5 years after the surgery. In unadjusted analysis, stand-alone fusion was associated with a lower hazard of reoperation (hazard ratio [HR] 0.53; 95% CI 0.29–0.98; p = 0.045). This association remained significant after adjustment for age, comorbidity burden, preoperative Cobb angle, and preoperative PI-LL mismatch (adjusted HR 0.50; 95% CI 0.26–0.96; p = 0.037). Five-year revision-free survival favored the SA-LLIF group (p = 0.04), with cumulative revision rates of 14% for the first group compared with 26% for circumferential fusion. Mean coronal Cobb angle correction was greater in the circumferential group ($-21.7^{\circ} \pm 9.6$) compared with the SA-LLIF group ($-11.0^{\circ} \pm 6.4$; p < 0.001). Most reoperations involved procedures to add levels to the index construct (68.4%), commonly due to adjacent segment disease, proximal junctional kyphosis, and hardware failure. Same-level revisions (31.6%) were less frequent and were primarily related to pseudarthrosis, hardware repositioning, neural decompression, and infection. Stand-alone fusion was associated with substantially lower estimated blood loss (88 ± 44 vs. 1154 ± 1061 mL; p < 0.001) and shorter length of hospital stay (4.7 ± 3.7 vs. 8.0 ± 4.0 days; p < 0.001).

Conclusion

In adult scoliosis, SA-LLIF was associated with a lower risk of reoperation compared with circumferential fusion, despite achieving less coronal deformity correction, highlighting the trade-off between deformity correction and surgical morbidity.

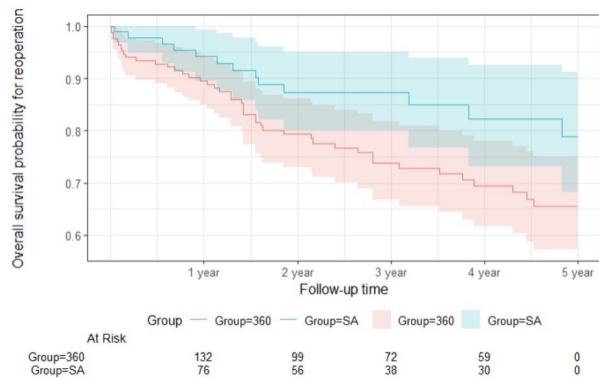


Figure 1. Kaplan–Meier reoperation-free survival curves for stand-alone (SA) and circumferential (360°) fusion. Shaded areas indicate 95% confidence intervals; numbers at risk are shown below.