Vertebral Growth Modulation in the Porcine Scoliosis Model assessed by Computed Tomography: 3-D Effect of a Corrective Tether

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Introduction: In theory, vertebral growth modulation through a convexly placed tethering implant in the setting of scoliosis would lead to progressive vertebral correction in the coronal plane (Hueter-Volkmann Principle). Using an established Porcine Scoliosis Model, this study aims to investigate the impact of a non-fusion corrective anterior convex spinal tether on an induced deformity, examining detailed vertebral morphology and axial rotation.

Methods: This IACUC approved Study included 10 immature Yorkshire Pigs divided into 2 groups: tether release group (TR, n=5) and corrective tether group (CR, n=5). All animals underwent induction of scoliosis. Once >50° was noted on radiographic follow up a second surgical intervention was pursued: TR had release of the inducing tether; AC had tether release and placement of a corrective tether over the 5 apical vertebrae. Both groups were observed for 20 weeks, then euthanized. Fine cut CT scans were used to create a volumetric 3D reconstruction of the apex (3 vertebrae, 2 discs). Student T-test was used to evaluate differences between groups.

Results: Regarding absolute vertebral heights, no significant differences were observed between TR and AC in posterior and concave side vertebral body heights. However, significant reduction was found in anterior and convex side vertebral heights in AC; anterior: TR 8.9cm vs. AC 7.9cm (p<0.01) and convex: TR 9.8cm vs. AC 8.7cm (p<0.01). No significant difference was found in apical vertebral body volumes between TR 18.3cm³ and AC 17.7cm³, while the AC group presented bigger vertebral endplates: TR 5cm², AC 5.5cm² (p=0.01). A significant reduction in coronal wedging angle of 18° was found between TR 36.1° and AC 18.1° (p<0.01). A significant increase in sagittal kyphosis was observed over the apex: TR +6° and AC -9.6° (p=0.04). A 25% correction in apical rotation was achieved.

Conclusion: This study demonstrated that using an anterior tether, favorable growth modulation was possible without affecting the overall vertebral volume and led to a 3 plane correction of the scoliosis: correction of coronal Cobb, reduction of axial rotation, restoration of sagittal kyphosis.
Vertebral Body Height Differences: TR vs AC

Parameter
- Convex
- Concave

[Vertebral Body Height Differences: TR vs AC]