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Outcomes of Distal Ulna Fractures Associated With Operatively Treated Distal Radius Fractures

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Abstract

Background: The purpose of this study was to report outcomes in patients with nonstyloid distal ulna fractures treated in conjunction with open reduction internal fixation (ORIF) of distal radius fractures. **Methods:** A retrospective review of all patients who had undergone ORIF of a distal radius fracture over a 5-year period at a single institution was performed. Radiographic review was performed to identify patients with a concomitant fracture of the distal ulna. Radiographs were examined to determine whether and how the distal ulna fracture was stabilized and to assess healing of the distal ulna. Range of motion (ROM) was determined by review of the patients' charts. All skeletally mature patients with distal ulna fractures (not including isolated styloid fractures) undergoing surgical fixation of the distal radius fracture were included. Patients were excluded if follow-up was inadequate. There were 172 fractures of the distal ulna meeting the inclusion criteria. Seven patients were excluded. There were 91 patients treated without ulna fixation (ulna-no) and 74 patients treated with ulna fixation (ulna-yes). **Results:** Seventy-two (97%) of the ulna-yes patients healed. All patients in the ulna-no group healed. The only significant difference in ROM was in pronation, although the magnitude of this difference was relatively small. **Conclusions:** Fractures of the distal ulna have high rates of healing and result in equivalent motion regardless of whether the distal ulna is treated operatively. Routine surgical fixation of concomitant distal ulna fractures during distal radius ORIF does not appear to be necessary.

Keywords: distal ulna fracture, ulnar neck fracture, distal radius fracture, radiograph, outcomes

Introduction

Distal radius fractures are common injuries and are frequently associated with concomitant distal ulna fractures. Fractures of the ulnar styloid are seen most frequently, and this injury has been well studied in the literature.[1-9] In general, these reports demonstrate that in the absence of distal radioulnar joint (DRUJ) instability, the ulnar styloid does not require discrete intervention.

Less commonly, the distal ulna can fracture at the level of ulnar metaphysis or distal shaft in patients with distal radius fractures, and there are less data to guide treatment. In a series of 11 patients with ulnar neck fractures, in association with surgically treated distal radius fractures (representing 2% of all of their surgically treated distal radius fractures), Paksima et al[10] reported favorable outcomes in patients irrespective of whether the distal ulna fracture was repaired. In this small cohort, there were no differences in the range of motion (ROM) or Disabilities of the Arm, Shoulder, and Hand (DASH) scores, and there was no information about radiographic alignment or healing of the fracture. These authors also described a classification scheme for fractures of the ulna at this level: Type A were simple fractures of the ulnar neck, type B were fractures of the neck plus styloid, type C were fractures of the ulnar head, and type D were comminuted fractures of the head and neck.

The purpose of this study was to report radiographic outcomes, healing rates, and ROM in patients with nonstyloid distal ulna fractures treated in conjunction with open reduction internal fixation (ORIF) of distal radius fractures.

Methods

A retrospective review was performed of all patients who had undergone ORIF of a distal radius fracture over a 5-year period at a single institution, a large regional practice cover-

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ing 3 trauma centers, using the *Current Procedural Terminology* (*CPT*) codes for surgical fixation of a distal radius fracture 25607, 25608, and 25609. A radiographic review was then performed to identify patients with a concomitant fracture of the distal ulna. Fractures were classified according to the scheme of Paksima et al.[10]

All skeletally mature patients with distal ulna fractures (not including isolated styloid fractures) undergoing surgical fixation of the distal radius fracture were included. Fractures of the distal ulna were considered for inclusion if they were in conjunction with a metaphyseal fracture of the distal radius and involved the distal one-fourth of the ulna. Exclusion criteria were patients with isolated ulnar styloid fractures, diaphyseal fractures of both the radius and the ulna, skeletally immature patients, patients with inadequate radiographs, or unhealed fractures and inadequate (less than 3 months) follow-up. Patients with less than 1 year of follow-up, but whose fractures had healed, were included.

Demographic information was collected, including patient age and sex. Postoperative radiographs were examined to determine the method of treatment of the distal radius fracture, whether and how the distal ulna fracture was treated, and to assess healing of the distal ulna. The alignment of the distal ulna fracture was measured using our Picture Archiving and Communication system (PACS, Sectra AB, Linköping, Sweden). Measurements were obtained using the PACS software on posterioranterior (PA) and lateral views to obtain sagittal and coronal plane alignment. All measurements were performed by one of the authors of the study, a fellowship-trained orthopedic hand surgery attending. Healing was determined based on follow-up radiographs demonstrating bridging trabeculae across the fracture site. The ROM was determined by review of the patient charts.

There were 2968 fractures of the distal radius treated surgically during the study period. Surgical fixation of the distal radius was performed with volar plate, dorsal plate(s), dorsal spanning plate, external fixation, or pins. Of these distal radius fractures, 172 (5.8%) had concomitant fractures of the distal ulna meeting the inclusion criteria. Seven patients from this group were excluded due to unhealed distal ulnar fracture at the time of last follow-up and inadequate follow-up. Five of these patients had not undergone ulnar fixation and 2 had their ulna fracture fixed. The mean age of these patients was 82 and the mean follow-up time was 4.7 weeks (range: 0.9-8.1 weeks). Four of these patients had only a single postoperative visit, and 1 did not follow up at all after surgery. Based on the classification of Paksima et al and of the 165 remaining patients who made up the study population, there were 83 type A, 8 type B, and 57 type C fractures. We had no type D fractures. There were 17 fractures of the distal ulnar shaft (13 were fixed and 4 were not). These fractures were just proximal to the ulnar head/neck, in the diaphysis, but in the distal fourth of the ulna. There were 91 patients (79 women and 12 men) treated without ulna fixation (ulna-no) and 74 patients (68 women and 6 men) treated with ulna fixation (ulna-yes). The average age was 70 years (range: 19-97 years). Fixation of the ulna was performed based on attending preference and intraoperative assessment, but there was no defined protocol for which fractures required stabilization. Assessment of the DRUJ is performed routinely at our institution during distal radius fixation, but DRUJ stability was not determined in this study. Standard postoperative protocol included early range of motion with a removable splint.

Institutional review board approval was obtained and informed consent was waived per institutional protocol.

Results

Of the 74 patients in the ulna-yes group, 46 of these were fixed with a pin or pins. One patient with an ulnar head fracture was treated with a headless compression screw. The remaining patients were treated with a plate and screws. All ulnar fractures except 2 that were treated with fixation healed. One patient who did not heal had early ($<$1 month) hardware failure and was treated with a removal of hardware and distal ulna resection. The other patient had evidence of callus formation but was not healed at last follow-up which was just over 3 months postoperatively.

Ninety-one patients were treated without fixation of the ulna (ulna-no). There were no nonunions in this group.

The average age of the ulna-no patients was 69 years and of the ulna-yes patients was 70 years. There was no statistically significant difference in patient age between groups ($P = .78$).

Based on radiographic measurements, the mean coronal plane alignment in the ulna-yes group was 5° apex radial (range: 15° apex ulna to 31° apex radial) and in the ulna-no group was 3° apex radial (range: 14° apex ulna to 23° apex radial). The difference in coronal plane angulation was not significant ($P = .10$). The mean sagittal plane alignment was 0° in the ulna-yes group (range: 26° apex ulna to 17° apex radial) and 0° in the ulna-no group (range: 22° apex ulna to 24° apex radial). The difference in sagittal plane alignment was not significant ($P = .80$).

Final ROM for patients was available in 54 (60%) of 91 ulna-no and 51 (69%) of 74 ulna-yes patients. The mean follow-up time was 17 weeks for ulna-no and 28 weeks for ulna-yes. The mean follow-up time for ROM overall was 22 weeks (range: 5-154 weeks). The ROM findings are summarized in Table 1.

Discussion

Ulnar wrist injuries are common in association with distal radius fractures.[4-7,11-13] Soft tissue injury, specifically trian-

Table 1. Mean Range of Motion for Patients With the Ulna Treated Nonoperatively (Ulna-No) and Surgically (Ulna-Yes).

	WE	WF	Sup	Pro
Ulna no	54	56	75	83
Ulna yes	57	56	74	77
P value	.47	.98	.77	.01

Note. WE = wrist extension; WF = wrist flexion, Sup = supination; Pro = pronation.

gular fibrocartilage complex (TFCC) tears, is frequently seen as are fractures of the ulnar styloid. The TFCC injury has been reported in approximately half of distal radius fractures, and ulnar styloid fractures occur approximately 60% of the time.[1,6,11] Data are conflicting on whether the presence of an ulnar styloid fracture affects outcomes[1-3,8,9]. However, most authors agree that ulnar styloid fractures do not typically require surgical stabilization after fixation of the radius unless there is residual instability of the DRUJ.[3,5,7]

There are little data available to guide surgeons on optimal management of patients with nonstyloid fractures of the distal ulna in association with distal radius ORIF. Biyani et al[14] reported an incidence of 6% of metaphyseal distal ulna fractures in a series of 320 patients. Outcomes after nonsurgical management of the ulna were inconsistent, with 6 (40%) of 15 patients treated without fixation of the ulna, having fair or poor results. Conversely, Ring et al[15] reported reasonably good results after condylar blade plate fixation of unstable distal ulna fractures. Their average reported ROM (50° flexion, 52° extension, 70° supination, and 76° pronation) is quite similar to our results in both groups. A small series of patients treated with locked distal ulna plates was reported by Dennison,[16] also with favorable outcomes and similar results.

In our study of distal ulna fractures in patients undergoing surgical fixation of the distal radius, we did not find a benefit to operative management of the ulna. Although the rate of union was high with fixation, there were no nonunions in our ulna-no group and no substantial benefit in terms of ROM outcomes. Radiographic alignment was similar between groups. Paksima et al[10] reported similar findings in a smaller series of patients. Five of their distal ulna fractures were treated nonoperatively and 6 surgically (including one treated with acute distal ulna resection). There were no differences in ROM or functional outcomes between groups.

There are several limitations to our study. The ROM measurements were taken at variable time points. As motion may continue to improve in 6 to 12 months or more after wrist fracture, patients' final ROM may have improved further beyond what we have reported. It is possible that with longer follow-up, one of the groups would plateau while the other might continue to progress. Given that our results are consistent with prior reports in the literature, that outcomes in both groups were similar, and that motion was not markedly limited in either group, we would not expect this to be the case. In addition, the study was not randomized and fixation of the ulna was performed at the discretion of the attending surgeon. It is possible that the more significantly displaced or unstable fractures were treated operatively and that they "needed" to be fixed, while the less displaced or less severe fractures were treated without fixation. The retrospective nature of our study, lack of well-defined guidelines on when fractures of the distal ulna require fixation, and limited availability of preoperative films preclude direct assessment of this. It has been our finding that significant DRUJ instability associated with metaphyseal fracture of the distal ulna is unusual. It is our experience that fixation of the ulna was performed during the study period due to a perception that this was necessary to maintain alignment and to facilitate early ROM after fixation of the radius. Our study does not definitely answer the question as to which, if any, fractures of the distal ulna require fixation during distal radius ORIF. However, we feel our results demonstrate that with or without fixation, ROM outcomes are similar despite, in some cases, residual radiographic malalignment. We had a wide range of patient ages in our study. While this is representative of our surgical population, it is possible that a more uniform younger or older cohort would fare differently. Finally, we do not have long-term follow-up information regarding subsequent surgeries in either group (removal of hardware or corrective treatment of malunion), and it is possible that some patients may have required additional treatment.

Based upon our findings, it does not appear that routine fixation of nonstyloid distal ulna fractures at the time of ORIF distal radius is required and we do not routinely repair these at the time of distal radius ORIF. We cannot determine conclusively which ulna fractures would benefit from fixation, although patients treated nonoperatively demonstrated good outcomes despite residual malalignment. Patients may begin early ROM and rehabilitation and can expect similar outcomes with respect to motion irrespective of whether or not the distal ulna is fixed. Although our data do not provide firm guidelines on when the distal ulna fracture requires fixation, we would suggest that residual gross instability after stabilization of the radius remains a reasonable indication for fixation of the ulna. Further prospective study would be beneficial to further define indications for stabilization of distal ulna fractures in association with operatively treated distal radius fractures.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent

Informed consent was waived per institutional protocol.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: KL has received consulting fees from Synthes. PB and LL have nothing to disclose.

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