Restoring L4-S1 Lordosis Shape in Severe Sagittal Deformity: Impact of Correction Techniques on Alignment and Complication Profile

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INTRODUCTION:

Surgeons often encounter patients with severe PI-LL mismatch and loss of L4-S1 lordosis. Limited data is available on the ability of anterior lumbar interbody fusion (ALIF), caudally placed pedicle subtraction osteotomy (PSO), or other surgical techniques to achieve regional and global alignment goals.

METHODS: Adult spinal deformity (ASD) patients included had preoperative PI-LL >20°, preoperative L4-S1 lordosis <30°, full body radiographs, and PROMs at baseline and 6 weeks postoperative. Ninety-eight patients were grouped into: ALIF (N=26; 1 or 2 ALIF at L4-S1), PSO (N=18, L4 or L5 PSO), and OTHER (N=54, TLIFs, ALIF/LLIF/Osteotomies at L3 or more cranial levels). Pre- and postoperative radiographic alignment and 90-day complications were compared between groups.

RESULTS:

Data reported as (ALIF, PSO, OTHER). Comparisons showed no significant difference in age (62-65 y.o.), gender (50-69% F), frailty scores (4.3, 3.4, 4.3), or baseline deformity severities (PT: 33°, 35°, 32°; PI-LL: 39°, 42°, 37°). PSO had a higher SVA vs. OTHER but was similar to ALIF (117mm±49, 153mm±56, 113mm±55, $p<0.05$), and a higher GSA (12°, 13°, 10°, $p<0.05$). PSO occurred more often in revision cases (46%, 88%, 61%, $p<0.05$). At 6 weeks postoperative, L4-S1 correction was larger in ALIF and PSO vs. OTHER (21°, 27°, 8°), PT correction was highest in ALIF (11°, 9°, 7°), and PI-LL correction was higher in ALIF and PSO vs. OTHER (34°, 32°, 26°), all $p<0.05$. At 6 weeks postoperative the apex of lumbar lordosis migrated caudally by 0.6 of a level in ALIF from between L4 and L5 to ~L4, $p<0.5$. However, the apex of lumbar lordosis did not change in PSO or OTHER at 6 weeks postoperative, $p<0.05$. PSO had significantly more intraoperative blood loss (1080ml, 2134ml, 1417ml, $p<0.05$), postoperative sensory (7%, 25%, 4%), and motor deficits (11%, 38%, 9%), all $p<0.05$.

DISCUSSION AND CONCLUSION: In patients with severe sagittal spinal deformity, ALIF restores L4-S1 lordosis as powerfully as L4 or L5 PSO, and results in a more caudal lumbar lordosis apex. PSO was performed in more patients with previous spinal fusion and was associated with higher intraoperative and postoperative complications compared to other techniques. When feasible, ALIF may be preferred over other techniques (L4 or L5 PSO and TLIF) for restoring lordosis in patients with severe sagittal malalignment.