Power-Assisted Versus Manual Pedicle Screw Tract Preparation: Safe Use and Proprioception

Amy A. Claeson PhD[1], Frank J. Schwab MD[2], Anup A. Gandhi PhD[3], David L. Skaggs, MD MMM[4]
1. Highridge Medical, Westminster, CO 2. Northwell Heath, New York, NY 3. Zimmer Biomet Spine, Westminster, CO 4. Cedars-Sinai Guerin Children's, Los Angeles, CA

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Introduction

Compare manual versus power-assisted techniques of pedicle screw tract preparation by qualitative evaluation of surgeon feedback and quantitative evaluation of incidence of pedicle screw breach using a cadaver model in a simulated surgical environment.

Materials and Methods:

Pedicle preparation and screw insertion were performed by four spine surgeons, three new to power-assisted technique, using four cadaver torsos exposed posteriorly from T1-Sac using standard technique. Pedicles were prepared using both manual and power-assisted technique, all screws were placed with power.

Power-Assisted Pedicle Preparation with Vital™ Power and Zimmer® Universal Power System

- Flexible Pilot Drill (Ø2.4 mm) or Standard Drill (Ø2.0 mm): Develop pedicle tract
- Blunt-Tip Reamer Probe (Ø3.2 mm): Dilate pedicle tract, compact adjacent cancellous bone
- Dual and Single Trigger Handpiece

Manual Pedicle Preparation Technique with Vitality® Instrumentation

- Lenke probe: Develop pedicle tract
- Tap: Dilate pedicle tract, cut threads

Procedure

- Pedicles of thoracolumbar vertebrae (T1-L5) were prepped bilaterally using either manual (n=58 pedicles) or power-assisted (n=58 pedicles) technique
- All pedicle screws (Vitality Ø5.5 mm Polyaxial)* were placed with power using a driver connected to either the dual or single trigger handpiece
- Surgeons provided retrospective procedural comments

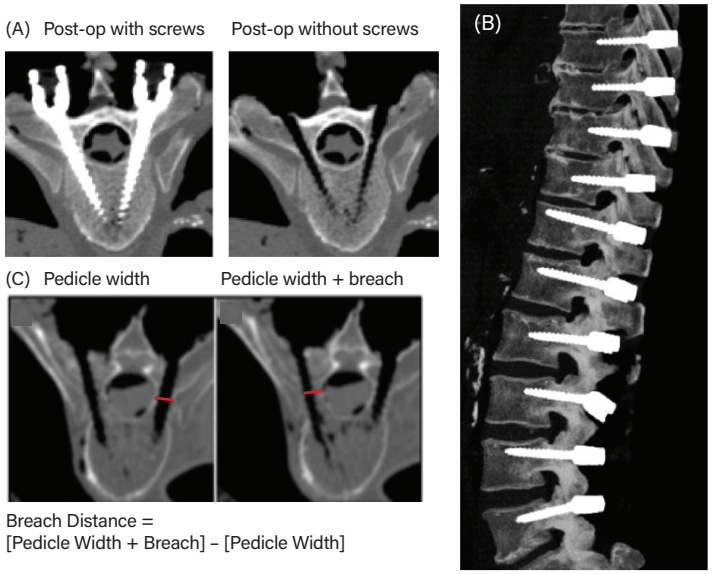

Figure 1. CT images show techniques for assessing incidence of (A) axial and (B) sagittal plane screw breach and (C) measuring breach distance.

Data Analyses

- Surgeon feedback was compiled
- Pedicle screw breach incidence and breach distance were quantitatively assessed by blinded research engineers via post-op CT scans (Figure 1)

Statistical Analyses

- Pedicle screw breach rate was compared with Fisher's exact test
- Pedicle screw breach distance was compared with Mann-Whitney's rank test
- Binomial confidence intervals for medial pedicle screw breach rates were calculated with Wilson score intervals
- Significance for all statistical tests set to $p<0.05$

**Pedicle screws of the Vital™ Spinal Fixation System and the Vitality® Spinal Fixation System share the same dual-lead thread form.*

Results

Power-assisted pedicle preparation:

- Affords superior tactile feedback
  - All surgeons reported greater proprioceptive sensation compared to the Lenke probe
  - Zero complications were reported in either preparation or screw placement
  - 100% of screws followed their prepared pedicle tracts as confirmed by CT images
- Significantly reduces overall breach rate ($p<0.05$, Figure 2)
  - Power-assisted: 3.4% [2/58]
  - Manual: 20% [12/58]
- Significantly reduces lateral breach rate ($p<0.05$, Figure 2)
  - Power-assisted: 3.4% [2/58]
    - Both in the thoracic spine in the "in-out-in" trajectory, screw tip within the vertebral body
  - Manual: 15.5% [9/58]
- Has no effect on breach distance ($p>0.05$, Figure 3)
  - Power-assisted: 2.7±0.9 mm [2.0-3.3 mm]
  - Manual: 2.6±1.8 mm [0.3-5.3 mm]

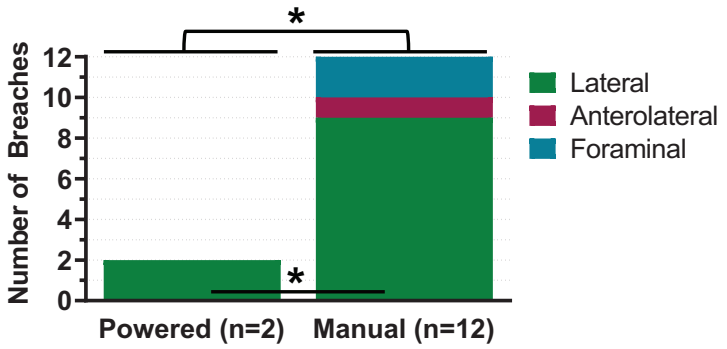

*Figure 2. Power-assisted pedicle preparation resulted in significantly fewer overall and lateral breaches [2/58]. Significance *: p<0.05*

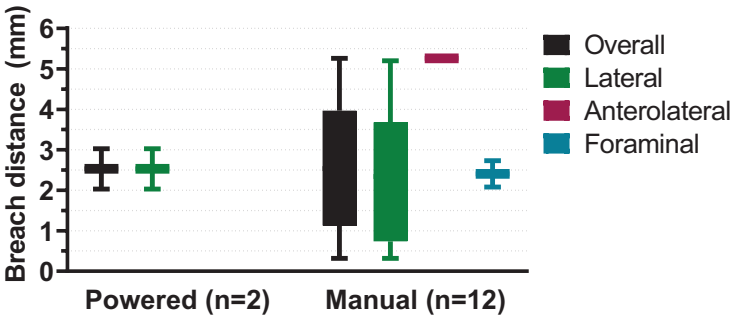

*Figure 3. Breach distance was not significantly different between the two techniques. Error bars denote standard deviation. Significance *: p<0.05*

CONCLUSION

Compared to manual technique, power-assisted pedicle preparation and screw placement technique affords superior proprioceptive feedback, and fewer pedicle screws violated the pedicle cortex.

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