Comparison of derotation achieved using two different surgical methods for the treatment of Lenke 1A Adolescent Idiopathic Scoliosis

Poster - 6

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Special Thanks to **Professor McCarthy** and **Mr Abdallah** for their guidance throughout this project and to the **School of Medicine Year 3 SSC Team** for providing this opportunity.

INTRODUCTION

Adolescent Idiopathic Scoliosis (AIS) is a three-dimensional deformity characterised by lateral deviation of the spine, vertebral rotation and a reduced thoracic kyphosis with unknown aetiology (1). AIS predominantly affects females and is one of the most common presentations of spinal deformity in paediatric clinics (1). Progressive scoliotic curves can worsen respiratory function and in severe cases lead to significant cardiopulmonary complications (2). Thus, surgical intervention aims to correct sagittal and coronal alignment, achieve derotation and minimise pain and morbidity (3).

Current surgical instrumentation vary from pre-contoured constructs with apical monoaxial screw based en masse correction techniques to manually contoured rod systems with polyaxial screws using dual-innie derotation methods. However, their relative effectiveness in spinal correction and derotation remains insufficiently quantified on standard radiographs. This study introduces a novel volumetric analysis of the apical vertebral body, alongside established metrics, to assess derotation outcomes and determine any significant differences between the two implant systems.

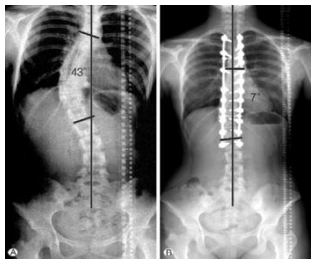

Figure 1 depicts AIS Lenke 1A Scoliotic curve with Cobb Angle of 43 degrees and subsequent correction with rod constructs (4)

METHODOLOGY

- Retrospecitve cohort of 60 female patients, aged 11-18years, with AIS Lenke 1A Scoliosis were selected. 30 patients had manually contoured implants with dual-innie system and 30 patients had pre-contoured implants with apical monoaxial screws.
- Pre- and post-operative erect PA and Lateral radiographs were analysed using Synapse 5 PACS Software
- Apical vertebral body were identified and a novel volumetric analysis was applied by measuring the projected vertebral body area on both PA and Lateral radiographs. Pre- and post-operative vertebral area ratios were calculated and the change in ratio quantified derotation and spinal correction.
- Secondary established metrics were also calculated and analysed.
- Data collected were analysed using independent samples t-test with corresponding effect sizes using IBM SPSS Version 29.

OBJECTIVES

- Using radiographic images, develop a novel volumetric analysis to assess derotation achieved in relation to the apical vertebrae and the spine.
- Incorporate established metrics such as Cobb Angles, Nash-Moe grading, and Rib Flare Distance (RFD) to quantify spinal correction and derotation.
- Determine if there are any significant differences between the two rod construct groups in each parameter.

RESULTS

Cobb Angles remain as the standard for quantifying scoliosis given its high reproducibility (5). Figure 2 demonstrates that patients receiving pre-contoured implants with apical monoaxial screws had significantly greater reduction in Cobb Angles (41.5° vs 33.9°, p=0.007) despite there being an insignificant pre-operative Cobb Angle between the two groups (67.6° vs 67.4°, p=0.951).

A negative change in the novel volumetric ratio indicates vertebral derotation as surgical correction reduces the PA/Lateral projected area. This metric demonstrated a non-significant trend favouring pre-contoured constructs (−0.24 ± 0.13 vs −0.20 ± 0.12, p=0.18) however Nash-Moe grading significantly improved in this group (0.90 ± 0.61 vs 0.70 ± 0.46, p=0.034), demonstrating a significant apical vertebral body derotation.

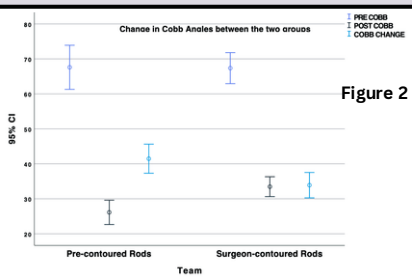

Figure 2

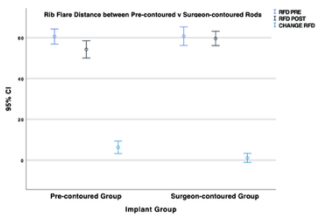

Figure 3

Figure 3 outlines that pre-operative Rib Flare Distance, shown by Figure 4, were insignificant between the two groups (60.5 vs 60.7 mm, p=0.95) however pre-contoured implants yielded significantly greater correction in rib symmetry (6.28 ± 8.18 vs 1.10 ± 5.88 mm, p=0.007). This had a moderate-to-large effect size (Cohen's d = 0.724), indicating a clinically meaningful advantage in thoracic correction for pre-contoured implants.

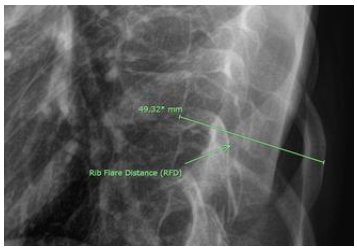

Figure 4

Screw density was significantly higher in the pre-contoured implant group (71.9% vs 64.1%, p=0.003) whereas Risser grade had shown no significant difference (p=0.297) though patients in the pre-contoured implant cohort were non-significantly less skeletally mature.

CONCLUSION

Pre-contoured rod constructs with apical monoaxial screws demonstrated significantly greater coronal and lateral correction compared to manually contoured dual-innie systems. Although the novel derotation metric showed a favourable but non-significant trend, established standard metrics consistently supported superior three-dimensional correction achieved with apical monoaxial screw based en masse correction. However, this group had insignificantly lower Risser grades and significantly higher screw densities which may have contributed to the stronger derotation observed. Despite this, the study's extensive use of established metrics and a large cohort supports the reproducibility and reliability of these findings. This study's findings also suggest that implant choice are crucial for achieving optimal derotation and deformity correction. Furthermore, it highlights the potential of using different radiographic metrics to guide future surgery. Going further, there are gaps for future research to evaluate how these implants perform in scoliosis of different Lenke classifications and different origins to improve best practices and deliver greater patient outcomes.

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