Impact of In-Vivo Rotational Device in the Growth Modulation of Rat Tail

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Introduction

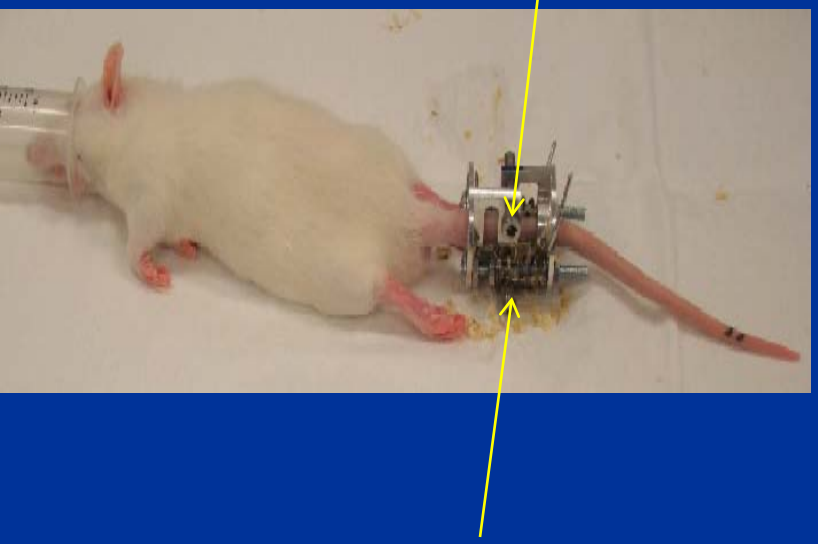
- Numerous studies have been done to evaluate the impact of sustained compression-tension loading on spinal growth for early onset of scoliosis.[1]
- Only an in-vitro study has been conducted in the examination of the impact of a rotational device (RD) on growth.[2]

Purpose

The goals of this study were to:

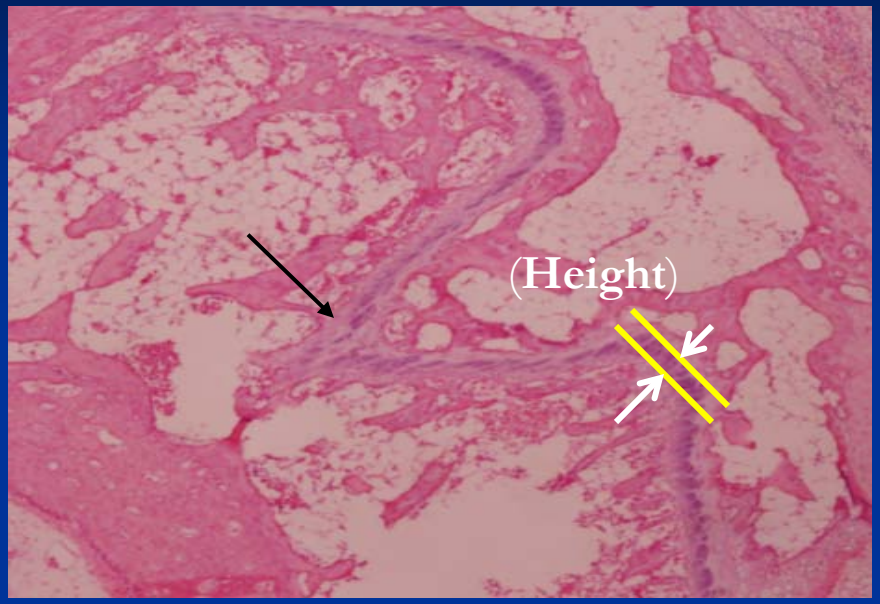
- 1) design an in-vivo rotational device (RD) for application of controlled torque and axial compressions to rat-tails;
- 2) determine the histological changes of the caudal vertebrae due to the torsional load.

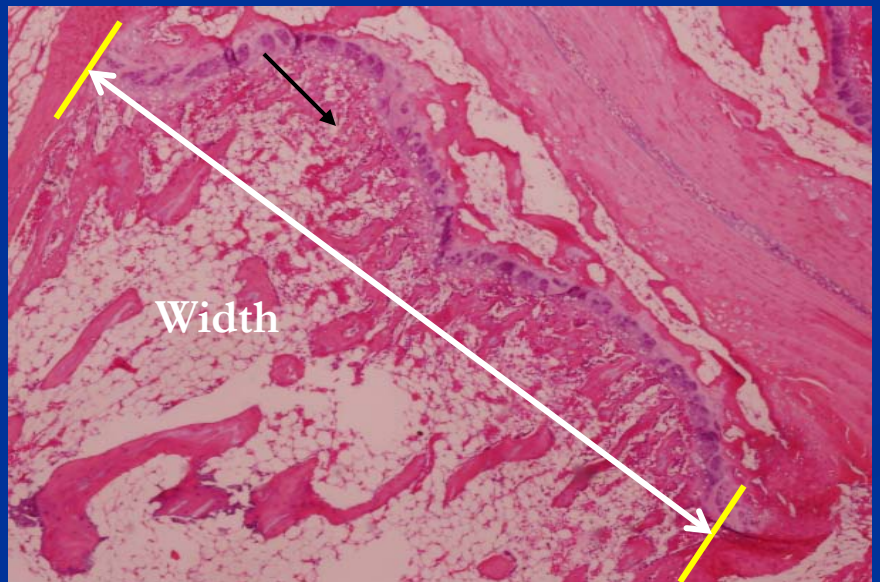
Methods



- The RD were implanted in six 5-week-old male Sprague-Dawley rats. Three rats served as a sham group and remaining three rats received a torque of 1.024 N·m and a bending moment of 0.106 N·m.
- Histomorphometry of the disc, vertebral body and growth plate were analyzed after sacrifice of the rats at 3.5 week growth.

Results





- The morphology of the growth plate is more curved in torque-induced rat (Top: angled physis, increased height, and reduced width), while flat in the sham rat (Bottom: more horizontal line of physis).

Results

- The rotational device leads to a 18% reduction of the width of the physis in the coronal plane as compared to sham at 2 weeks, and 29% reduction of the width of the physis at 3.5 weeks.
- The results also show that the growth plate height (increase of 86% to 111%) is much greater in the torque group.

Results

The average caudal vertebral body height, disc space, and growth plate height and width in left, medial and right region (n=5,mean)

Parameter (mm)	Left		Mid		Right	
	Torque	Sham	Torque	Sham	Torque	Sham
Vertebral height	6.46	5.60	6.79	5.71	6.39	5.51
Disc space	1.11	0.67	0.47	0.55	1.15	0.74
Physis height	0.19	0.09	0.19	0.04	0.26	0.14
Physis width	0.57	0.54	1.98	1.98	0.47	0.73

Conclusion

- Increased height in the growth plate as affected by the rotational device was found during growth of the caudal vertebral bodies.
- The physis developed an undulating appearance.
- This study has limited animal samples in a short-term follow up.

Reference

1. Stokes I.A., Burwell, RG, and Dangerfield, PH., 2006, "Biomechanical Spinal Growth Modulation and Progressive Adolescent Scoliosis," Scoliosis, Vol. I, pp. 16-25.

2. Rizza, R., Liu, X.C. Mahinfalah, M., Wang, Y., Thometz, J., Lyon, R., and Tassone, C. "An in-Vitro Experiment to study sustained torque on the ox Spine," ASME 2009 Summer Bioengineering Conference. June 17-21 Lake Tahoe, CA.