Adjunctive Dorsal Spanning Plate Fixation in the Stabilization of Perilunate Dislocations

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INTRODUCTION: Perilunate dislocations and traumatic instabilities are often associated with additional injuries. Fixation of these injuries has principally utilized open reduction and percutaneous Kirschner wires for stability, requiring a period of reduced weight-bearing to the injured limb. A recent retrospective work employed dorsal spanning plate fixation to empower wire fixation of these injuries to allow immediate weight-bearing following surgery. No biomechanical data exists that evaluate the effects of adjunctive dorsal spanning plate fixation on construct load to failure or parameters of carpal alignment. We hypothesized that that the addition of a dorsal spanning plate to Kirschner wire fixation of perilunate dislocations would allow for increased loads to be applied before construct failure and better maintain carpal alignment in a robotically tested cadaveric model.

METHODS: Fourteen fresh-frozen cadaveric wrists underwent simulated perilunate injury by means of sharp ligament division. The specimens were randomly allocated to either wire fixation vs. wire and dorsal spanning plate fixation. Wire fixation was performed with five 0.045-inch wires including one scaphocapitate wire, two scapholunate wires, and two lunotriquetral wires. The dorsal spanning plate was applied at the radius and third metacarpal. The dorsal scapholunate ligament was repaired with a suture anchor. The constructs were tested on a robot (Figure 1). Wire only constructs were loaded with 50N of compressive force for 100 cycles of 10° extension and 15° of flexion. Due to the rigidity of the dorsal spanning plate construct, cyclical loading was carried out with a maximum of 3Nm of torque in both flexion and extension when 10° of extension and/or 15° flexion could not be obtained. Fluoroscopic images were obtained of the specimens prior to simulated injury, after fixation, after 10 and 100 loading cycles, and at construct failure. Failure was defined as capitolunate subluxation, hardware failure, and/or fracture. The data were determined to be normally distributed via Shapiro-Wilk test. Differences in scapholunate and lunotriquetral intervals, as well as scapholunate and capitolunate angles, were compared using t tests between constructs after fixation and after application of forces as noted above.

RESULTS: There were no statistically significant differences between the two group's carpal alignment parameters after fixation. Specimens fixated with wires and dorsal spanning plate required significantly higher loads to achieve construct failure (436 Nm vs. 132 Nm, ($p < 0.001$). The only significant difference between the two groups' carpal alignment parameters was scapholunate interval change at failure (5.01mm vs. 2.9mm, dorsal spanning plate vs. wire alone, respectively ($p = 0.04$). Other parameters suggested better maintenance of alignment with the dorsal spanning plate construct (Table 1).

DISCUSSION AND CONCLUSION: Adjunctive dorsal spanning plate fixation resulted in significantly increased loads to failure and decreased change in scapholunate interval at time of failure compared to Kirschner wire fixation alone. This may be a useful technique in the polytraumatized patient where providing back a weight-bearing extremity may be advantageous in the rehabilitation process.