A Dual Screw Technique for Vertebral Compression Fractures Using Robotic Navigation in the Osteopenic Lumbar Spine

An In-Vitro Biomechanical Analysis

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Disclosures:

• M.P.S.
  – Grants/Research Support: Globus Medical, Inc.
  – Consulting Fees: Globus Medical, Inc.; Intellirod
  – Speakers’ Bureau: Globus Medical, Inc.
  – Royalty/Patent Holder: Zimmer/Biomet; Elsevier; Theime

• J.B.B.
  – None

• C.A.W.
  – Grants/Research Support: Globus Medical, Inc.

• J.R.R.; J.A.H.; M.M.H.; B.J.F.; B.S.B.
  – Salary: Globus Medical, Inc.
**Objective:** To quantify the in-vitro stability of the novel technique utilizing both cortical screws (CS) and pedicle screws (PS) in the same vertebral level using a robotic-assisted guidance system to improve posterior fixation in patients with severe osteopenia and VCF.

**Experimental Endpoints:**
- Flexion-Extension ROM
- Lateral Bending ROM
- Axial Rotation ROM
Methods: Vertebral Compression Fracture

- Holes were created at L3 using a 1/8” drill bit
  - Weakened cortical shell
  - Allowed for controlled burst fracture

- Custom-built drop tower guided the axial load onto specimen
  - Produced complete destabilization of the vertebral body
  - 45 lb. circular weight was dropped on the vertically mounted specimen
Methods: Surgical Technique

Technique:

• Pedicle screws were inserted using a Weinstein converging trajectory.
• Cortical screws were inserted using the modified “straight ahead” cortical screw trajectory.
• Screws were planned using robotic-guidance in specimens pre-selected to accommodate 2 screws per pedicle.

Axial radiograph: L4 vertebral body, PS+CS group
Methods: Constructs

2 Groups  \( n=7 \)/group  Total \( n=14 \)

PS Group

PS + CS Group

PS 2-Rod

PS 4-Rod

RTRC

PS + CS 2-Rod

PS + CS 4-Rod
Methods: Constructs

2 Groups  n=7/group  Total n=14

PS Group
- PS 2-Rod
- PS 4-Rod RTRC

PS+CS Group
- PS + CS 2-Rod
- PS + CS 4-Rod
Methods: ROM

ROM
- Intact Condition
- Pedicle Screw (PS)
  - Two Rod vs. Four Rod
- Pedicle Screw + Cortical Screw (PS+CS)
  - Two Rod vs. Four Rod

Test
- Flexion-Extension (FE)
- Lateral Bending (LB)
- Axial Rotation (AR)

Parameters
- Max Torque: ± 7.5 N-m
- Markers at L1, L2, L4, L5
- VCF at L3
Results: ROM

*R vs. Intact (*p < 0.05)
Conclusions

• Multi-rod reconstruction increased stability, regardless of single or dual screw technique in all loading-modes.
• 4-rod reconstruction with dual screws provided the most fixation in FE and AR, with the additional bony anchor points adding stability as compared to compared to 2-rods with rod-to-rod connectors; however statistical significance was not achieved.
• Further testing regarding long-term performance of instrumentation may further elucidate construct differences.