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Dorsal Distraction Plating for Highly Comminuted Distal Radius Fractures

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Keywords

Distal radius fracture; distraction plate; bridge plate; comminuted

THE PATIENT

A 60-year-old woman fell from a standing height, fractured her left distal radius, was splinted at an emergency room without reduction, and presented to the office six days after injury. Radiographs revealed a comminuted intraarticular distal radius fracture (DRF) with metaphyseal comminution and a complex articular fracture with both coronal and sagittal fracture lines (AO Subtype C3.2).

THE QUESTIONS

When is dorsal distraction plating a good option for a DRF?

CURRENT OPINION

Fractures with fragmentation of both the articular surface and the metaphysis (AO C3.2) are difficult to stably realign, particularly if there is extension into the diaphysis (AO C3.3). A variety of operative techniques are used for complex articular fractures. Dorsal distraction plating, often referred to as bridge plating and commonly used in patients with multiple injuries, has emerged as a promising treatment option for AO C3.2 and AO C3.3 fractures. The dorsal distraction plate provides both internal distraction and buttress support of the dorsal part of the fracture, and may allow greater patient participation in transfers and other activities in the early postoperative period.[1,2] Unlike external fixation, the bridge plate can be left in place for an extended period of time without the risk of pin loosening or infection.

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THE EVIDENCE

Ring et al.[3] reviewed 25 fractures of the distal radius with complex articular and metaphyseal fragmentation (AO C3.2) treated with combined dorsal and volar plate fixation. At final follow up, wrist flexion and extension averaged 51° and 54° respectively, and forearm pronation and supination averaged 79° and 74°, respectively. Subsequent plate removal was performed in 21 patients and surgery for ruptured tendon in two patients.

Benson et al.[4] reviewed 81 patients with 85 intraarticular DRFs managed with a fragment-specific approach (a separate implant on each fracture fragment). These included 8 B2, 1 B3, 31 C1, 27 C2 and 18 C3 fractures. An average of 32 months after fracture, they reported an average wrist flexion and extension of 60° and 69° respectively.

Distraction plating for comminuted and displaced fractures of the distal radius was first described in a case report by Burke and Singer in 1998.[5] They reported acceptable reduction of comminuted intraarticular fractures using a 3.5-mm plate through the fourth dorsal compartment and affixed to the long finger metacarpal.

In the same year, Becton et al.[6] presented an alternative approach utilizing antegrade placement though the second dorsal compartment onto the index metacarpal in 35 patients (35 wrists) with comminuted extraarticular fractures of the distal radius. They reported fracture union at eight weeks with only two complications, one involving plate breakage at the index metacarpal and the other with fracture of the index metacarpal through a screw hole. Both patients healed uneventfully and had uncomplicated hardware removal.

In 2005, Ruch and colleagues[1] reviewed 22 high-energy DRFs with metaphyseal comminution and diaphyseal extension (2 A3.3 and 20 C3.3 fractures) treated with open reduction and internal fixation with a 3.5-mm plate applied retrograde through the fourth dorsal compartment with fixation to the long finger metacarpal. The authors reported good or excellent results in 20 of 22 patients with only one case of radiographic articular incongruity (step-off >2 mm) after plate removal. The average duration between placement and removal of the plate was six months. Despite prolonged immobilization across the wrist joint, the final ROM of the wrist averaged 35° of flexion 45° of extension an average of 6 months after plate removal. Three patients had a long finger extensor lag but there were no reported extensor tendon ruptures.

Hanel et. al.[2] described 62 highly comminuted metadiaphyseal DRFs treated with dorsal distraction plating using a 2.4-mm plate placed antegrade using the second dorsal compartment and index finger metacarpal. Multiple traumatic injuries were present in 23 of the 62 patients (37%). There were 18 AO A3.3 fractures; 3 AO B2.3, and 41 AO C3.3 fractures. There were no articular gaps greater than 2 mm and the average radial inclination was greater than 5° in all patients with neutral palmar tilt on average. Although there were no reported values for average range of motion, the authors reported “functional range of motion” within a year of plate removal in their cohort. It is notable that follow up only included 52 of sixty patients and was not uniform. One patient had a broken plate and extensor tendon rupture when he did not return for planned plate removal.

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In a follow-up study, Hanel et al.[7] studied 140 patients with 144 fractures treated with either a 2.4-mm or 2.7-mm plate placed retrograde through either the second or fourth dorsal compartment and affixed to either the index or long finger metacarpal. They reported minor and major complication rates of 4.6% and 8.5%, respectively. Three cases of plate breakage occurred with a 2.7-mm implant as well as two cases of screw failure with 2.4-mm screws; the authors recommended use of a larger 3.5-mm plate and 2.7-mm screws to avoid implant failure.

Richard et al.[8] studied 33 patients (33 wrists) treated with either a 2.4-mm or 3.5-mm plate placed either antegrade or retrograde through the fourth dorsal compartment; in 12 patients, the plate was fixed to the index finger metacarpal and in 21 patients it was secured to the long finger metacarpal. They reported an average palmar tilt of 5° and radial inclination of 20° at the time of final follow-up (average 47 weeks). A congruent distal articular surface (step-off <2 mm) was maintained in 30 of 33 wrists, and ROM an average of one year after plate removal included average flexion and extension values of 46° and 50° respectively, and average pronation and supination values of 79° and 77°, respectively. They documented finger stiffness in 10 of 33 wrists with one patient requiring extensor tenolysis.

Mithani et al.[9] described dorsal distraction plating for 8 distal radius nonunions in 8 patients treated initially with various other forms of fixation. They reported 100% union and significant gains in ROM and subjective outcomes based on Disabilities of the Arm, Shoulder, and Hand (DASH) scores. Although not directly relevant to the management of acute fractures, these data highlight the versatility of a technique that can help manage complications of other treatments.

SHORTCOMINGS OF THE EVIDENCE

The evidence regarding the use of dorsal distraction plates for highly comminuted DRFs is limited to retrospective case series. There are no data comparing distraction plating to external fixation or plate fixation. Given the interobserver variability in classification of distal radius fractures, it is difficult to compare the results from different series. The technique varies somewhat between series with some authors[2] passing the plate through the second dorsal compartment and fixing the plate to the index metacarpal and others[1] passing the plate through the fourth dorsal compartment and fixing it to the long finger metacarpal, with both approaches used either antegrade or retrograde. The plates vary as well from long generic 2.4-mm or 3.5-mm plates to plates designed specifically for use in the distal radius.

There are advocates of dorsal distraction plating for more straightforward fractures in multiply injured patients—described by Hanel et al.[2] as those with concomitant injuries that benefit from weight-bearing across the injured wrist to sit up, transfer, and walk—but no data regarding advantages and disadvantages compared to other methods of fixation.

DIRECTIONS FOR FUTURE RESEARCH

Prospective randomized controlled trials comparing dorsal distraction plating with external fixation and volar plating for fractures of the distal radius with both articular and metaphyseal/diaphyseal fragmentation (AO C3.2 or 3.3) would help determine the

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advantages and disadvantages of each technique. Parameters of interest include radiographic alignment, wrist, forearm, and digit motion, symptoms and disability, and adverse events. These fractures are uncommon and any trial would have to include multiple centers. The role of distraction plating for more straightforward fractures in multiply injured patients would also need to be compared prospectively to other methods of fixation in studies involving multiple centers.

It would also be useful to compare various methods of bridge plate fixation utilizing different plate sizes and compartment placements. These studies would also have to be prospective and randomized to be certain that the cohorts were comparable.

OUR CURRENT CONCEPTS FOR THIS PATIENT

We prefer dorsal distraction plating for AO C3.2 and C3.3 fractures in which complex articular and extraarticular fragmentation with fragments that are small enough would be poorly fixed or supported with screws if a locking volar plate was used alone. As noted by Ruch et al.[1] and Hanel et al.[2], the distraction plate allows for prolonged immobilization across the wrist joint without compromising functional outcomes and circumvents the risk of pin loosening and pin infection associated with external fixation. Furthermore, the distraction plate may allow for earlier weight bearing across the affected wrist in the multiply injured patient. Our preferred method of placement is retrograde (distal to proximal) through the second compartment with fixation of the plate to the index finger metacarpal. The implant is left in place for about 3 months.

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