Low extra-articular (transcondylar) fractures of the distal humerus

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ABSTRACT

Background We reviewed our experience with low transcondylar, extra-articular distal humerus fractures to determine the prevalence of extra-articular distal humerus fractures, the percentage that are low transcondylar fractures, and the results of treatment.

Material and methods One hundred seventy-four fractures of the distal humerus in adult patients were identified. Patients with at least 1-year of follow-up were evaluated based on the medical record according to the system described by Broberg and Morrey.

Results Twenty-six fractures (15%) were extra-articular (AO Type A), 15 involved both the medial and lateral columns (8.6%), nine of which were low transcondylar fractures representing 5% of all fractures and 60% of the extra-articular bicolumnar fractures. Among the nine patients with low transcondylar fractures, two had non-union and three died within 3 months of injury. Among the eight patients with healed fractures after sufficient follow-up, patients with higher extra-articular distal humerus fractures had better motion and function than patients with low transcondylar fractures.

Conclusions Transcondylar fractures are the most common type of extra-articular bicolumnar fracture and may be more common than previously recognized. Mortality within 3 months and non-union appear common with this fracture type.

INTRODUCTION

Most distal humerus fractures involve the articular surface [1,2]. Extra-articular fractures are less common and are addressed specifically in only a few studies [3–5]. A subset of extra-articular bicolumnar fractures involving both the medial and lateral columns occur very low, at the base of the olecranon fossa, and are often referred to as transcondylar fractures [3,6].

Given that low transcondylar fractures of the distal humerus are relatively uncommon, it is remarkable that they appear to be over-represented in many non-union series [7–9]. Considering the relative lack of published data available, as well as our impression that these fractures may be more common than previously recognized, we reviewed the experience of a level 1-trauma centre treating extra-articular (AO Type A) fractures of the distal humerus over a period of 6 years [10].

The present study aimed to measure the prevalence of extra-articular distal humerus fractures, the percentage that comprises low transcondylar fractures, and to compare the results of treatment of the low transcondylar fractures with higher extra-articular bicolumnar distal humerus fractures.

MATERIALS AND METHODS

Using a trauma database and billing records, we identified 174 consecutive acute distal humerus fractures in adult (aged ≥ 18 years) patients who were treated at a level 1-trauma centre between 2002 and 2007. Under a protocol approved by our Human Research Committee, we reviewed the medical records and applied the following inclusion criteria: (1) extra-articular fracture and (2) very low fracture at the level of the base of the coronoid and the olecranon fossa (transcondylar fracture). Twenty-six of the 174 fractures (15%) were extra-articular fractures, of which 11 were single extra-articular epicondyle fractures and 15 were bicolumnar metaphyseal fractures, of which nine were low transcondylar fractures at the level of the base of the olecranon and coronoid fossae (transcondylar fracture) (Fig. 1).

We compared the demographics, injury characteristics and results of treatment for the nine transcondylar fractures and the six higher bicolumnar fractures (Fig. 2).
Transcondylar fracture of the distal humerus

Fig. 1 Breakdown of adult patients with distal humerus fractures (fx) treated at our level 1 trauma centre between 2002 and 2007.

patients. One patient had an ipsilateral distal radius fracture. Two patients had grade 1 open fractures [11].

Three non- or minimally displaced transcondylar fractures were treated with cast immobilization. Six patients with displaced fractures were treated with open reduction and fixation, five were treated using parallel plates and one was treated using a single lateral plate. The ulnar nerve was identified and transposed in three patients; released and relocated back into its original position in one patient and identified and protected in two patients. An olecranon osteotomy was used for exposure in two patients and the remainder were treated using a paratricipital approach [12].

The mean duration between date of injury and surgery was 3.6 days (range 1 day to 15 days; median 1.5 days).

Higher biconular fractures

The higher biconular fractures occurred in four women and two men with a mean age of 68 years (range 26 years to 85 years). The right elbow was fractured in three patients and the left was fractured in three patients. Five patients were retired and one was unemployed. All fractures resulted from a fall from a standing height. One patient had an ipsilateral proximal humerus fracture. No open fractures were seen.

All six patients had displaced fractures treated with open reduction and fixation, four using parallel plates, one using a single lateral plate, and one using three plates. The ulnar nerve was transposed in five patients and released and relocated back into its original position in one patient. Olecranon osteotomy was used in one patient and a paratricipital approach was used in five patients. The mean duration between the date of injury and surgery was 1.5 days (range 0 days to 3 days; median 1.5 days).

Evaluation

Three patients with transcondylar fractures died within 3 months of injury, one of whom died in the hospital. Three patients were followed for less than 1 year and either could not be contacted or declined to return for a research specific visit (one transcondylar fracture and two higher fractures). The nine patients (five transcondylar fractures and four higher fractures) with at least 1-year of follow-up (mean 3.0 years, range 1.0 years to 6.0 years).

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Fig. 2 A 79-year-old male sustained a left transcondylar fracture. The anteroposterior radiograph shows the extra-articular fracture line at the level of the base of the olecranon and coronoid fossa. (B) An 80-year-old male fractured his left distal humerus. The anteroposterior radiograph shows a high extra-articular metaphyseal fracture.
were evaluated based on the medical record according to the system described by Broberg and Morrey [13]. Non-union was defined as a persistent fracture line with either instability of the arm in patients treated non-operatively or loose or broken implants after surgery.

RESULTS

Transcondylar fractures

Among the six operatively-treated patients, one died and four had a minimal follow-up of 1 year (mean 3.8 years, range 2.4 years to 6.0 years). The mean arc of ulnohumeral motion was 108° (range 90° to 125°), with a mean flexion of 125° (range 110° to 135°) and a mean flexion contracture of 18° (range 10° to 20°). All patients retained full forearm rotation. According to the Broberg and Morrey system [13], the result was rated excellent in one patient, good in two patients and fair in one patient, with a mean score of 89.5 (range 76 points to 98 points), which represents a good score.

One patient developed a postoperative wound infection, non-union and osteomyelitis. He was treated with multiple debrisments and hardware removal to eradicate the infection and achieve healing.

Among the three patients who were treated non-operatively, two died and one developed a non-union, which was treated with open reduction and internal plate and screw fixation without bone grafting. However, the patient did not return for any subsequently scheduled visits. When admitted for an ununited left proximal femur, his distal humerus non-union was unstable with broken hardware. Additional elbow surgery was deemed too risky because of multiple medical co-morbidities. His elbow was rated poor (30 points) according to the Broberg and Morrey System (Table 1).

Higher bicolumnar fractures

Four patients were followed for at least 1 year (mean 2.7 years; range 1.0 years to 3.9 years). The mean arc of ulnohumeral motion was 128° (range 105° to 135°), with a mean flexion contracture of 8° (range 0° to 30°). All patients maintained full flexion and forearm rotation. According to the system of Broberg and Morrey [13], the result was rated as excellent in two patients and as good in two patients, with a mean of 95.0 (range 87 to 100), which represents a mean excellent score.

One patient developed a postoperative infection and underwent irrigation, debridement and implant removal, after which fracture healing was obtained. Another patient had a postoperative ulnar neuropathy.

DISCUSSION

AO Type A, extra-articular fractures comprised 15% of the distal humerus fractures seen at our institution. Fifteen of 174 (8.6%) were bicolumnar extra-articular fractures and nine of 174 fractures (5%) were low transcondylar fractures. Low transcondylar fractures were the predominant type of bicolumnar extra-articular fractures, comprising 60% of the total compared to 39% reported by Robinson et al. [14].

Consistent with the study by Robinson et al. [14], low transcondylar fractures comprised 5% of all distal humerus fractures and resulted largely from falls from a standing height in older patients. The mean age in their series was 59.6 years, although they included children (range 12 years to 99 years). Our mean age of 67 years may be more representative of transcondylar fractures in adults.

Three of nine (33%) patients with transcondylar fractures in our series died within 3 months of injury. These patients had a mean age of 82 years and all had medical co-morbidities. Four patients with transcondylar fractures were aged <65 years; two of which had substantial co-morbidity and one was physically impaired by chronic knee pain after multiple knee surgeries. The low transcondylar fracture may be similar to a femoral neck fracture in that it is associated with infirmity and a high risk of

Table 1  Transcondylar fractures

<table>
<thead>
<tr>
<th>Case</th>
<th>Sex, age (years)</th>
<th>Fracture</th>
<th>Mechanism</th>
<th>Treatment</th>
<th>Complications</th>
<th>Additional surgery</th>
<th>Follow-up (days)</th>
<th>Range of motion Flexion/extension (°)</th>
<th>Broberg and Morrey score and rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M, 79</td>
<td>Transcondylar</td>
<td>Fall</td>
<td>ORIF</td>
<td>—</td>
<td>—</td>
<td>867</td>
<td>110/– 20</td>
<td>91, good</td>
</tr>
<tr>
<td>2</td>
<td>F, 41</td>
<td>Transcondylar</td>
<td>Fall</td>
<td>ORIF</td>
<td>Infection, non-union, osteomyelitis</td>
<td>—</td>
<td>908</td>
<td>135/– 20</td>
<td>76, Fair</td>
</tr>
<tr>
<td>3</td>
<td>M, 49</td>
<td>Transcondylar</td>
<td>Fall</td>
<td>ORIF</td>
<td>—</td>
<td>Multiple</td>
<td>1576</td>
<td>120/– 20</td>
<td>93, Good</td>
</tr>
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<td>4</td>
<td>F, 52</td>
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<td>Fall</td>
<td>ORIF</td>
<td>—</td>
<td>—</td>
<td>2149</td>
<td>135/– 10</td>
<td>98, Excellent</td>
</tr>
<tr>
<td>5</td>
<td>M, 55</td>
<td>Transcondylar</td>
<td>Fall</td>
<td>Cast</td>
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<td>—</td>
<td>421</td>
<td>110/– 30</td>
<td>30, Poor</td>
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<td>6</td>
<td>F, 76</td>
<td>Transcondylar</td>
<td>Fall</td>
<td>ORIF</td>
<td>—</td>
<td>—</td>
<td>153</td>
<td>135/– 10</td>
<td>NA†</td>
</tr>
<tr>
<td>7</td>
<td>F, 85</td>
<td>Transcondylar</td>
<td>Fall</td>
<td>ORIF</td>
<td>—</td>
<td>—</td>
<td>49</td>
<td>120/– 20</td>
<td>NA†</td>
</tr>
<tr>
<td>8</td>
<td>F, 84</td>
<td>Transcondylar</td>
<td>Fall</td>
<td>Cast</td>
<td>—</td>
<td>—</td>
<td>59</td>
<td>80/– 50</td>
<td>NA†</td>
</tr>
<tr>
<td>9</td>
<td>M, 78</td>
<td>Transcondylar</td>
<td>Fall</td>
<td>Cast</td>
<td>—</td>
<td>—</td>
<td>71</td>
<td>110/– 40</td>
<td>NA†</td>
</tr>
</tbody>
</table>

*Untraceable/opted out.
† Died within 3 months after injury.
NA, not available; ORIF, open reduction and internal fixation.
Weening et al.

Table 2 High bicolumnar extra-articular fractures

<table>
<thead>
<tr>
<th>Case</th>
<th>Sex, age (years)</th>
<th>Fracture</th>
<th>Mechanism</th>
<th>Treatment</th>
<th>Complications</th>
<th>Additional surgery</th>
<th>Follow-up (days)</th>
<th>Range of motion Flexion/extension (°)</th>
<th>Broberg and Morrey score and rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F, 68</td>
<td>High metaphyseal into lateral epicondyle</td>
<td>Fall</td>
<td>ORIF</td>
<td>Ulnar neuropathy</td>
<td>—</td>
<td>367</td>
<td>135/0</td>
<td>93, Good</td>
</tr>
<tr>
<td>2</td>
<td>M, 80</td>
<td>High metaphyseal</td>
<td>Fall</td>
<td>ORIF</td>
<td>—</td>
<td>—</td>
<td>943</td>
<td>135/0</td>
<td>100, Excellent</td>
</tr>
<tr>
<td>3</td>
<td>F, 71</td>
<td>High metaphyseal</td>
<td>Fall</td>
<td>ORIF</td>
<td>Infection</td>
<td>I&amp;D and HW removal</td>
<td>1162</td>
<td>135/–30</td>
<td>87, Good</td>
</tr>
<tr>
<td>4</td>
<td>F, 85</td>
<td>High metaphyseal</td>
<td>Fall</td>
<td>ORIF</td>
<td>—</td>
<td>—</td>
<td>1398</td>
<td>135/0</td>
<td>100, Excellent</td>
</tr>
<tr>
<td>5</td>
<td>F, 77</td>
<td>High metaphyseal</td>
<td>Fall</td>
<td>ORIF</td>
<td>—</td>
<td>—</td>
<td>166</td>
<td>120/–20</td>
<td>NA*</td>
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<tr>
<td>6</td>
<td>M, 26</td>
<td>High metaphyseal</td>
<td>Fall</td>
<td>ORIF</td>
<td>—</td>
<td>—</td>
<td>11</td>
<td>85/–30</td>
<td>NA*</td>
</tr>
</tbody>
</table>

*Untraceable/opted out.

NA, not available; ORIF, open reduction and internal fixation.

mortality [15,16]. At our institution, we now mention both total elbow and ‘bag of bones’ non-operative treatment as options for infirm older patients with this fracture.

We had adequate follow-up in only nine of 15 (60%) patients and cannot judge statistical significance in terms of functional outcome, although the finding that patients with higher extra-articular fractures gained more motion than patients with transcondylar fractures merits additional study.

Many studies describe transcondylar fractures as being problematic. Bryan reported on two transcondylar fractures [6]. Both were initially treated with closed reduction and cast immobilization. One patient lost fracture alignment and underwent a secondary closed reduction and percutaneous pinning [6]. Robinson et al. reported a greater risk of delayed or non-union for ‘low’ extra-articular fractures compared to ‘high’ extra-articular fractures, although no specific numbers are provided [14]. Considered together, eight of 54 (15%) bicolumnar extra-articular fractures in their study went on to delayed or non-union [14]. Indeed, among three large series of patients treated for non-union of the distal humerus [7–9], 63% of the non-unions followed initially extra-articular fractures, which is far greater than the prevalence of extra-articular fractures among all distal humerus fractures. Two of the nine patients (22%) with at least 1 year of evaluation in our series developed non-unions: one in conjunction with postoperative infection, and one after open reduction and internal fixation.

On the other hand, some studies report good results. Imatami et al. treated 12 AO Type A2 fractures with a custom AO small T plate and described excellent results with a union rate of 100% [4]. Similarly, Perry et al. described good results for operative treatment of two displaced fractures and for non-operative treatment of three non-displaced transcondylar fractures [3].

Conclusions

In summary, we consider that transcondylar fractures are more common than previously assumed and are the predominant bicolumnar distal humerus fracture pattern; however, a larger study population is needed to confirm this. Transcondylar fractures appear to have a relatively high risk of non-union and are also associated with a substantial rate of co-morbidity and post-injury mortality. Operative treatment of a displaced fracture is challenging because of the small, largely articular distal fragment, complex elbow anatomy and osteoporosis. Unfortunately, the results of non-operative treatment, even for non- or minimally displaced fractures, appear to be unpredictable.

References


