

## Is Intramedullary Screw Fixation Biomechanically Superior to Locking Plate Fixation or Tension-Band Wiring in Transverse Olecranon Fractures?

### A Cadaveric Biomechanical Comparison Study

*Alexander Hahn, MD; Nathan N. O'Hara; Kyung Koh, PhD; Li-Qun Zhang, PhD; Robert V. O'Toole, MD; W. Andrew Eglseder, MD*

*University of Maryland School of Medicine, Baltimore, MD, United States*

**Purpose:** Controversy exists regarding the best fixation of transverse olecranon fractures with advocates for 3 techniques: (1) tension-band wire, (2) locking plate, or (3) intramedullary (IM) screw. These implants and techniques vary in cost and hardware removal rate; however, little work has compared their ability to compress the fracture gap or survive cyclic loading. The purpose of this study was to compare clinically important mechanical properties in a realistic loading protocol.

**Methods:** This study used a fresh-frozen cadaveric transverse olecranon fracture model (n = 18 paired arms, average age: 72 years). Fractures were fixed using standard surgical technique by a resident surgeon under direction of the senior author with a 6.5-mm cancellous screw (IM screw), a Synthes 2.7/3.5-mm VA-LCP olecranon plate (locking plate), or IM 0.062 Kirschner wires and an 18-gauge steel wire (tension band). The primary outcome measure was peak compression at the fracture measured by a sensor (Tekscan). The secondary outcome measure was percent failure after potted samples were loaded through the triceps tendon with a custom linear loading device for 500 cycles of 0-500 N at 1 Hz to simulate the force of pushing up from a chair. Differences in mean compression among techniques were compared with analysis (unadjusted) and a multivariable regression model that adjusted for testing order, age, sex, and DEXA (dual-energy x-ray absorptiometry) T-score of samples. A  $\chi^2$  test compared the frequency of implant failure among techniques.

**Results:** There was no difference ( $P = 0.89$ ) in mean compression across the fracture between IM screw (mean: 162 N, 95% confidence interval [CI]: 27-297 N), locking plate (mean: 125 N, 95% CI: -9-260 N), and tension band (mean: 163 N, 95% CI: 29-298 N). Similarly, no difference in mean compression was seen between techniques in the adjusted analysis ( $P = 0.82$ ). However, during cyclic loading, 100% of tension-band constructs failed due to implant failure with fracture gap displacement compared to 0% implant failure with either IM screw or locking plate ( $P < 0.01$ ).

**Conclusion:** We found no evidence of differences in compression of the fracture site between 3 techniques in cadaveric bone. This contradicts a prior Sawbones study showing greater compression with locking plate versus tension band. No previous study has reported IM screw compression, and we found no advantage in compression. However, this study demonstrated a higher risk of implant failure with tension band compared to the other methods during cyclic loading. These biomechanical data, in addition to the relatively low cost of IM screw compared to locking plate, may argue for clinical benefit of IM screw in treating transverse olecranon fractures.