

Introduction

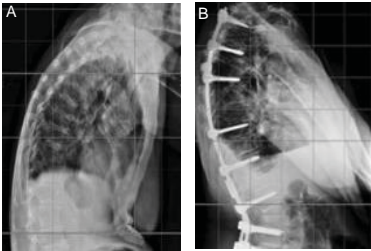


Figure 1: The gold standard procedure to stabilize spinal deformities requires instrumentation with pedicle screws and rods¹

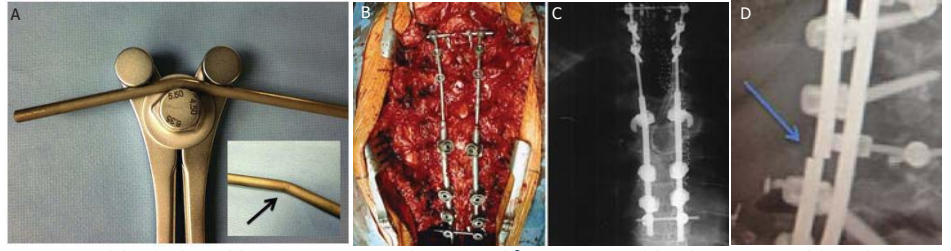


Figure 2: French bender device (A) used to intra-operatively contour rods². Intra operative (B) and post operative (C) visuals. The device introduces residual stresses and notches which may affect fatigue performance of the rod (D)³ [http://stormanesthesia.com/]

Materials and Methods

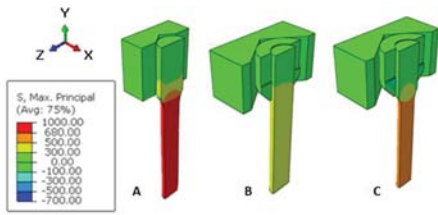


Figure 3: Choice of the best numerical tensile test configuration for material characterization.

Material properties

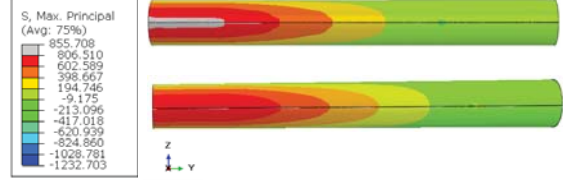
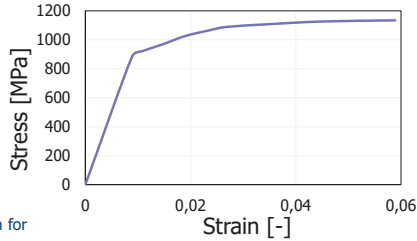


Figure 4: Evaluation of K_t in rods contoured by means of French Bender (above) with respect to a straight control one (below).



Figure 5: Summary of experimental and numerical fatigue testing configurations, regarding Straight rods (S), French bender (FB) and homogeneously bent rods through Four points bending (FP). The fatigue configurations are lordotic (L) and kyphotic (K).

Results

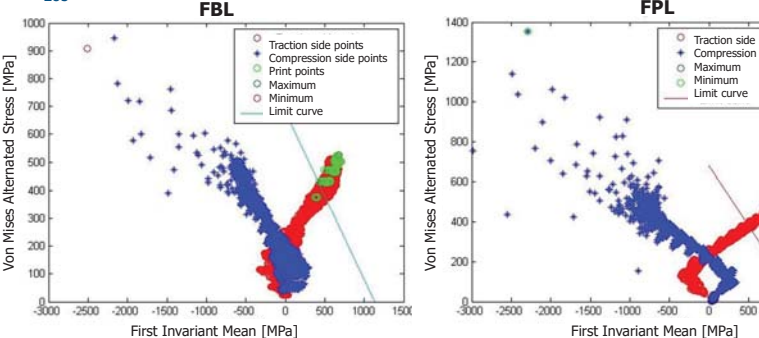
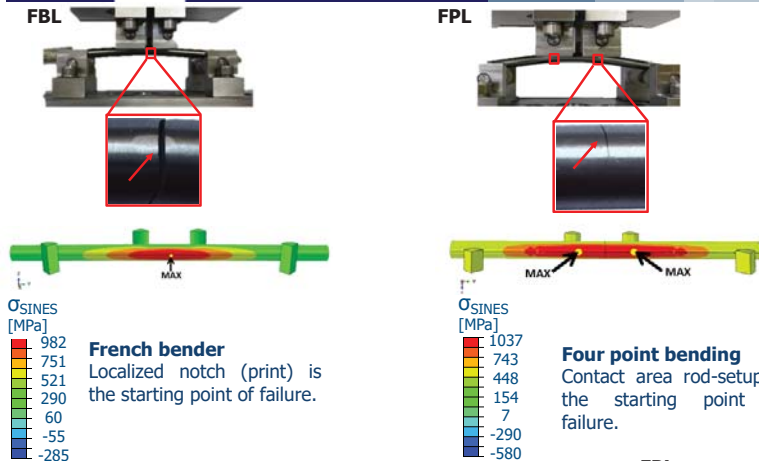


Figure 6: Crack localization and Haigh diagrams in FBL and FPL; on the right the same for S, FPK and FBK. Configurations which exhibit points overcoming the limit curve are more dangerous in terms of fatigue life.

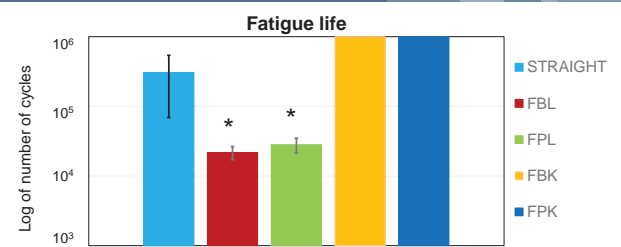
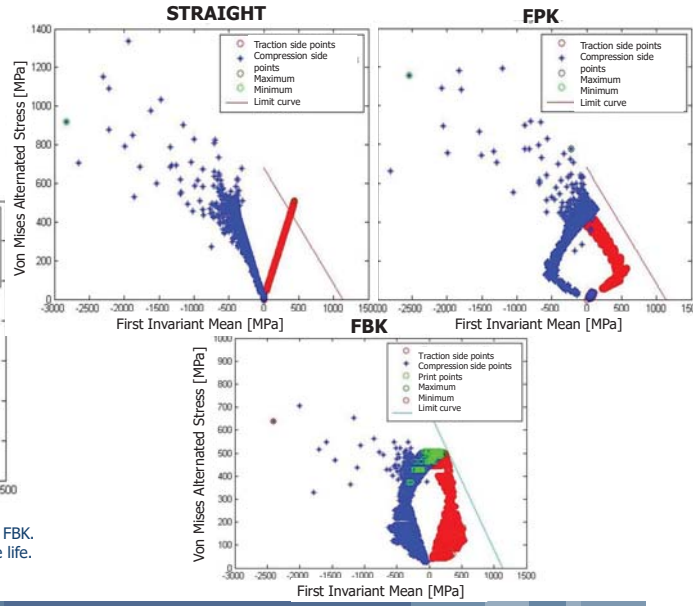


Figure 7: Summary of fatigue tests



References

¹Lindsey C., Deviren V., et al. *The Effects of Rod Contouring on Spinal Construct Fatigue Strength*, The Spine Journal, 31(15):1680–1687, 2006
²H. Yoshihara. *Rods in spinal surgery: a review of the literature*. The Spine Journal, 2013
³Smith, J., Shaffrey C., et al. *Assessment of Symptomatic Rod Fracture After Posterior Instrumented Fusion for Adult Spinal Deformity*, Neurosurgery, 71:862–868, 2012