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Does the Law of Diminishing Returns Exist in EOS with Connective Tissue Disorders?

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Disclosures

 Research support: POSNA, FDA, NuVasive, DePuy Synthes Spine, Growing Spine Foundation, Children's Spine Foundation



Introduction

- Growth friendly rods (GFR) are effective in growing spinal lengths in deformity
- Law of diminishing returns (LoDR) is defined as a decrease in gain of coronal height over time
- Sankar et al. demonstrated the presence of LoDR in all- cause early onset scoliosis



- Little is known about whether this same phenomenon occurs in patients with lax connective tissue disorders (CTD)
 - Marfan
 - Ehlers Danlos (EDS)
 - Loeys Dietz (LDS).





Hypothesis

- Connective tissue properties may modify this phenomenon
- Patients with CTD undergoing Growth Friendly (GF) surgery may not have evidence of diminishing returns.





- Retrospective review of prospective registry
- Inclusion criteria
 - Patients with CTD
 - -<10 years old at initial surgery</p>
 - Minimum 5 year follow up
 - Distal and at least 1 proximal *spine* anchor
 - No self growing techniques



- 21 patients met inclusion criteria
 - 17 (81%) Marfan syndrome
 - -1 (5%) Ehlers Danlos Syndrome
 - -2 (10%) Loeys Dietz syndrome
 - -1 (5%) uncharacterized CTD



Patient Characteristics

- Mean follow-up was 8.4 years
- Mean preoperative Major Curve 77° ± 21°

 7 had definitive fusion, 7 had implants retained and 7 with continuing growing rod distraction

Mean age at final follow-up (definitive fusion) =12.5 years



Patient Characteristics

- Mean age at initial implantation was 4.9 + 2.9 years
- Mean T1- T12 at first preop visits was 175 + 33mm
- Total mean improvement in coronal height at final follow up, including implantation, was 102 <u>+</u> 48mm



- Radiographic parameters were assessed at pre-index surgery, post index and prior to every lengthening
 - T1 S1 Length
 - T1 T12 Length
 - Major curve angle
 - Kyphosis



- Outcomes of interest:
 - Difference in mean height gain during early- set distractions vs late- set distractions
 - Early set distractions defined as : D1 D6 and Late set distractions as D7 - D10
 - T1 S1 height gain per year (mm/year)
 - Example gain per year between 5th and 4th lengthening: [PreL5 (mm) – preL4 (mm) *365]/ Days between 5th and 4th lengthenings



- Paired sample t-test was performed
 - To determine difference in coronal height gained from early set distraction and late set distractions.
 - Only patients with radiographic data beyond 6 lengthenings were included in the analysis
- Analysis of variance (ANOVA) was performed
 - To determine difference in gain per year after each subsequent lengthening



Results

- Among patients with greater than 6 lengthenings:
 - The mean height change in late set distraction was 12mm greater than the mean height change in early set distraction (p=0.304)





Results

 When normalized for time, there was no significant difference in net gain per year at different lengthening time points (p=0.59)





Results

 14 (67%) of patients had >22cm T1 – T12 lengths at final follow up



Limitations

Retrospective nature

Sample size

Sagittal plane not considered



Conclusions

- Our results demonstrate that the LoDR is not see among patients with EOS and CTD.
- These results have implications for timing of GR surgery among patients with CTD.



Thank You !

