Effect of posterior distraction forces on anterior intradiscal pressure in dual Growing Rod technique

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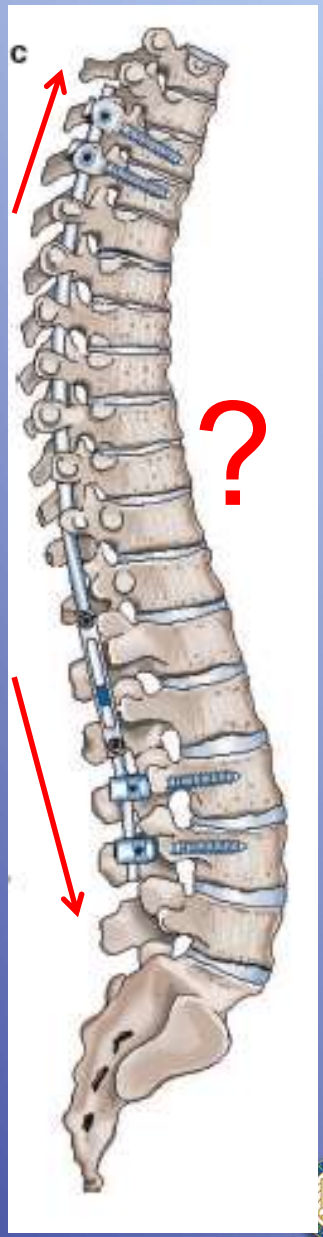
Background

It is theoretically possible that distraction maneuvers used in GR surgery:

- Produce a focal kyphogenic force
- Affects only one vertebral segment rather than multiple ones.
- Influences the growth of the spine



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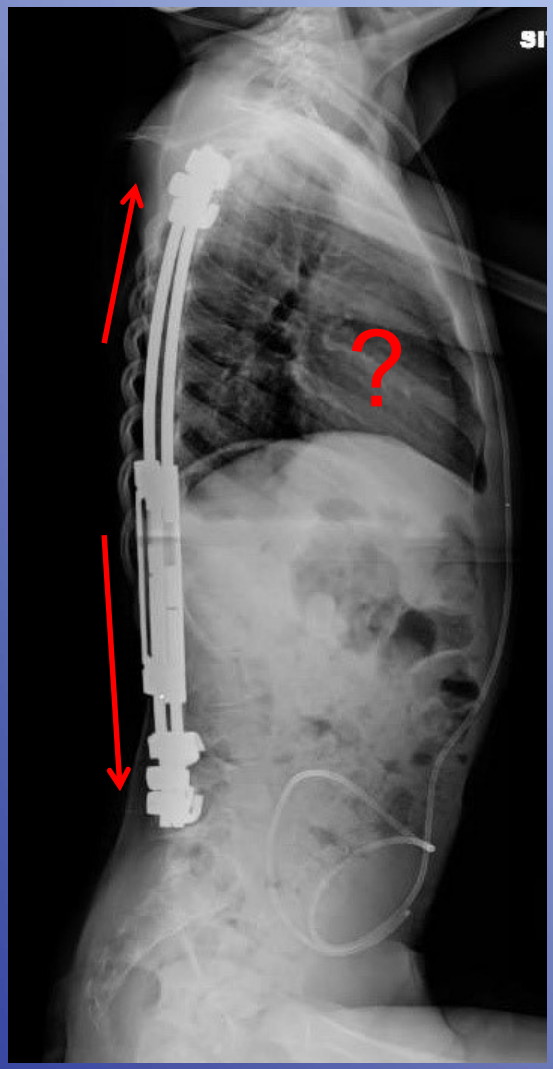
Purpose- Research questions

- Are the posteriorly applied distractive forces transmitted anteriorly in a distractive or compressive mode?

- How will they affect the anterior intradiscal pressure during growing rod surgery?



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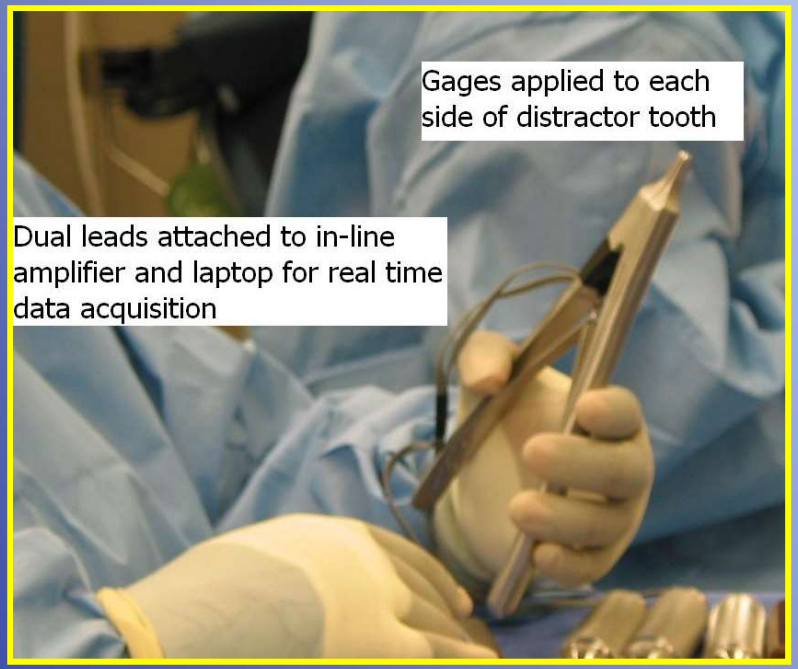
Materials and methods

- Six immature porcine spines were harvested with soft tissues and rib heads attached
- Upper foundation (T3-T4) was instrumented with 4.75 mm screws in 3 and with laminar hooks in the other 3
- Lower foundation (L3-L4) was instrumented with 4.75 mm screws in all 6

Materials and methods

- A distractor was instrumented with strain gauges and calibrated to calculate distraction forces
- One pressure sensor was inserted into the intradiscal space just inferior to the upper foundation (T3-T4) and one was inserted into the space midway between the upper and lower foundations



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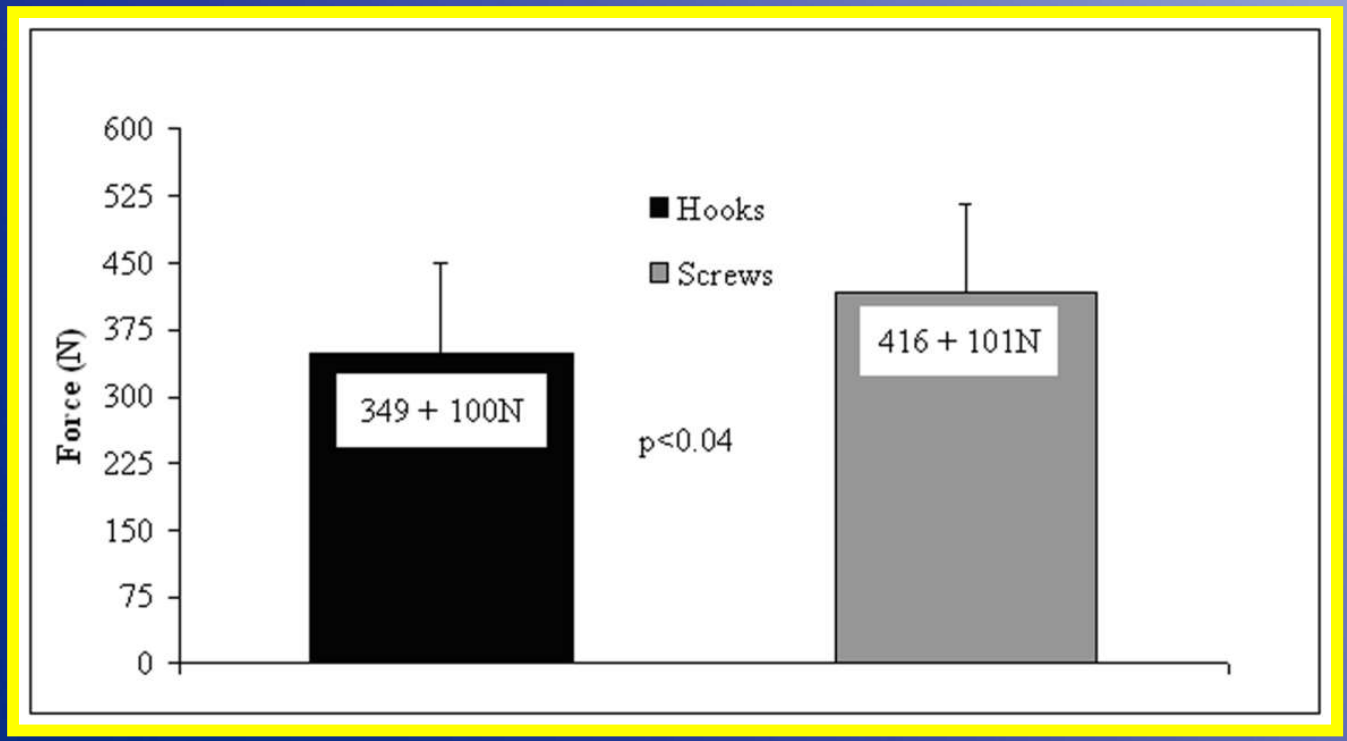
Results

- Distraction with screw-anchor upper foundation (416 ± 101 N) produced significantly higher distractive forces compared to hook-anchor model (349 ± 100 N).



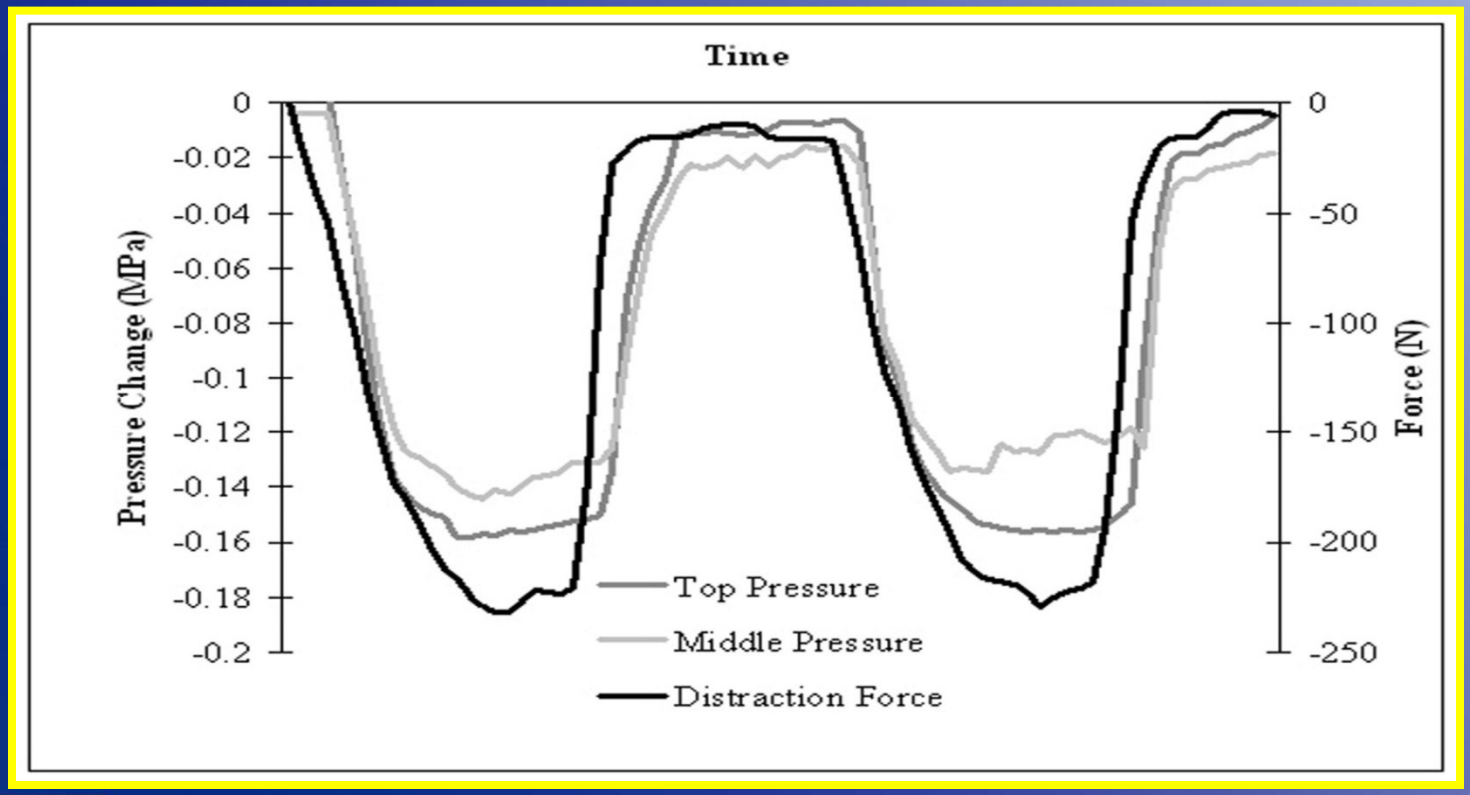
Results

There were no significant differences in disc pressure between levels or between different upper foundation constructs

	ADJACENT PRESSURE		MIDDLE PRESSURE	
	Hooks	Screws	Hooks	Screws
Mean	0.183	0.194	0.161	0.173
SD	0.098	0.062	0.065	0.083

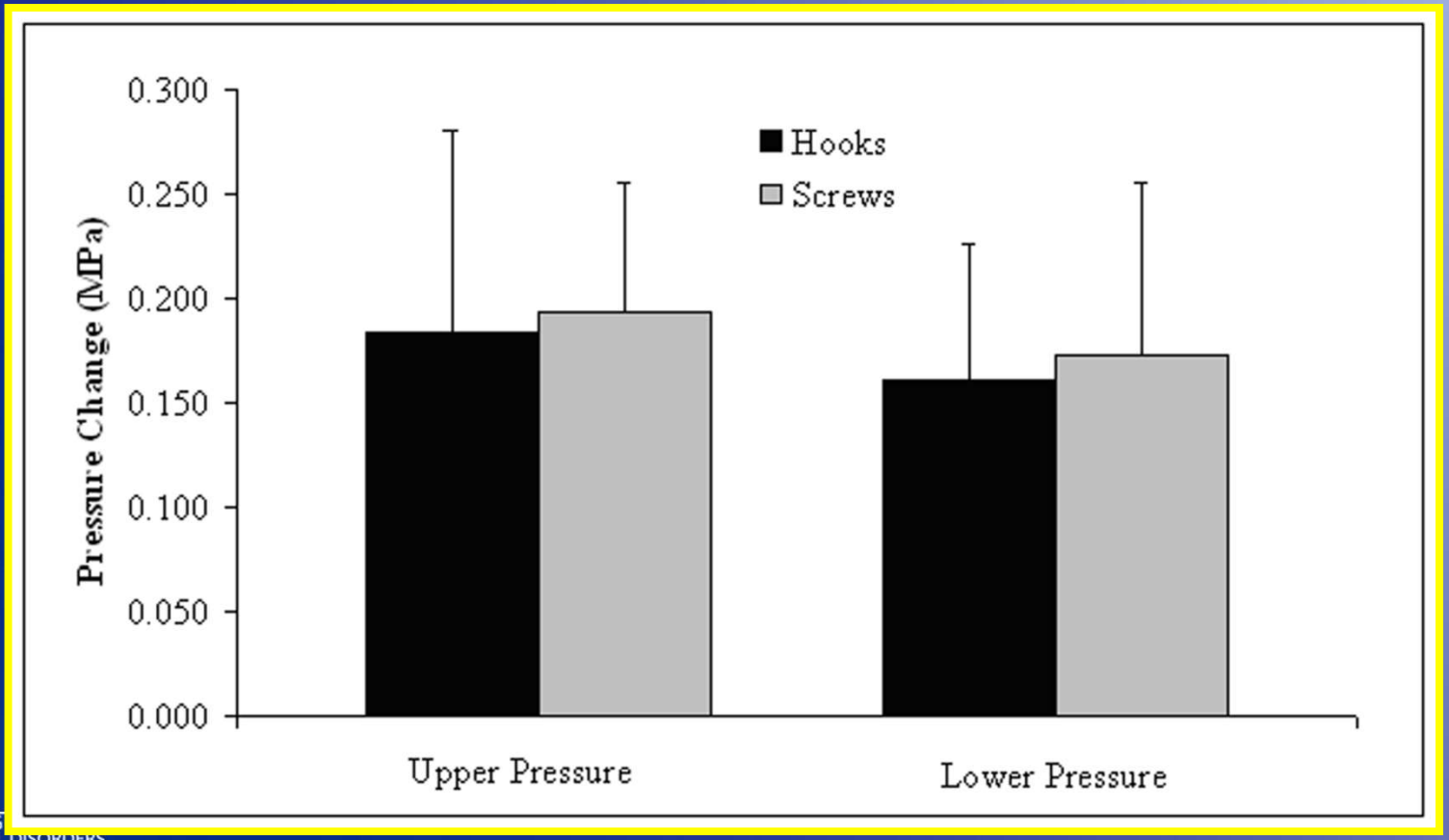
Results

- Intradiscal pressure adjacent to upper foundation consistently had greater reduction than the level equidistant within the construct



Results

Distraction performed with pedicle screw construct consistently demonstrated greater reduction in disc pressure compared to laminar construct.

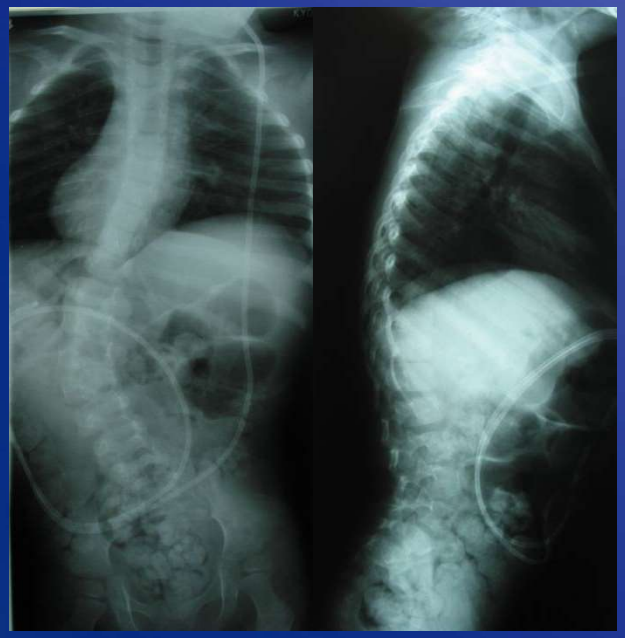


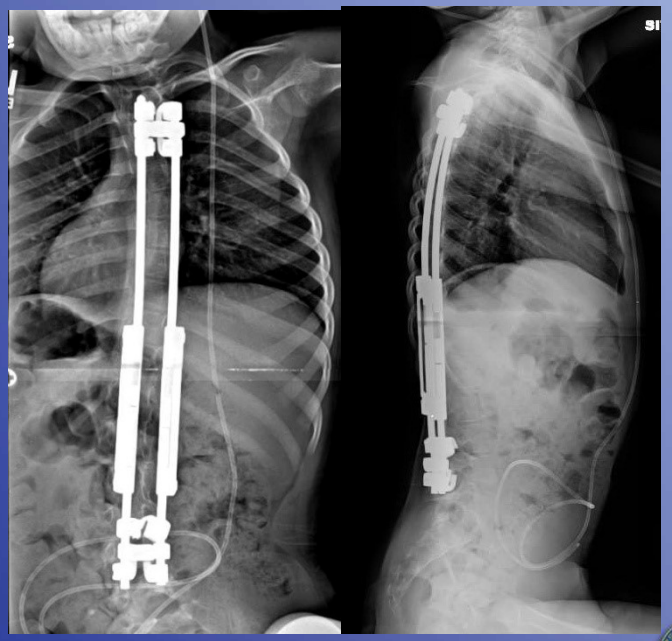
Discussion

- More posterior location and more freedom of movement during distraction might be one explanation for the lower pressures recorded in hook vs pedicle constructs
- Applying a stronger distractive force via screw-anchor constructs resulted in more distraction (end plate separation) throughout the spine

Discussion

- Possible iatrogenic canal stenosis due to neurocentral cartilage injury with pedicle screws should be weighed against controlling severely progressing curves in some very young syndromic cases.





Limitations

- This animal model does not replicate the in vivo sagittal profile of the EOS patient population
- No coronal plane deformity existed in this model
- Connective tissue of the animal may be different compared to human
- Adult spine, if attainable at all, would be different from children in terms of dimension and degenerative changes due to aging

Conclusion

- In the dual growing rod technique:
  - posterior distraction forces are transmitted as distractive forces to anterior column as evidenced by reduction in intra-discal pressure at two spinal levels.
  - posterior distraction forces are distributed at multiple levels rather than delivered to the disc immediately adjacent to the foundation

Conclusion

- The distribution of loads at multiple levels may assist with curve control and may also affect the vertebral growth as well as maintaining sagittal alignment

Thank You

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