Risk of Tendon Entrapment Under a Dorsal Bridge Plate in a Distal Radius Fracture Model

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Purpose To determine the risk of iatrogenic damage to the extensor tendons and sensory nerves under a bridge plate along the second versus third metacarpal.

Methods Using 6 paired (left–right) cadaver forearms–wrists and via a volar approach, we created a distal radius fracture with metaphyseal comminution. We then applied a dorsal distraction plate to either the second or third metacarpal. We next performed dorsal dissection of the hand and wrist over the zone of injury to determine the position of the plate relative to the extensor tendons and sensory nerves.

Results The bridge plate on the third metacarpal entrapped tendons of the first and third compartment in all 6 specimens. When the plate was applied to the second metacarpal there were no cases of tendon entrapment. There were no instances of nerve entrapment in plating to either the second or third metacarpal.

Conclusions Distraction plating has been proposed for use in the second and third metacarpals for unstable comminuted distal radius fractures. We recommend formal exposure of the extensor tendons over the zone of injury when applying a distraction bridge plate to the third metacarpal.

Clinical relevance Plating to the second metacarpal decreases the risk of entrapment of extensor tendons compared with plating to the third metacarpal. *(J Hand Surg Am. 2015;40(3):500–504. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Distal radius fracture, bridge plate, dorsal distraction plate.

The goal in surgically treating distal radius fractures is to restore and maintain anatomic alignment in an effort to optimize pre-injury wrist and hand function.[1] Distal radius fractures with severe comminution, a large zone of injury, and osteopenic bone pose major challenges to open reduction internal fixation. Some fractures are not amenable to open reduction internal fixation. External fixation is an alternative that results in improved fracture alignment, is applied through incisions away from the zone of injury, and does not entail opening the fracture site. However, external fixation is cumbersome and has its own risks.

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As an alternative to external fixation, Burke and Singer[2] used an internal distraction plate. Their indication for treatment was a comminuted displaced fracture. Subsequent studies have expanded the use to include distal radius fractures with metaphyseal and diaphyseal comminution, patients with multiple extremity involvement, and elderly patients with extensive comminution.[3–5]

The distraction plate uses ligamentotaxis for indirect fracture reduction and provides a dorsal buttress to prevent dorsal tilt and subsidence, similar to an external fixator.[2–5] However, distraction plating is more stable and has higher resistance to axial loading compared with external fixation.[6,7] Clinical studies have demonstrated good return of function and limited complications with distraction plating.[2–5]

Two techniques are available for application of the distraction bridge plate for distal radius fractures.

One method places the plate under the second extensor compartment with distal fixation into the second metacarpal.[8] The alternative technique places the plate under the fourth extensor compartment, with fixation into the third metacarpal. Usually the fracture site is not exposed during the application of a spanning plate and the position of the plate relative to the vital structures over this area is not well defined. Because of the known risks of extensor pollicis longus (EPL) rupture and extensor adhesion,[9] we sought to assess and compare the relative position of the spanning bridge plate to vital structures over the injury zone using these 2 methods in a cadaveric model.

MATERIALS AND METHODS

We inspected 6 fresh cadavers of unknown age (3 male and 3 female) and examined their medical histories and causes of death before using them, to rule out signs of gross deformity or prior surgery to the hand, wrist, forearm, or elbow. None of the 6 cadaveric specimens showed signs of prior trauma or surgery from elbow distal. To control for unforeseen differences in specimens we used the left and right wrist of each body to compare plating with the second versus third metacarpal, which resulted in a total of 12 specimens. Each specimen was used only once for this study.

We first created an unstable distal radius fracture model through a standard volar Henry approach. We measured 1 cm proximal to the radiocarpal joint and then used an osteotome to remove 1 cm of metaphyseal bone. We next hyperextended the wrist to 90° to simulate soft tissue disruption common to distal radius fractures.

Two investigators performed distraction plating to the second or third metacarpal of either wrist using each cadaver as a matched control. A 2.4-mm distal radius bridge plate and screws (DePuy-Synthes, West Chester, PA) were used for the study. We superimposed the plate along the skin of the dorsal hand and forearm, which allowed us to mark incisions in line with the screw holes proximally along the radial diaphysis and distally along the appropriate metacarpal. A 4-cm dorsal incision was made over the second or third metacarpal diaphysis. Another 5-cm incision was made along the diaphysis of the radius. Special care was taken to incise only through skin and subcutaneous tissue and then to dissect to bone bluntly at each location.

When plating to the second metacarpal, we retracted the extensor tendons and inserted the plate from distal to proximal, sliding it along the second metacarpal. We met no resistance in any of the 6 specimens. We had direct visualization of the extensor tendons at the level of the metacarpal as the plate advanced proximally along the radial shaft. The distal end of the plate was approximately 1 cm proximal to the metacarpophalangeal joint. The plate was secured with 2.4-mm non-locking cortical screws at both the most distal hole along the second metacarpal and the most proximal hole along the radial shaft.

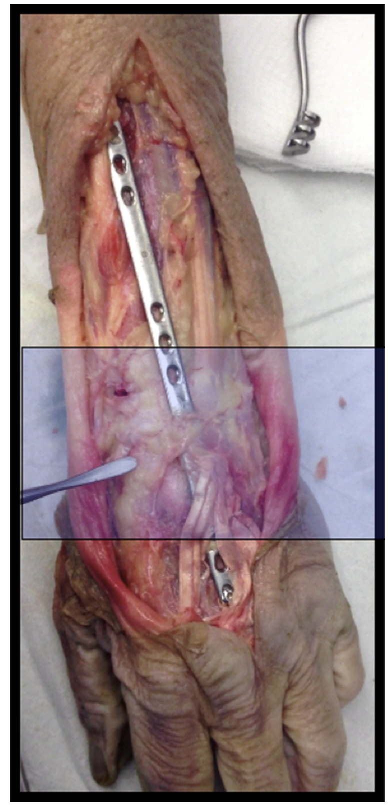

FIGURE 1: Dissection connecting proximal and distal incisions. Highlighted area is zone of fracture injury.

The third metacarpal was plated in similar fashion. All specimens where checked before dissection and were found to have full passive digit range of motion with the wrist in neutral. We then dissected the hand and wrist between the 2 incisions (Fig. 1) to evaluate plate position relative to soft tissue structures.

RESULTS

In all 6 third metacarpal specimens, the plate was positioned on periosteum along the metacarpal diaphysis, displacing the extensor digitorum communis to the middle finger radially. In 3 of 6 specimens the plate split the extensor retinaculum of the wrist, leaving a layer of retinaculum above and below the plate (Fig. 2). In the other 3 specimens the plate was on top of the extensor retinaculum with loose connective tissue lying over the plate (Fig. 3). In all 6 specimens the plate was positioned on top of one or both tendons of the first