

## **What Effect Does T1 Slope Have on Sagittal Balance and the Relationship with Caudal End of Three or More Level Posterior Cervical Fusions?**

Eric Truumees, Devender Singh, Ashley Therese Duncan, Cortney Matthews, John K Stokes, Matthew J Geck<sup>1</sup>

<sup>1</sup>Seton Spine & Scoliosis Center

### **INTRODUCTION:**

Sagittal balance of the spine is achieved through the equilibrium created through the natural curvatures of the cervical, thoracic, lumbar vertebrae, and pelvis. As the body ages, degenerative pathologies and muscular deconditioning can pull the body's center of mass forward, creating sagittal imbalance. Extending posterior cervical fusions into the upper thoracic spine for degenerative cervical pathologies has been thought to reduce rates of pseudoarthrosis and distal junctional kyphosis, leading to overall improved clinical outcomes. However, this extension is also associated with increased surgical time, blood loss, and invasiveness. This study investigated the effect of T1 slope on postoperative Sagittal Vertical Axis (SVA) and whether extension of posterior cervical fusions into the upper thoracic spine (T1/ T2 caudal levels) provides improved sagittal balance in comparison to C7 caudal level.

### **METHODS:**

A database of 327 patients from seven different centers who underwent a three or more level posterior cervical fusion was created. Only patients with two years follow up data were included. Two cohorts were created based on fusion caudal level, those whose fusion terminated at C7 and those whose fusions extended to T1 or T2. Basic demographic data was collected along with SVA and T1 slope radiographic measurements at preoperative and incrementally up to two years postoperative intervals (1 month, 3 months, 6 months, 12 months, 24 months postoperative). The cohorts were then divided again into two subgroups, high T1 slope ( $>25^\circ$ ) and low T1 slope ( $\leq 25^\circ$ ) and subject to comparative analysis.

### **RESULTS:**

A total of 224 patients were included in the C7 caudal cohort and 103 were included in the T1/T2 caudal cohort. The C7 cohort was 55% female, with a mean age of  $61 \pm 12$  yrs. The T1/T2 cohort was 44% female with a mean age of  $63.1 \pm 12.6$  yrs. Mean BMI of the C7 cohort was  $28.9 \pm 6.8$ , and  $29.1 \pm 5.8$  in the T1/T2 cohort. Mean SVA was significantly higher in patients with high T1 slopes (mean range 34.2-44.1mm) as compared to patients with Low T1 slopes (mean range 21-28.9mm) across all time intervals (preoperative to 24 months postoperative). Additionally, the 25<sup>th</sup> percentile SVA of High T1 slopes were greater than the median SVA values of Low T1 slopes at all intervals. For both the high and low T1 slope cohorts, patients with a caudal T1/T2 had comparatively higher SVA values than their C7 counterparts at all intervals despite maintenance of cervical lordosis, however these differences were not statistically significant.

### **DISCUSSION AND CONCLUSION:**

Increased sagittal imbalance was comparatively higher in patients with  $>25^\circ$  T1 slope ranging across preoperative to 24 months postoperative radiographic measurements. Extension of the posterior cervical fusion to T1 or T2 did not improve sagittal balance in patients with high T1 slopes. In fact, extension of posterior cervical fusions across the junction lead to increased positive sagittal imbalance. The results of this study do not support routinely extending posterior cervical fusions into T1 or T2 to improve postoperative sagittal balance. Longer thoracic extension or other intraoperative measures must be sought in patients at high risk for sagittal decompensation.