



Force Variability in a Classic Distraction Technique

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Introduction

Given the advent of the magnetically controlled growing rod (MCGR) and how much force we know it delivers onto the spine, understanding what the older systems impart on anatomy is critical to further technology advancements.¹ Nordeen reported on the traditional growing rod (TGR) in vivo and Sankar taught us about the increasing force requirement/law of diminishing returns.^{2,3} Knowledge of the forces imparted by the Vertical Expandable Prosthetic Titanium Rib (VEPTR) by different surgeons will help us advance remote lengthening technology.

Methods

Six surgeons performed an expansion on four different VEPTR constructs (pelvis to rib, spine to rib, pelvis to spine, and spine to spine) that had been previously inserted into cadavers. They approximated the amount of force they would apply during a standard expansion operation. A strain gauge adhered to the distraction tool wired to a strain indicator and recording device was used to collect data and was zeroed after every measurement. All data were withheld from the surgeons during the expansions as to not influence their applied force. A compression spring acted as a conversion tool to convert the strain to pounds. The data was converted to Newtons, graphed (Figure 1), and averages and relative standard deviations were calculated.

Results

The average force applied across all constructs was 321N with a relative standard deviation of

approximately 11% (36N). Of the four different constructs, the spine to spine was the only construct that on average required over one standard deviation less force than the average (270N). This seems to be due to only five of the surgeons performing on the construct. When compared to the average of only surgeons who performed on it (272N), it fell well within one standard deviation. Amongst the six surgeons, each maintained a force standard deviation of 5% to 20% between constructs, though trends can be seen indicating different constructs requiring different amounts of force. Five of the surgeons used a single hand technique while one of the surgeons, the most experienced one, used a second hand.

Conclusion

The prosthetic rib construct expansion in cadaveric specimens imparts on average 320N of force per surgeon with surgeon experience playing some role in the amount force accepted during a lengthening procedure. Construct design does appear to play a role in forces imparted to the deformity.

References

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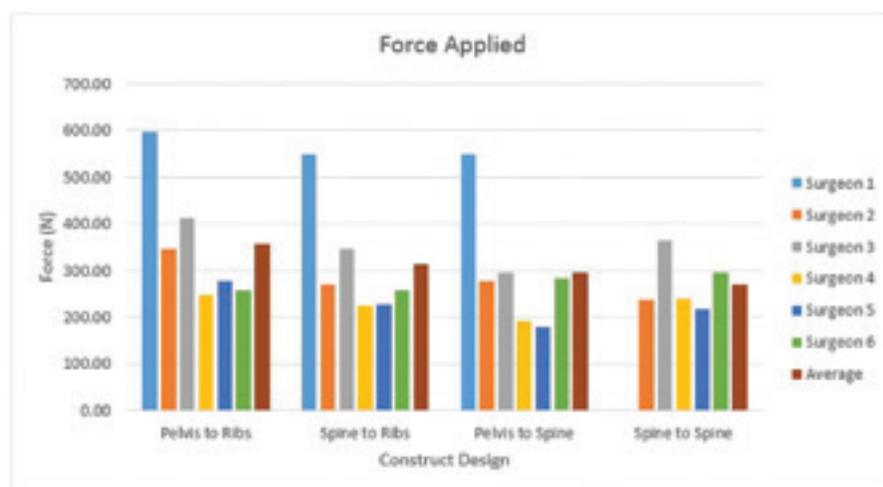


Figure 1. Various forces recorded by 6 spine surgeons on 4 different prosthetic rib constructs during an expansion operation.