PREDICTION OF CURVE PROGRESSION IN AN IDIOPATHIC SCOLIOSIS MODEL BASED ON THE PERCENTAGE OF VERTEBRAL BODY WEDGING IN THE REGION OF MAXIMAL DEFORMITY

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Introduction

Approximately 2% of the world population have a lateral deviation in their spine which can be called scoliosis. However, only 10% of those affected actually will need treatment. Many people have curves which do not progress to significant enough magnitudes that require treatment, while other curves can even be self-corrective. Currently, prediction of the progression of a scoliotic curve is done through a fairly complex analysis of several factors, none of which provide distinct answers. Lonstein et al. have possibly provided the most common way of analyzing curve progression which looks at a number of factors such as: Cobb angle, age of patients, sex, and riser sign. Idiopathic scoliosis is commonly accompanied by wedging of the vertebral bodies and intervertebral discs. The purpose of this study was to predict curve progression in a goat idiopathic scoliosis model based on the percentage of vertebral body wedging in the region of maximal deformity. It was hypothesized that a greater percentage of vertebral body wedging would be seen in the progressive curves over the non-progressive ones.

Methods

Structural, lordoscoliotic curves of significant magnitude (≥ 30°) convex to the right in the thoracic spine were created in 15 immature goats using a rigid posterior asymmetric tether, in combination with convex rib resection and concave rib tethering. 2 At 12 weeks all posterior tethers were removed and the goats were observed for an additional 4 week period. Serial x-rays were used to document progression (defined as ≥ 5°) of curves and vertebral body wedging within the maximal scoliotic deformity. The data was analyzed using independent t-tests to check for statistical significance, with the level of significance set to $P < 0.05$.

Essential Results

During the 12 week tethering period all goats achieved a structural, lordoscoliotic curve of significant magnitude (mean: 53°, range: 30° - 76°). Additionally, all curves demonstrated characteristic radiographic features of scoliosis, including: significant displacement of apical vertebra from the midline, wedging of both the vertebral bodies and intervertebral discs, rotation of the posterior elements (average Nash-Moe II) and decreased flexibility. During the additional 4 week observation period following removal of the tether, 7 goats developed progressive curves (mean progression: +10.1°, range: +6° to +17°) and 8 goats developed non-progressive curves (mean: −1.6°, range: −8° to +4°). At the beginning of the observation period the percentage of vertebral body wedging was 60.4% versus 50.2% in the progressive versus non-progressive groups ($P = 0.002$). Thus, at 55.2% vertebral body wedging, prediction of curve progression was possible for 85% of progressors and 88% of non-progressors.

Discussion

The data from this study supported the hypothesis that a greater percentage of vertebral body wedging would be seen in progressive curves, compared to non-progressive ones. It is believed that once a certain threshold of vertebral body wedging is reached, the curve will ultimately begin to continually progress on its own. The results of this study may lead to a more specific indicator as to the progression of scoliotic curves as opposed to the more complex, multiple indices offered by Lonstein et al.

Prediction of curve progression is often difficult when based on skeletal maturity and curve magnitude alone. In an immature goat scoliosis model, however, in which these two factors are relatively well controlled, curve progression can be predicted based on the percentage of vertebral body wedging in the region of maximal deformity.

In the case of the experimental scoliosis model used, the 55.2% vertebral body wedging level appears to be the determining factor of whether or not a curve will progress. This wedging level may be different in the case of human idiopathic scoliosis, which would require further studies to be conducted using human clinical data comparing progressive and non-progressive curves to see if a different level of vertebral body wedging should be used for prediction.

References


Figure 1. Average percent bony wedging in non-progressive and progressive groups following removal of tether.

Figure 2. Goat 20 (left) having a 43° curve and 51.2 % bony wedging at removal of tether decreased in curvature by 8 over the next 4 weeks. Goat 50 (right) having a 44° curve and 60.2 % bony wedging at removal of tether increased in curvature by 17 over the next 4 weeks.