New Techniques and Emerging Evidence #NT7

Clinical Cases, Solutions, and Novel Techniques

Monitoring Tibial Fracture Healing Via Telemetric Bending

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Purpose: Using a noninvasive direct electromagnetic coupling (DEC) measurement system, it is possible to determine bending compliance of fractures as a measure of early-stage healing. The goal of this study was to evaluate DEC for monitoring tibial fractures in an exploratory observational study.

Methods: 14 patients with diaphyseal tibial fractures and intramedullary nail fixation collected daily bending compliance data from 2-8 weeks post-injury using a telemetric DEC device in their home (Fig. 1A, B). For comparison, radiographs obtained at clinic visits were graded using the Radiographic Union Score for Tibia fractures (RUST) method.

Results: One fracture that resulted in nonunion exhibited a slightly increasing bending compliance (Fig. 1C). All other fractures resulted in union, and the corresponding compliance decreased during the first 6 weeks (Fig. 1D). The DEC-measured compliance rate of change significantly correlated with RUST at 11 ± 1 weeks (P = 0.03, R2 = 0.37), suggesting that bending measured during the first 6 weeks is indicative of the rate of healing as seen by radiographs at 11 weeks. However, DEC showed no correlation with RUST at 6 ± 1 weeks (P = 0.2, R2 = 0.14), suggesting that 6 weeks is too early for RUST to provide meaningful results.

Conclusion: These results demonstrate a proof of concept for monitoring healing via telemetric bending. The 6- week rate of change in bending compliance appears to indicate the rate of healing prior to radiographically visible bridging.

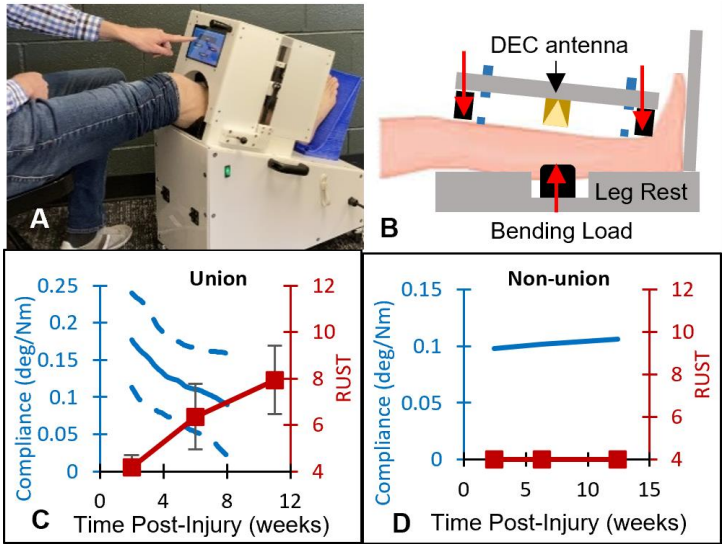

Fig 1: (A) The telemetric device is automated and allows for daily self-use by the patient. (B) The device applies 3-point bending and measures deflection via DEC antenna. Example bending compliance and RUST data are shown for patients with (C) union and (D) non-union healing outcomes.