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Original Research

Distal Ulna Fracture Fixation with the Specialized Threaded Pin

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Purpose: Distal ulna fractures can often be treated nonsurgically; however, many surgeons consider significant displacement or instability, especially following fixation of an associated distal radius fracture, an indication for surgical fixation because of potential problems associated with malunion of these fractures. Traditionally, these fractures have been addressed with plate fixation but hardware in this location is often prominent and associated with a high rate of symptomatic hardware and subsequent hardware removal. We proposed a method of intramedullary fixation using a specialized threaded pin. As this fixation is intramedullary, it avoids many of the problems associated with traditional surgical treatment methods for this fracture. We present a series of nine patients treated in this manner, all of whom had associated distal radius fractures.

Methods: Preoperative and postoperative radiographs were reviewed, after which patients were contacted via phone. Patient-reported outcome measures, including *Quick*DASH and visual analog scale scores, were assessed.

Results: The average *Quick*DASH score was 13.6 (range, 0–100), with a median of 9.1. Three patients reported occasional ulnar-sided wrist pain, with an average visual analog scale score of 1.3 (range, 0–10) and a median of 0.5. All patients returned to all activities except one patient who could not resume playing musical instruments because of stiffness. No patient required removal of the threaded pin, but one patient underwent removal of the radial volar plate. No other patients underwent secondary procedures.

Conclusions: Threaded pin fixation is a viable alternative to existing options for distal ulnar neck fractures and may have an advantage over plate fixation because of a lack of hardware prominence.

Type of study/level of evidence: Therapeutic IV

Distal ulnar neck fractures commonly occur with associated distal radius fractures; on occasion, they occur in isolation. They may be related to injuries to adjacent structures, including the distal radioulnar joint (DRUJ) or the triangular fibrocartilage complex.[1] Under many circumstances, nonsurgical treatment is appropriate,[2] but with persistent displacement or with DRUJ instability following the fixation of the distal radius, treatment remains controversial.[3] Biyani et al[4] presented a series of 19 patients with associated distal radius and ulna fractures where the ulnar fracture was treated nonsurgically. They noted that three patients had ulnar fracture callus encroaching on the DRUJ, resulting in limited forearm rotation, and six fractures went on to nonunion (two were comminuted and four of five were simple transverse metaphyseal fractures).[4] Many surgeons consider significant displacement or instability an indication for surgical fixation, especially following fixation of an associated distal radius fracture.[1,5]

Surgical fixation of distal ulna fractures can be accomplished with plate fixation, pins, or intramedullary fixation. Plate fixation has traditionally been the method of choice; however, it requires significant soft tissue dissection and is associated with a high rate of hardware prominence and subsequent hardware removal.[6–8] Intramedullary fixation avoids the risk of hardware prominence and has the additional advantage of minimal soft tissue dissection. Intramedullary fixation with headless compression screws has been described with good results; however, in the case of comminuted fractures, compression may not be advantageous as it may shorten the ulna and alter wrist mechanics. Pin fixation does not typically allow for early motion.

Declaration of interests: J.S.T. is the owner of Union Surgical, LLC. A patent for the threaded pin device has been issued. No benefits in any form have been received or will be received by the other authors related directly to this article.

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The specialized threaded pin (T-pin, Union Surgical) is a useful device for fixation of distal radius fractures[9] because it provides better purchase of fracture fragments compared with smooth pins by virtue of the threads and width, thus allowing early active wrist range of motion with minimal soft tissue dissection.[9] Similarly, the T-pin can be used for intramedullary fixation of distal ulna fractures. We present a case series of patients with distal ulnar neck fractures fixed with intramedullary fixation using the T-pin. Compared with existing methods, this method has the advantage of stable fixation with minimal soft tissue dissection requirement and without prominent hardware and compression.[9]

Methods

The study was approved by the institutional review board and the patients consented verbally by phone when they were contacted to answer the patient-reported outcome measures (PROMs). We identified patients aged 18 or older who presented with distal ulna fractures and were subsequently treated with T-pins at our institution over the past 3 years. Distal ulna fractures amenable to fixation with T-pins are primarily metaphyseal fractures, both simple (2UA2) and comminuted (2U3A3). One metaphyseal fracture with nondisplaced extension into the articular surface (2U3C) was included in the series. Ulna styloid fractures (2U3A1) and most fractures involving the distal articular surface (2U3B or 2U3C) are not amenable to T-pin or other intramedullary fixation (AO classification).[10] More proximal ulna fractures that are amenable to traditional compression plating were treated as such and were not included in the study. Indications for fixation were as follows: (1) significant initial displacement, defined as one-third of the diameter of the neck; (2) subsequent displacement following the fixation of a concomitant distal radius fracture; or (3) DRUJ instability after distal radius fracture fixation. The primary outcome was whether or not radiographic union was achieved. Radiographs at the most recent visit were evaluated. Union was defined as bridging fracture callus across the fracture line in anteroposterior and lateral views. Secondary outcomes included maintenance of reduction. Maintenance of reduction was defined as a significant change in angulation or shortening compared with intraoperative imaging. Secondary outcomes also included PROMs, including return to activity, *Quick*DASH,[11] visual analog scale (VAS) scores, presence or absence of hardware irritation, and any secondary surgery addressing issues such as hardware removal. The mean, median, and range were calculated for each metric.

Surgical technique

The surgical technique started with a 1 cm incision made just distal to the dorsal ulnar head. Branches of the ulnar sensory nerve, extensor carpi ulnaris, and extensor digiti minimi are protected if they pass the plane of dissection. Soft tissues were retracted, and the fracture was reduced; a T-pin guide wire was passed retrograde into the intramedullary canal of the ulna under fluoroscopic guidance. A measuring guide was used along with the appropriate length T-pin. The T-pin, which is cannulated, was passed over the guide wire; if there was any bowing of the guide wire, it was pulled back 1–2 cm prior to introducing the T-pin to prevent kinking of the guide wire. The guide wire was removed, and the T-pin was evaluated to ensure the threads were seated in the intramedullary canal and the trailing threads of the pin were not prominent. The break-off driving mechanism was then removed by bending the smooth shaft, breaking it at the juncture of the threads and the smooth shaft.

Results

Nine patients met the inclusion criteria; the average age was 65 years (range, 28–94 years). One was a man, and eight were women; all ulnar fractures were associated with distal radius fractures. Of the distal ulna fractures, four were classified as 2U3A3, two as 2U3A2.3, one as 2U3A2.2, and one as 2U3C according to the AO classification.[10] Four of the distal radius fractures were extra-articular fractures, four were intraarticular, and one was adjacent to a volar plate from a prior open reduction internal fixation (ORIF). All associated distal radius fractures were treated surgically using T-pins or a volar plate. One patient had an associated scaphoid fracture, which was treated with a headless compression screw and one fracture was open. Four of nine were high-energy mechanisms (all-terrain vehicle rollover, motor vehicle collision, fall from height), whereas the other five were low-energy mechanisms (fall from standing).

One patient was lost to follow-up; the remaining eight achieved union of the ulna fracture with maintenance of reduction (Figure). The mean radiographic follow-up was 10.5 weeks. Seven patients (77%) consented and responded to the questionnaire, all of which were 6 months postoperative or longer at the time of the survey. One patient declined to participate in the survey. The average *Quick*DASH score was 13.6 (range, 0–100), with a median of 9.1. Three patients reported occasional ulnar-sided wrist pain, with an average VAS score of 1.3 (range, 0–10) and a median of 0.5. All patients returned to unrestricted prior activities, except one who could not resume playing musical instruments because of stiffness. No patient required removal of the T-pin, but one patient underwent removal of the radial volar plate. None of the other patients underwent any secondary procedures.

Discussion

Distal ulnar neck fractures can often be managed nonsurgically, but when they do require fixation, the choice of instrumentation can be challenging. ORIF of distal ulnar fractures can be achieved with plate fixation as well as intramedullary fixation. Plate fixation requires extended exposure and is often associated with symptomatic hardware prominence with a high rate of hardware removal. Ring et al[6] reported good results after ORIF of 24 distal ulnar fractures associated with distal radius fractures treated with condylar blade plates. However, they did report seven of the 24 patients had the plate subsequently removed.[6] Denisson[7] and Han et al[8] reviewed five patients treated with locking plates and 17 patients treated with locking compression plates, respectively, with good and excellent results and no subsequent hardware removal.[7,8]

Intramedullary instrumentation allows for stable fixation of these fractures with minimal soft tissue dissection and low risk for hardware prominence. Oh et al[12] presented a series of 11 patients treated with intramedullary headless compression screws with good results. Options for intramedullary fixation include Kirschner wires, headless compression screws, and T-pins. The T-pin is a threaded pin that provides better purchase of fracture fragments than smooth pins by virtue of the threads and width, thus allowing early active wrist range of motion with minimal soft tissue dissection. Conceptually, the T-pin technique is similar to headless compression screw fixation, which was reported with successful results.[12] One advantage of the T-pin over the headless compression screw is the ability to use it for comminuted fractures. The T-pin functions as an intramedullary threaded rod and does not risk overcompressing a comminuted fracture, which risks altering the ulnar height, thereby disrupting DRUJ mechanics and compression loads across the proximal carpal row.

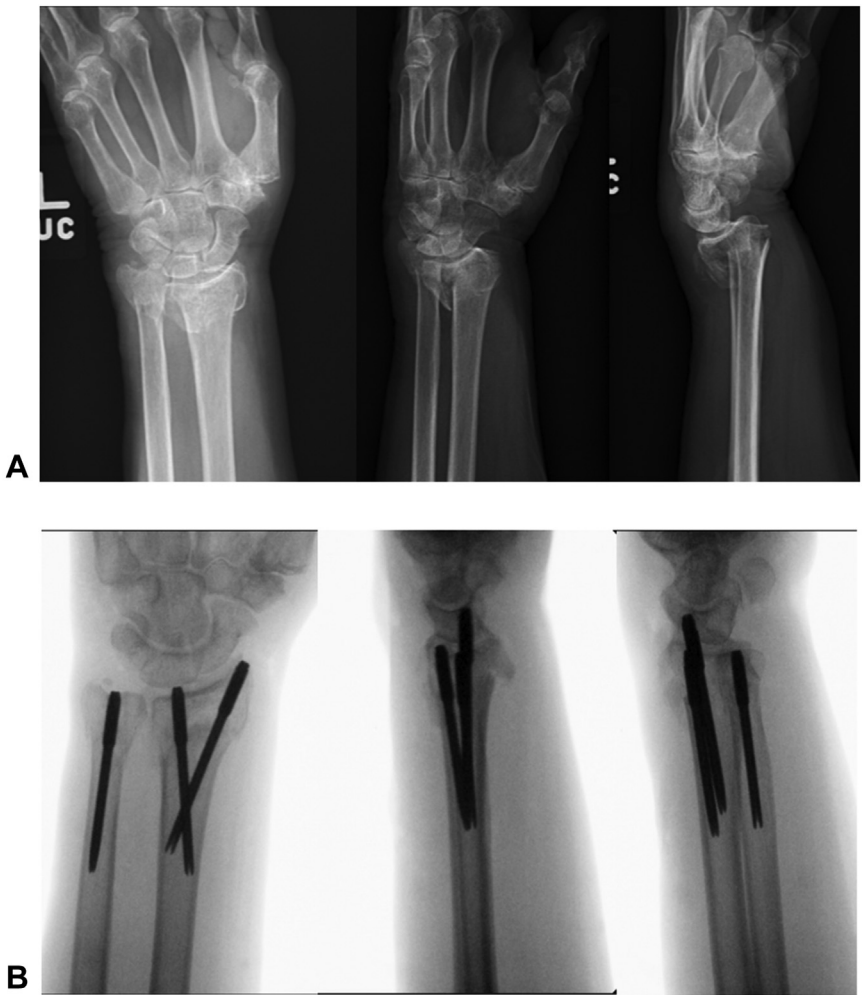

Figure. **A** Anteroposterior, lateral, and oblique preoperative and **B** postoperative images of distal radius and ulna fractures fixed with T-pins.

To our knowledge, there are no large studies reporting PROMs for distal ulna fractures to which we can directly compare our results; however, a previous study of 259 patients with surgically treated distal radius fractures reported *Quick*DASH scores of 22.7, 18.7, and 14.1 (range, 0–100) at 6, 12, and 24 months, respectively.[13] The mean *Quick*DASH score in our series was 13.6 at an average of 17.2 months after surgery (range, 7.0–27.7 months). This finding is similar to previously published PROMs despite the distal radius fractures in our series being associated with unstable or displaced ulnar neck fractures, which may indicate a more severe injury.

Limitations of this study included the limited sample size related to the relative rarity of ulnar neck fractures requiring stabilization. In addition, the single arm and survey nature of the study limit its implications. A study directly comparing intramedullary fixation with plate fixation could be useful but would be difficult to conduct, given the relative rarity of these injuries. In future studies comparing methods of treatment for distal ulna fractures, it may be useful to develop DRUJ or distal ulna–specific outcome measures, as existing PROMs do not distinguish ulnar symptoms from radiocarpal symptoms.

Threaded pin fixation is a viable alternative to existing options for distal ulnar neck fractures and may have an advantage over plate fixation because of a lack of hardware prominence. Patient-reported outcome measures, including VAS and *Quick*-DASH, are comparable with published outcomes for distal radius fractures.

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