Reduced Rate of Proximal Junctional Fractures Above Long Instrumented Constructs Utilizing a Tapered Dose of Vertebral Cement – A Biomechanical Study

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Disclosures

- Consultant – DePuy Synthes Spine, Biomet, Amendia, Innovative Surgical Solutions, Safe Wire
- Royalties – Biomet
Introduction

- PJK is not uncommon and can result in significant complication after spinal deformity surgery.
- Risk factors include increased mechanical stress at the proximal junction due to the transition of a fixed to a mobile spine segment, along with osteoporosis.
Hypothesis

- Prophylactic vertebroplasty has been advocated to reduce PJK but cementation results in the translation of stress cranial to the cemented “super-vertebra” that is created.
- We utilized a tapered dose of cement in T10, T9, and T8 to reduce junctional stress and the rate of proximal junctional fractures.
Methods

- Fifteen ligamentous, osteoporotic T6-pelvis specimens with screw/rod instrumentation from T10-S1 were divided equally into 3 Groups.
  - Group 1 - No cement
  - Group 2 - 4cc of cement in T10 and 4cc in T9 (2cc through each pedicle)
  - Group 3 - 4cc of cement in T10 (UIV), 3cc total in T9 (UIV + 1), and 2cc in T8 (UIV +2)
Methods

• The pelvis and T6 vertebra were potted and compression was applied 10mm anterior to the center of T6 using an MTS actuator.

• Maximum load to failure was measured in newtons (N).

• The spines were evaluated using fluoroscopy and CT.
Results

- There was a significant reduction in fractures in Group 3 vs 2 and 1 (0 vs 5 vs 5, p=0.0019, respectively).

- Posterior ligamentous rupture occurred in 4 specimens in Group 3; 3 in Group 2; and 1 in Group 1.

- The mean peak load-to-failure values showed an increasing trend from Groups 1 to 3 (p=0.38).
Results

- There was no difference in specimen DEXA values (p=0.71).
- There was no hardware failure in any Group.
- Finite element analysis (FEA) mirrored the cadaveric data and the maximum load to failure increased from Groups 1 to 3.
- Endplate stresses were reduced in Group 3 vs 2 and 1.
Conclusion

- In both cadaveric and FEA models, tapering the dose of cement in the UIV, UIV + 1, UIV + 2 (Group 3) decreased endplate stresses, increased the load required for failure, and significantly reduced vertebral fractures above long instrumented constructs.

- This technique may protect the spine from PJK due to fracture, but may increase the risk of posterior ligamentous failure.
Conclusion

- Further clinical analysis is required.
Thank you