# Clavicle Angle and Concordant T1 Tilt Can Reliably Predict Postoperative Shoulder Balance, defined by RSH, in Adolescent Idiopathic Scoliosis (AIS) Patients

Vishal Sarwahi[1], Katherine Eigo[1], Effat Rahman[1], Sayyida Hasan, Swara Reddy Kalva, Brian Li, Yungtai Lo[2], Terry David Amaral[1]
[1]Cohen Children's Medical Center, [2]Albert Einstein College of Medicine

INTRODUCTION: Shoulder imbalance following Posterior Spinal Fusion (PSF) is a significant concern. While numerous studies have examined various radiographic parameters associated with postoperative shoulder imbalance, there is a lack of research investigating predictors for achieving balanced shoulders. This study aimed to identify radiographic predictors of shoulder balance by analyzing X-rays of patients with Adolescent Idiopathic Scoliosis (AIS) who underwent PSF, as well as control patients with no spine deformity.

METHODS:

The study used Radiographic Shoulder Height (RSH) as a proxy for shoulder height, with RSH less than 20 mm considered normal. T1 tilt and clavicle angle (CA) in the same orientation as RSH were defined as concordant. The study was divided into three parts:

Part I: X-rays of control patients were evaluated, with T1, CA, and RSH recorded to determine "normal" values. Kruskal-Wallis tests were performed to analyze the results.

Part II: Preoperative, postoperative, and final follow-up X-rays of AIS patients who underwent PSF were measured. Spearman's correlation was used to assess the correlation between radiographic parameters and RSH. Fisher's exact test was used to evaluate the distribution of abnormal postoperative RSH.

Part III: X-rays from multiple surgeons were evaluated to predict RSH, and Fisher's exact test was used to evaluate the distribution of abnormal postoperative RSH.

RESULTS:

Part I: 243 control patients were evaluated. 224 had normal RSH and 19 were abnormal. T1 tilt (2.4 vs 5.0) and CA (1.5 vs 5.0) were significantly different between the two groups ($p<0.05$).

Part II: In 336 patients, preoperative and postoperative CA correlated very strongly with RSH ($r = 0.83$). Concordant T1 tilt correlated weakly with RSH ($r = 0.25$). CA below 3 degrees yielded normal RSH postop ($p<0.001$). Restoring Concordant T1 tilt below 3 degrees yielded normal RSH in nearly all cases ($p=0.012$).

Part III: In 127 patients across 4 surgeons, restoring CA below 3 degrees yielded normal RSH at postop in all cases. Restoring concordant T1 tilt below 3 degrees yielded normal RSH at postop in nearly all cases.

DISCUSSION AND CONCLUSION: Our findings suggest restoring CA < 3° yields normal RSH postoperatively. In addition, when T1 is concordant, restoring it to < 3 degrees can yield normal RSH. Proximal thoracic fusion did not correlate with post op RSH.