

Biomechanical Testing of a Tension Plate for Olecranon Fractures

A. Spiegel, PhD; J. Schonhardt; N. Pochlatko; T. Glanzmann
Medartis AG, Basel, Switzerland

Introduction

Olecranon fractures with interfragmentary support (or osteotomies) are usually treated by tension band (TB) wiring [1]. This method presents some disadvantages though as soft tissue problems have been reported [2]. Medartis has therefore developed an olecranon tension (OT) plate that offers more stability while potentially preventing soft tissue irritation. A biomechanical fatigue test setup was developed to compare this OT plate with the traditional TB wiring.

Method and Materials

A 3D ulna CAD model (Sawbones) was used to obtain anatomically correct fixtures featuring a fracture with interfragmentary support. Fixtures were manufactured in glass fiber reinforced PA using rapid prototyping techniques.

2 groups of 6 constructs were tested (Figure 1):

- TB wire: K-wire (1.6 mm) and cerclage wire (1.2 mm)
- OT plate: APTUS TriLock Olecranon Tension Plate (A-4856.01) with 2.8 mm cortical and TriLock screws (A-5800.xx and A-5850.xx) from Medartis

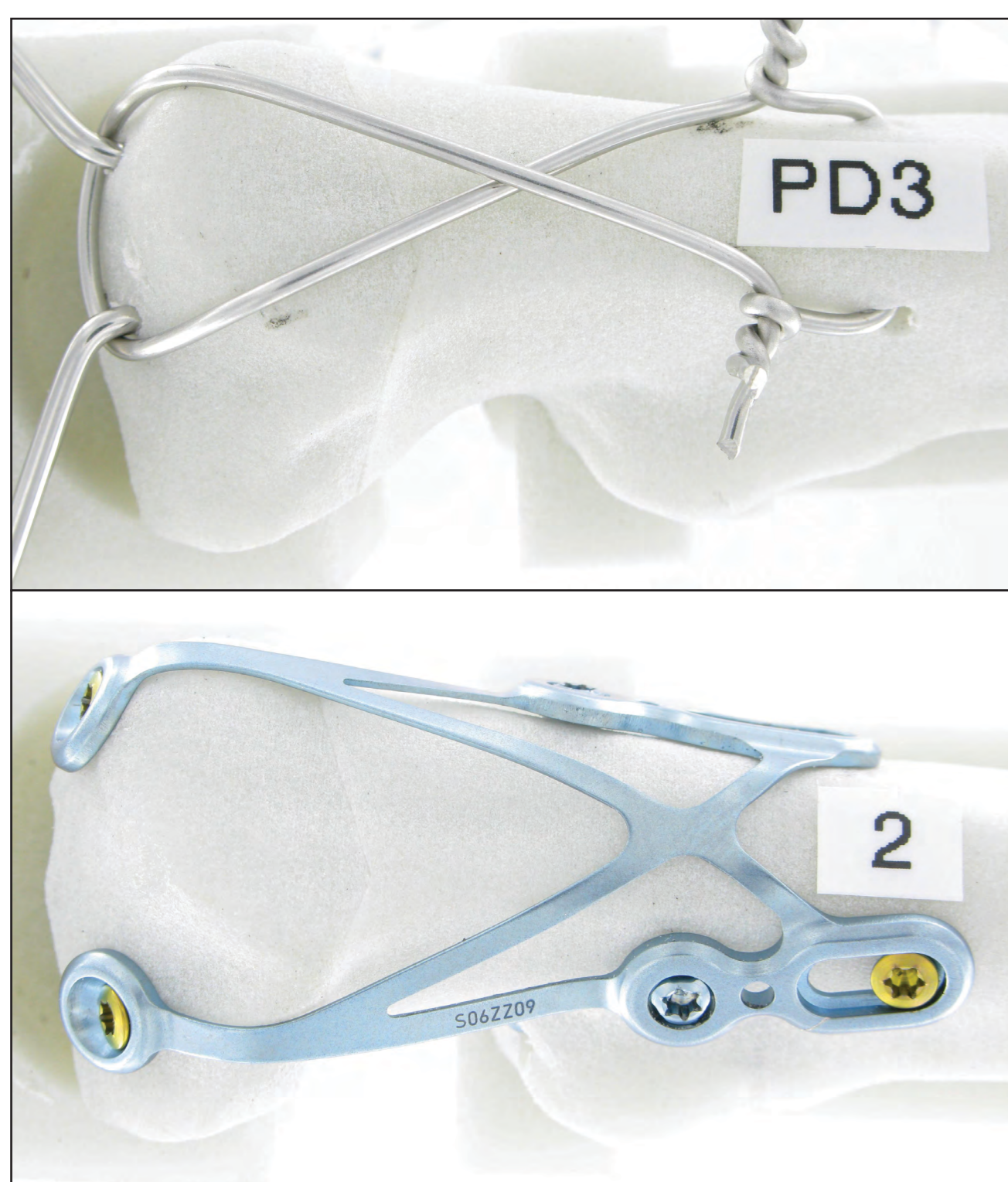


Figure 1: Mounted Samples; Top: TB Wire, Bottom: OT Plate

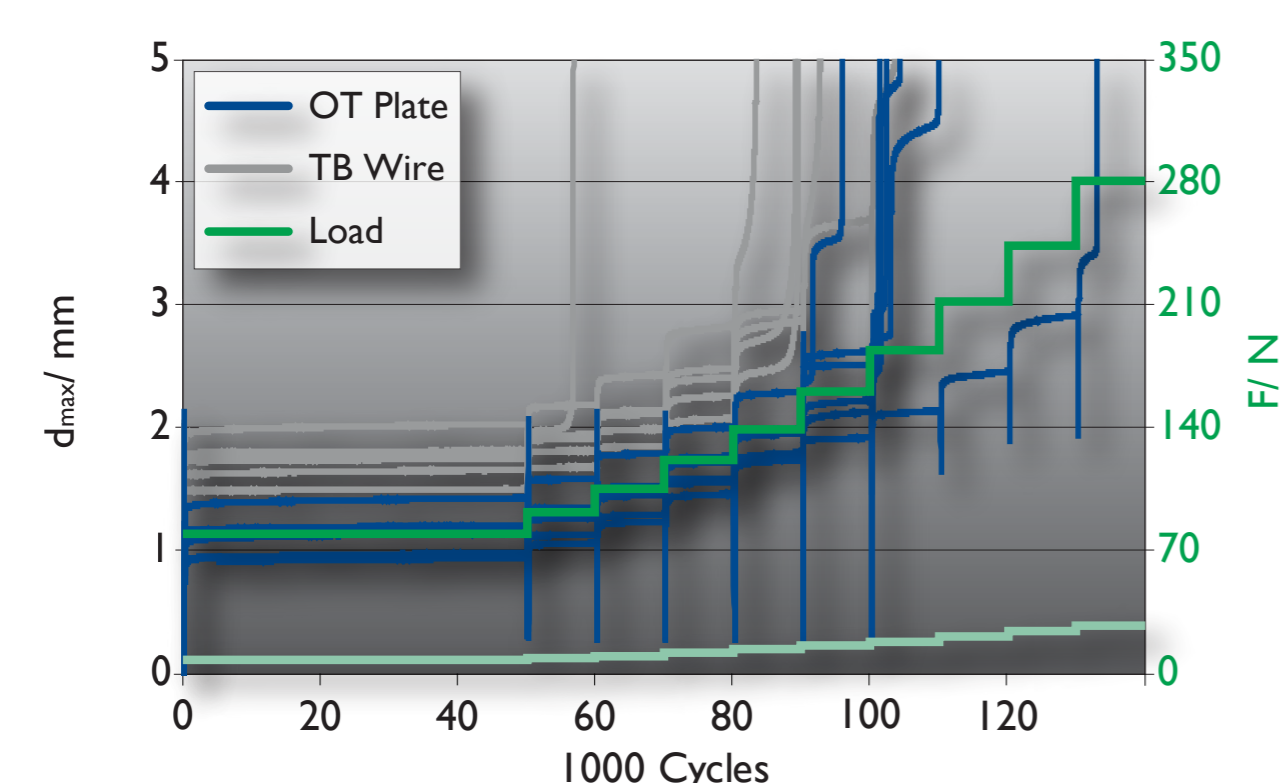


Figure 3: Displacement (Blue and Grey) and Load (Green) Curves

Fatigue testing (sinusoidal load at 5 Hz) was performed using a Zwick LTM-1000 load frame (Figure 2) following a modified Locati approach: samples were tested at periodically increasing loads until mechanical failure. Load ratio (F_{min} to F_{max}) was 1:10 (Figure 3, green line). Load and deformation were recorded.



Figure 2: Test Set-Up

Result

Figure 3 (grey and blue lines) shows deformation curves for all samples tested, Figure 4 summarizes the results. The OT plate had a fatigue strength of 197 N compared to the TB wiring's 143 N. Deformation of the OT plate (roughly 1.5 mm at 140 N) was also lower than the TB wire's (2.0 mm). Typical fracture patterns are shown in Figure 5.

Conclusion

A novel olecranon tension plate was compared to tension band wiring for the treatment of olecranon fractures with interfragmentary support. Fatigue testing showed that the OT plate offers both lower deformation and higher fatigue strength.

The OT plate combines the advantages of TB wiring (such as low profile) with the secure fixation and reproducible application of a plate.

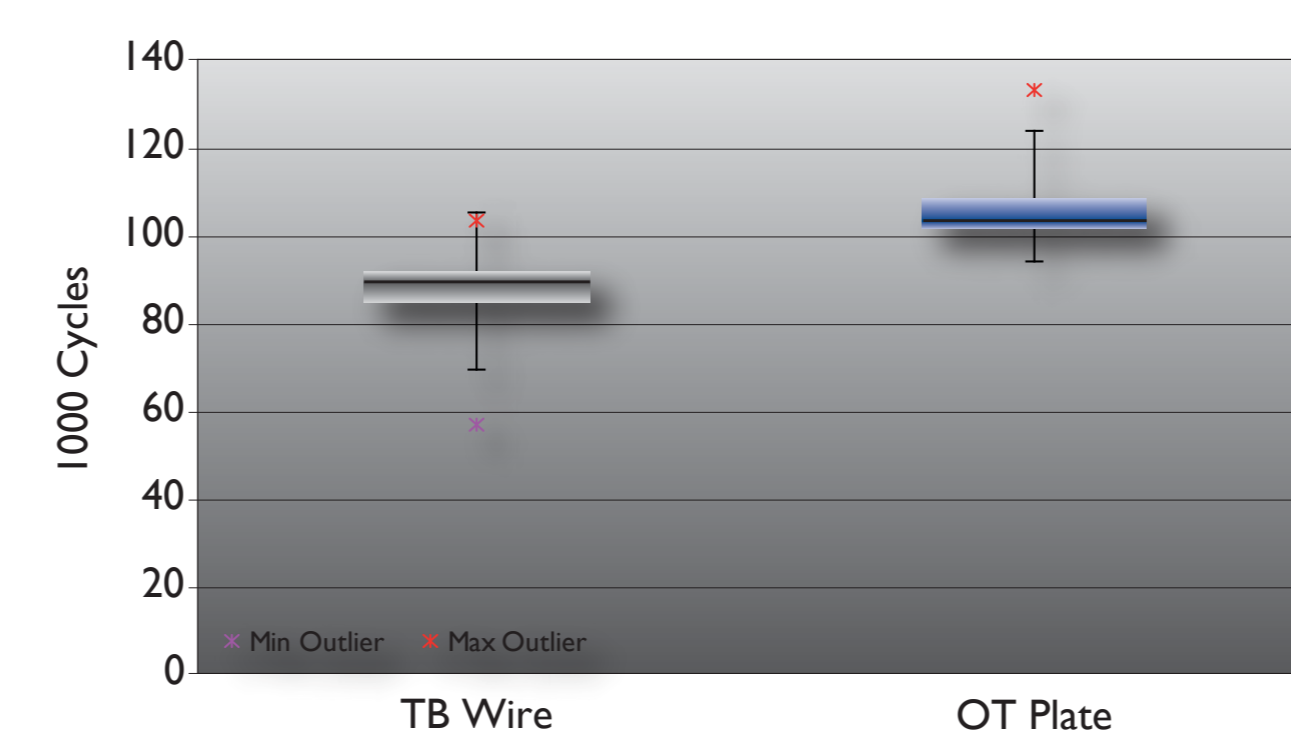


Figure 4: Box Plots of Deformation (Left) and Load (Right) of OT Plate and TB Wiring



APTUS®
Elbow

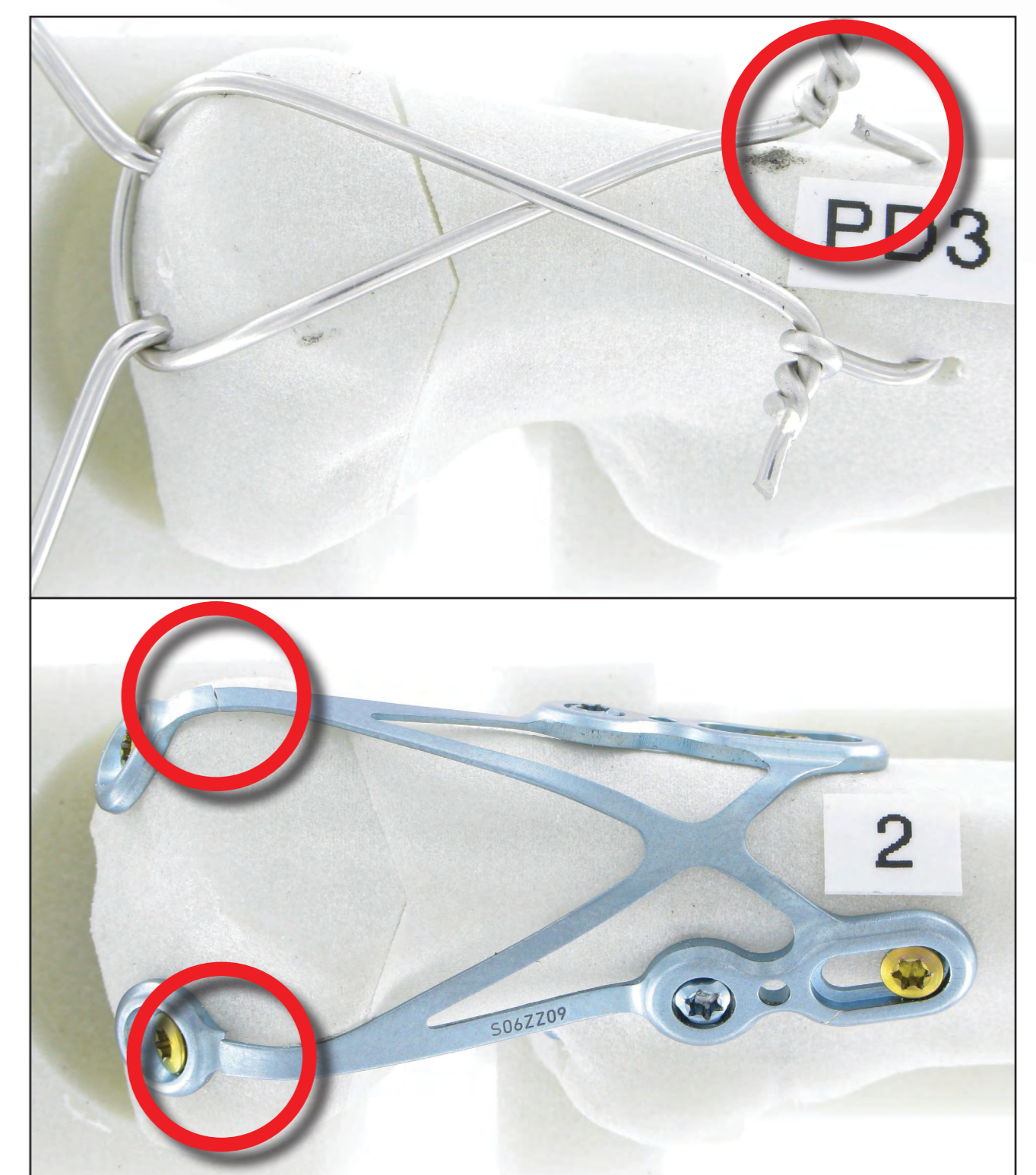


Figure 5: Fractured Samples; Top: TB Wire, Bottom: OT Plate

Soft tissue irritation is potentially reduced and the problem of K-wire migration mitigated.

Literature

- [1] Weber et Al., Z Unfallmed Berufskr, 56, 90 (1963).
- [2] Macko et Al., J Bone Joint Surg Am., 67, 1396 (1985).