Retrospective analysis demonstrates no advantage to operative management of distal ulna fractures

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Abstract

Background Isolated fracture of the distal one third of the ulna (the “nightstick fracture”) is a common injury no clear consensus on its optimal management. The purpose of this study is to compare the clinical outcomes of operatively and non-operatively treated distal ulna fractures.

Methods Patients treated over a 5-year period at a level I trauma center for distal ulna fracture were identified and medical records were analyzed. Data were collected on demographics, injury mechanism, fracture pattern, type of treatment, estimated time to osseous healing, and complications. Estimated bony healing time was analyzed with the *t* test, and treatment types were analyzed with the chi-square test.

Results Forty-seven patients with 48 ulna fractures met inclusion criteria for the study. Mean follow-up was 36 weeks. One third of the group was female and mean patient age was 43 years. Eighteen ulnas were treated operatively. There was not a significant difference in the non-operative and operative groups regarding proportions of patients with angulation greater than 15° or 25% or greater translation. There was no significant difference in time to bony consolidation. The operative group had more complications, but the rate was not significantly different than the non-operative group.

Conclusions Isolated distal ulna fractures, including those angulated greater than 15° or translated more than 25%, appear to heal well with non-operative treatment. Operative treatment of closed isolated distal ulna fractures does not appear to confer a treatment advantage when compared to non-operative treatment.

Keywords Fracture · Ulna · Distal · Surgery

Background

Commonly known as the “nightstick fracture” and sustained due to an isolated blow to the forearm, isolated fracture of the ulna is a traumatic injury that lacks evidence-backed indications for operative or non-operative treatment. Despite several studies regarding treatment of these injuries, there is no clear consensus on their optimal treatment. In 2004, a Cochrane review of the existing data on treatment of isolated ulna fractures noted insufficient data for determining appropriate treatment and called for future studies [9]. These conclusions are similar to those of Mackay and colleagues [7].

Contrary to the evidence supporting rigid fixation for other bony injuries, prior studies have demonstrated seemingly more rapid healing of ulna fractures in the absence of operative fixation, or even casting [1, 4]. Nonetheless, traditional orthopedic principles for treatment of displaced or unstable fractures lead many practitioners to address these injuries with operative intervention. This approach is supported by biomechanical models demonstrating an inverse relationship between soft tissue disruption at the fracture site and fracture stability [5]. Previous studies suggest that displacement of the fracture by at least one quarter of the ulna width and/or increasing angulation

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correlate with delayed healing and poorer outcomes using non-operative management, lending credence to the recommendation of operative intervention with these patients [1, 4, 11, 12].

Other groups have demonstrated rapid progression to union with non-operative interventions [1, 2, 5]. If successful, non-operative treatment avoids the morbidity of surgical incisions, implanted hardware and the possibility of a second surgery for removal of the hardware. Additionally, in most non-operative protocols, the patient is allowed functional use of the injured arm as tolerated. This could result in more rapid return to work and/or daily activities.

The purpose of this study is to analyze patients who have sustained an isolated fracture of the distal ulna. We specifically wish to determine if there is a difference in osseous healing and the incidence of complications between surgical and non-surgical treatment of these injuries.

Methods

After obtaining institutional review board approval, patients who had sustained a fracture of the distal one third of the ulna and presented for treatment at a level-one trauma center over a 5-year time span (January 2002 to December 2006) were identified. This was accomplished by searching for applicable ICD-9 codes from this institution's inpatient and outpatient databases. Once the cohort of patients was assembled, medical records and radiographs were reviewed to identify patient demographics, mechanism of injury, type of treatment, time to bony union, and any evident complications.

Patients were excluded if they were under the age of 18 years, presented more than 1 week following injury, had ipsilateral injuries of the forearm and/or wrist (carpus, distal radius, radius, and ulna shafts), or had an absence of follow-up examinations four or more weeks after injury.

The treating physician determined the treatment modality for each patient. Some patients in the series were referred to the hand surgery group at this institution, and others to the orthopedic trauma surgery group. Bony union was determined by the treating physician. Determination of healing was based on radiologic evidence of cortical bridging and lack of tenderness to palpation over the fracture site on clinical examination. Patients were generally examined clinically and with radiographs 1–2 weeks after their initial presentation and at 2–4-week intervals thereafter; however, the specifics of follow-up varied by physician. No standardized protocol for serial assessment of the osseous healing of these fractures was used.

Means were calculated for demographic data. Age and time to bony union in the operative and non-operative

groups were analyzed with the *t* test using Excel (Microsoft, Redmond, WA). Chi-square was used to determine correlation between sex and type of treatment.

Results

One hundred seven patients were identified during the 5-year study period. Four patients were excluded due to their age, 10 patients were excluded because of delayed presentation, 3 patients were excluded due to ipsilateral bony injuries, 49 patients were excluded due to inadequate follow-up. With some duplication in these categories for exclusion, this left a cohort of 47 patients (with 48 fractures) who met inclusion criteria. Average follow-up was 36 weeks with a range of 4 to 195 weeks.

The study cohort contained 17 women and 30 men (Table 1). The average patient age was 43 years (range 21 to 87 years). There were 33 left ulna fractures, 15 right ulna fractures, and 1 patient with bilateral fractures. Records indicated that 8 fractures occurred in the dominant hand, 14 in the non-dominant hand and, for 26 patients, hand dominance was not available.

Eight fractures were open. Seventeen fractures were comminuted. Twenty-eight fractures were displaced greater than or equal to 25% of the diameter of the ulna and/or more than 15°.

The mechanism of injury was varied (Fig. 1). Twenty-two injuries were the result of a motor vehicle collision, ten from assault, five from a fall, four from an accidental blow to the arm, two from a crush injury, two from gunshot wounds, one due to a pedestrian versus vehicle accident and one from stab wounds. Twenty-seven fractures were associated with concomitant injuries. Most of the patients with concomitant injuries were hurt in motor vehicle or motorcycle crashes, and their other injuries were predominantly orthopedic in nature.

Eighteen fractures underwent operative reduction and fixation. Thirteen ulnas were treated with plating. Three patients had the fracture treated with lag screws and two with pin fixation. The remaining 30 wrists were treated with a splint or cast until clinically healed. Figure 2 demonstrates images of a non-operatively managed right ulna fracture in a 71-year-old woman that was sustained in a motor vehicle crash. Figure 3 demonstrates images of an operatively managed left ulna fracture in a 21-year-old woman that was sustained in a motor vehicle crash. The operatively managed fracture was open due to a large overlying forearm laceration.

For ulna fractures that had follow-up long enough to potentially judge fracture consolidation, the average estimated time to healing (as judged with radiographs and

Table 1 Demographics, fracture characteristics, time to healing and complications of all distal ulna fractures in the study, grouped by operative and non-operative treatment

	Surgically treated fractures	Conservatively treated fractures	<i>p</i> value	Total
Number of included ulna fractures	18	30		48
Follow-up mean (weeks)	56.3	23.5		
Men	13	17		30
Women	5	13		18
Mean age	42.3	45.9		
Open fractures	7 (38.9%)	1 (3.3%)		8
Comminuted fractures	9 (50%)	8 (26.7%)		17
Angulated or displaced fractures	12 (66.7%)	16 (53.3%)	0.55	28
Concomitant injuries	17 (94.4%)	10 (33.3%)	<0.01	27
Time to healing (weeks)	11.3	9.0	0.12	
Complications	3 (16.7%)	2 (6.7%)	0.35	6

clinical examination) was 10.0 weeks (range 4.1 to 26.4 weeks). For two patients, the time to healing could not be reasonably determined because they were lost to follow-up for a number of months, and returned well after the completion of bony healing. Three other patients did not return for adequate follow-up to determine bony consolidation. Forearms that were treated with operative intervention had an average of 11.3 weeks to fracture healing (range of 5.0 to 26.4 weeks). Non-operative treatment resulted in an average of 9.0 weeks to healing (range 4.1 to 18.1 weeks). These differences in healing time were found

not to be statistically significant by the two-tailed *t* test ($p=0.124$). Age and sex demonstrated no correlation with operative versus non-operative treatment.

Of patients treated operatively, 67% (12) demonstrated preoperative angulation greater than 15° or displacement of at least one fourth of the diameter of the ulna. Fifty-three percent of the non-operatively treated fractures demonstrated similar angulation or displacement. This was not statistically significant ($p=0.55$). Ninety-four percent of patients treated operatively had concomitant injuries. This was statistically significant compared with patients who

Fig. 1 Mechanism distribution for ulna fractures in the study

Fig. 2 (a–d) Radiographs of a conservatively managed right ulna fracture in a 71-year-old woman that was sustained in a motor vehicle crash

underwent non-operative treatment ($p<0.01$), only 33% of which had concomitant injuries.

Two patients were initially treated with non-operative management, but appeared to fail that treatment (as determined by the treating physician). These patients underwent operative intervention with plating 23 and 29 days, respectively, after injury.

The overall complication rate was 10.4% and was lower for non-operative management (6.7%) than for operative fixation (16.7%), though this did not demon-

Fig. 3 (a–d) Radiographs of an operatively managed left ulna fracture in a 21-year-old woman that was sustained in a motor vehicle crash. The operatively managed fracture was open due to a large overlying forearm laceration

strate statistical significance ($p=0.35$) One operatively managed and one non-operatively managed ulna had no demonstrable healing, resulting in a nonunion rate of 4.2%. One patient developed distal radioulnar synostosis requiring operative intervention, one patient had hardware failure requiring repeat open reduction and internal fixation, one patient experienced painful hardware that was removed 16 months after it was placed, and one patient was returned to the operating room for acute carpal tunnel syndrome. All patients with complications had other concurrent injuries.

Discussion

Healing of the distal ulna fracture has been noted by some authors to be unpredictable, particularly in patients with confounding features, including the elderly and individuals with multiple injuries [4]. The population of this study offers good representation of patients who fit into these categories. Five of the 48 ulna fractures were sustained by individuals over the age of 60 years. Over 50% of all study patients sustained ulna fractures through high-energy mechanisms and more than 56% had concomitant injuries. Most of these concurrent injuries were orthopedic in nature.

Fracture healing time in this study is consistent with that reported by others [7]. Statistical analysis failed to demonstrate a difference in the healing time between operative and non-operative treatment groups, although it was suggestive of a faster time to healing for the non-operative group. However, assessment of bone healing is a notoriously inexact science when using plain radiographs and physical examination alone. And, with no “standard” timetables for follow-up, the time to union is really just an estimate. In our patient population, even a general routine for obtaining follow-up 1 to 2 weeks after the patient’s initial presentation and every 2 to 4 weeks thereafter was complicated by variance in treating physician plans for each patient as well as patient compliance with their follow-up plan. This absence of fixed time-points for assessment is a notable limitation of our data set and a point of variability for these patients in the trauma center setting in general. Nonetheless, it is likely that these non-significant differences in time to union between the operative and non-operative groups do not result in any real differences in clinical outcome and long-term function.

The larger percentage of patients in this cohort that sustained multiple injuries and complicated fracture patterns make it difficult to elucidate the factors that could contribute to the trend of slightly longer healing time with operative intervention. Again, this finding could simply be an effect of the differences in follow-up protocol used by the treating surgeons. Equivalent representation of like individuals in operative and non-operative management groups will be required in further studies to elucidate the influence of these factors on patient outcomes.

Despite studies of various non-operative treatment protocols, there is no consensus on the finer points of immobilization and resumption of motion [2–5, 8, 10]. There do not appear to be clear differences in short arm and long arm immobilization [2–5, 8, 10]. Some authors advocate a non-stabilizing dressing [1]. However, this approach is significantly limited by patient symptoms with

range of motion. It is not fully understood why fractures of the distal ulna generally heal well with minimal intervention. The biomechanics of the wrist likely play a role in this phenomenon, with studies demonstrating only a modest amount of load at the wrist being transmitted to the distal end of the ulna [6]. In the end, various types of immobilization are effective. Review of the current data supports that conclusion because the immobilization protocol varied among treating physicians, and all but one of the fractures treated without surgery eventually healed.

Many of the patients in this series who underwent surgical treatment for an ulna fracture did so in conjunction with the planned surgical treatment of other orthopedic injuries. This may represent a more surgically aggressive approach to patients who have been previously noted to have higher rates of suboptimal outcomes with non-operative management, but more likely, it is done in the interest of patient “convenience” and surgeon bias [4]. It is not unusual to operate on upper extremity fractures that, in isolation, would not otherwise be treated with surgery in the interest of maximally stabilizing the fracture in preparation for mobilization on crutches, walker, or some other ambulation assist device. Our study demonstrates a significant correlation between concomitant injuries and operative intervention. In this cohort, the most dramatic difference between the operatively and non-operatively treated groups was in concurrent injuries, rather than fracture displacement and angulation.

Surgical intervention for this injury is not without its potential pitfalls as noted by prior studies with a surgical treatment arm [11]. Though just over one third of this study’s patient population underwent surgical intervention, this group represents 60% of the patients with post-treatment complications. Analysis of patients with complications in the operative and non-operatively treated groups demonstrated an increased incidence of complications in the operatively treated group, though this did not achieve statistical significance in our study. Additional consideration should be given to the fact that other studies, as well as our own data, have not always supported improved fracture union with internal fixation [12].

Like all studies, this one has limitations. The chief limitation is the retrospective nature of the study. The data from the study relies on each individual practitioner recording uniform data points, which rarely happens. There is the potential for a large amount of bias based on this aspect of the study. Furthermore, when data is reviewed by a third party not originally involved with the treatment of the patients, it can be difficult to glean nuances of each patient encounter. The lack of follow-up is also a limitation

that is often out of the practitioners' control, and this causes problems in determining long-term outcome. The lack of functional data from a standardized survey such as the Disabilities of the Arm, Shoulder, and Hand Survey or Michigan Hand Questionnaire severely limits the conclusions that can be drawn regarding functional outcome. Functional data would be further confounded by the patients' concurrent injuries which include ipsilateral tendon and soft tissue injuries and, potentially, bony injuries of the hand distal to the carpus. These patients were intentionally included in the study cohort because management of these injuries was felt to have little impact on fracture healing at the ulna, but would have a much more substantial impact on the patient's return to full function.

In conclusion, this study lends support to the tenet that isolated distal ulna fractures heal at least as well and as quickly with non-operative as with operative management. However, patient subgroups with known complicating factors such as open fracture, complicated fracture pattern, or multiple injuries cloud the conclusions that can be drawn from these trends as they are currently demonstrated. Further studies with more equitable allocation of these patients to operative and non-operative groups would potentially allow more definitive conclusions to be drawn regarding the influence of each of these factors on treatment outcomes. As the evidence currently stands, no compelling support for operative treatment of isolated closed distal ulna fractures exists.

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