Paper #28

Induction of a Flexible Idiopathic-like Scoliosis with Axial Rotation Using a Dynamic Torsional Spring System: A Mini-pig Scoliosis Model

Sebastiaan Wijdicks, Justin Lemans, Gijsbertus Verkerke, Edsko Hekman, Rene Castelein, Moyo Kruyt

Summary: Scoliosis is a 3D deformity with a prominent torsional component. Therefore, a derotational force should be given to reduce it. To investigate the feasibility of a novel torsional implant that can (de)rotate the spine, we combined it with a tether in growing Göttingen minipigs to induce a 3D scoliosis. The scoliotic spines were analyzed for morphology.
Hypothesis: The addition of a torsional implant to a unilateral tether will result in a scoliosis that is morphologically more like idiopathic scoliosis than a scoliosis induced with a unilateral tether alone.
Introduction: The 3D morphology of scoliosis comprises a coronal deformation together with relative hypokyphosis and apical rotation. Current growing rods are capable of altering coronal and sagittal planes, but cannot provide correction in the axial plane. We developed a spinal implant that can revert axial rotation with a torsional spring (Figure 1). Since idiopathic scoliosis does not occur naturally in animals, the current study aims to test the devices; efficacy by creating the very deformity that it aims to reduce, i.e. an idiopathic-like curve with coronal deformity, relative anterior spinal overgrowth (RASO) and axial rotation
Methods: Scoliosis was induced in 10 male, 7 month old Göttingen minipigs. One group (N=5) received only a lateral tether spanning 8 vertebrae; T10-L3 (TO; tether only). The other group (N=5) was implanted with both a tether and a torsional spring implant fixed to the apex on the contralateral side (TR; tether-rotation). Major curve, lordosis, apical rotation, RASO and spinal growth were measured radiologically during the 12 week follow-up.
Results: Major curve increased during follow-up from 0.5° post-operatively to 15.7° at 12 weeks for the TO group and from 3.3° to 20.3° for the TR group (p=0.39). Lordosis increased from 2.2° to 13.0° for the TO group and from 0° to 10.3° for the TR group (p=0.68). Axial rotation increased from 1.2° to 2.9° in the TO group and from 7.6° to 19.3° for the TR group (p<0.01). Mean spinal growth at 12 weeks was 1.5cm for the TO group and 1.3cm for the TR group (p=0.22). The TR group showed a larger increase in RASO during follow-up (-2.0% to 0.3%) compared to the TO group (-0.5% to 0.2%) (p<0.01).
Conclusion: A torsional, non-fusion device added to a contralateral tether induces a flexible scoliosis in Göttingen minipigs that is morphologically similar to idiopathic scoliosis. This shows the potential of (de)rotational forces on the growing spine.
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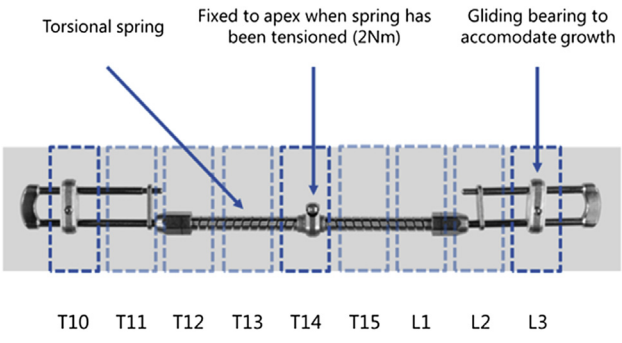

Paper #29

Lung Function before and after Spine fusion in Children with EOS Treated Previously with Distraction-based Devices

Gregory Redding, Noriaki Kawakami, Hiroko Matsumoto, Vivana Bompadre, Walter Krengel III, Klane White

Summary: Average FVC% did not change for two cohorts of children with EOS after spine fusion. However, 21% improved >8% FVC% and 47% declined by >8% after spine fusion. Outcomes differed signficantly for different etiologies of EOS. Evaluating outcomes by thresholds of change (+/-8% FVC%) identified patients with EOS likely to Improve and/or at risk to decline after spine fusion.
Hypothesis: Different etiologies for EOS among children previously treated with distraction-based devices is associated with different lung function changes following spine fusion.
Introduction: Pulmonary function changes before and after spine fusion have not been described in children with EOS previously treated with distraction-based devices.
Methods: We reviewed spirometry results of children with EOS from 2 centers to determine the average change in lung functions (paired t-test) and the proportion of children who experienced a significant change (>8% differences in Forced Vital Capacity as a % of normal (FVC%) for better or worse after spine fusion. We also compared the proportions of children who improved or worsened according to C-EOS etiologies of EOS. (Chi square test)
Results: 55 children from Meijo Hospital and 23 children from Seattle Children's Hospital received spine fusion after previous treatment with distraction-based devices EOS. Thirty two and 15 patients respectively underwent spirometry before and 1+/- .5 years after spine fusion. The mean pre-operative values for FVC% for the two groups were 56.9+/-2.6% and 52.7+/-5.1% The mean FVC% for each cohort after fusion, 47.2+/-3% and 56.7+/-6.1% ,were not significantly different from pre-op values. (p = .22 and .06) Ten of 47 (23%) children had a >8% improvement in FVC% and 22/47 (45%) had a >8% decline after fusion. By etiology: 2 of 25 (8%) congenital EOS improved and 15/25 (60%) worsen; 5/12 (45%) neuromuscular ESO improved and 6/12 (50%) worsened; 1/6 (17%) syndromic improved and 1/6 (17%)worsened. The outcomes based on etiology were significantly different by Chi-square analysis, p=.006)
Conclusion: Mean values of FVC% before and after spine fusion do not adequately describe the likelihood of improvement or worsening after spine fusion in children with EOS previously treated with distraction-based devices. Etiologies for EOS are associated with different proportions of patients who improve or worsen after spine fusion.
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Paper #30

Is Performing a Definitive Fusion for Scoliosis in Juvenile Cerebral Palsy Patients a Good Long-term Surgical Option?

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Summary: Performing a definitive fusion in skeletally immature patients with cerebral palsy (CP) results in improved coronal deformity, pelvic obliquity, and CPCHILD outcomes scores that remain stable at the 5-year mark.
Hypothesis: Postoperative curve correction will be maintained at 5-year follow-up without major adverse outcomes in skeletally immature CP patients who undergo definitive fusion.
Introduction: Progressive scoliosis in skeletally immature patient with cerebral palsy (CP) presents a unique challenge as it requires the surgeon