# How Well Do We Maintain Lordosis in L4-S1 After Primary Decompression and Fusion?

Adrian Wu, Harrison Kin Chi Tam, Berit Ann Swanberg, John M Dawson, Omar Ramos

INTRODUCTION:

It is reported that L4-S1 lordosis is nearly constant at 35 degrees and independent of pelvic incidence (Presenti, et al., CORR 2018). L4-S1 apparently functions as a unit in sagittal alignment, and pelvic incidence influences only proximal lumbar lordosis in asymptomatic patients. Compensatory loss of lordosis above L4-L5 appears linked with the extent of segmental lordosis creation at the index L5-S1 level (Nguyen, et al., Global Spine J 2023). Segmental lordosis and compensatory changes at adjacent levels influence clinical outcomes. In our study, we measured our success rate for achieving a radiographic goal of 35 degrees of lumbar lordosis along the L4-S1 segment. We compared open transforaminal lumbar interbody fusion (TLIF) and minimally invasive (MI) TLIF.

METHODS:

This was a retrospective analysis of adult patients undergoing primary L4-S1 decompression and fusion between January 2014 and December 2022 with a minimum 1-year follow up. Trauma, tumor, and infection cases were excluded. Patient demographics were collected. Oswestry Disability Index (ODI) and Visual Analog Pain Scale (VAS) scores were obtained at preoperative, 3-month, and 2-year time points. Surgical data were documented. Full-length, standing spine radiographs were analyzed for preoperative, 6-weeks postoperative and 2-year postoperative time points. Two patient groups were compared: Open TLIF and MI-TLIF.

RESULTS:

106 patients met the inclusion criteria; 85 were open TLIF and 21 were MI-TLIF. Age, Body Mass Index, Sex, Smoking Status, and American Society of Anesthesiologists (ASA) score were not statistically different between Open TLIF and MI-TLIF groups. The estimated blood loss was greater for the Open TLIF group compared to the MI-TLIF group (median 200 ml vs 250 ml, $p=0.05$). The length of hospital stay was greater for the Open group, too (median 3 days vs median 2 days, $p<0.01$). Radiographic pelvic parameters for Open and MI-TLIF groups are presented in Table 1. For all patients, L4-S1 was 30±7 preoperatively, 30±6 at 6-weeks postoperatively, and 30±7 at 2-years postoperatively. Patient reported outcomes are presented in Table 2.

DISCUSSION AND CONCLUSION:

We found that 2-level TLIF at L4-S1 does not significantly change distal lumbar lordosis. This suggests that it is difficult to achieve a goal of 35 degrees of lumbar lordosis from L4-S1. This was true for both Open and MI-TLIF approaches. Patients in both groups improved clinical outcomes at 2-years postop despite not achieving optimal sagittal balance. Open TLIF subjects tended to have better patient reported outcomes at 2-years, but the difference between Open and MI-TLIF was not statistically significant. Our study is limited small sample sizes, particularly for MI-TLIF. We also had loss to follow up and missing radiographic data. We note that radiographs do not account for neural element decompression, muscle quality, and dynamic effects of balance and alignment.

Table 1. Pelvic Parameters, t-tests (mean ± sd):

| Parameter | Open TLIF (n=85) | MI-TLIF (n=21) | p-value |
|---|---|---|---|
| PI | | | |
| PreOp | 54 ± 9 | 51 ± 12 | 0.32 |
| 6-wk PostOp | 55 ± 10 | 52 ± 10 | 0.11 |
| 2-yr PostOp | 55 ± 10 | 51 ± 8 | 0.24 |
| L4-S1 | | | |
| PreOp | 30 ± 7 | 29 ± 8 | 0.79 |
| 6-wk PostOp | 30 ± 6 | 32 ± 5 | 0.25 |
| 2-yr PostOp | 29 ± 7 | 32 ± 7 | 0.37 |
| L1-S1 | | | |
| PreOp | 49 ± 13 | 46 ± 13 | 0.34 |
| 6-wk PostOp | 48 ± 12 | 48 ± 11 | 0.96 |
| 2-yr PostOp | 46 ± 14 | 46 ± 10 | 0.92 |
| L1-S1 | | | |
| PreOp | 11 ± 5 | 10 ± 4 | 0.37 |
| 6-wk PostOp | 12 ± 5 | 10 ± 4 | 0.01 |
| 2-yr PostOp | 12 ± 5 | 9 ± 4 | 0.07 |

Table 2. Patient Reported Outcomes, Mann-Whitney test (median, range)

| Outcome | Open TLIF (n=85) | MI-TLIF (n=21) | p-value |
|---|---|---|---|
| Oswestry Disability Index | | | |
| PreOp | 48 (20 - 80) | 49 (26 - 87) | 0.54 |
| 3-mo PostOp | 34 (0 - 76) | 18 (0 - 62) | 0.05 |
| 2-yr PostOp | 20 (0 - 80) | 42 (4 - 66) | 0.21 |
| Visual Analog Scale Back Pain | | | |
| PreOp | 6.5 (0 - 10) | 6.3 (0.5 - 9) | 0.42 |
| 3-mo PostOp | 1.5 (0 - 8) | 0.0 (0 - 8) | 0.02 |
| 2-yr PostOp | 1.0 (0 - 9) | 4.0 (0 - 10) | 0.15 |
| Visual Analog Scale Leg Pain | | | |
| PreOp | 6.5 (0 - 10) | 3.5 (0 - 8.5) | 0.04 |
| 3-mo PostOp | 1.0 (0 - 10) | 0.0 (0 - 7) | 0.07 |
| 2-yr PostOp | 0.5 (0 - 9) | 4.0 (0 - 10) | 0.07 |