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Effect of Cervical Mismatch on Sagittal Alignment and Patient Reported Outcomes in Long Posterior Cervical Fusions-A Multi-Center Analysis

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Background: The relationship between T1 Slope and Cervical Lordosis (CL), much like the relationship between Pelvic Incidence (PI) and Lumbar Lordosis (LL), serve as indicators of not only spinal alignment, but also outcomes related to overall disability and pain.

Research Question: Investigate the effect of T1-CL on outcomes in patients undergoing multi-level cervical fusions, and to establish a normative value of T1-CL in this cohort.

Methods: Demographics, radiographic measurements (T1 slope, C2-C7 CL, C2-C7 Sagittal Vertical Axis (SVA)), patient reported outcomes, complication and revision data.

Results: 356 patients from seven different centers were included in analysis. Mean age was 63 $\pm$ 12 years, mean BMI 28.7 $\pm$ 6.4. There was a strong correlation between T1 and CL ($r=0.79$), and positive correlation between T1-CL and SVA ($r=0.76$), ODI ($r=0.62$) and VAS ($r=0.65$). Patients were divided into 3 different groups based on the distribution of T1-CL data: Group 1, T1-CL $<34^\circ$; Group 2, $34^\circ \geq \text{T1-CL} \leq 56.4^\circ$; Group 3 T1-CL $>56.4^\circ$. Group 1 had better alignment (20.6 mm), VAS (3.2) and ODI (32.6) as compared to Groups 2 (SVA 52.9, VAS 4.8, ODI 45.2) and 3 (SVA 70.4, VAS 5.4, ODI 47.4) at 2 years follow-up. SVA of Group 1 improved significantly more than those in Groups 2 and 3. There was no difference in complication and revision rates between three groups. Analysis revealed that T1-CL demonstrated a constant value of 21.7° ($r^2=0.68$). A subgroup analysis with T1-CL value between 21.7° and 34° , vs. others revealed a significant improvement in alignment, disability and pain.

Discussion: T1 slope and CL are strongly correlated, and when a parameter of T1-CL is created, that value, in turn, is positively correlated with SVA, as well as pain and disability scores. Patients with T1-CL values (between 21.7° and 34°) were significantly better aligned and reported less pain and lower disability scores. A range of T1-CL between 21.7° to 34° may be necessary to maintain horizontal gaze.