

Mini Review

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## Transolecranon Distal Humerus Fractures: A Mini Review

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### Article Info

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#### Keywords

Transolecranon  
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Outcomes  
Complications

### Abstract

**Background:** Transolecranon distal humerus fractures are uncommon injuries. The purpose of this study is to review the outcomes and complications associated with transolecranon distal humerus fractures.

**Material and Methods:** We performed a systematic search of PubMed for articles published between 1990 and 2021. Included studies reported outcomes and complications of transolecranon distal humerus fractures. Data was extracted from the included studies to describe patient demographics, injury characteristics, outcome measurements, and complications.

**Results:** A total of 4 studies met inclusion criteria for data extraction and analysis. Two studies evaluated an adult cohort of a total of 18 patients. The average Disabilities of the Arm, Shoulder, and Hand (DASH) score was 40 (range 4.2 – 76.5). Fifteen patients (83%) had a complication. Elbow stiffness (11/18, 61%) was the most common complication. Eleven patients (61%) underwent more than one procedure. Two studies evaluated a pediatric cohort of a total of 9 patients. Five patients (56%) underwent non-operative treatment with immobilization and four patients (44%) underwent open reduction and internal fixation. There were no complications reported. All the pediatric patients regained near full range of motion of the elbow at their final follow-up.

**Conclusion:** Transolecranon distal humerus fractures are complex elbow injuries. In the adult population, they remain a challenge for orthopaedic surgeons. Complications, including elbow stiffness and infection, are high with frequent long-term functional limitations as represented by DASH scores. In contrast, pediatric patients have good outcomes and minimal complications that are similar to isolated olecranon and distal humerus fractures in children.

### Background

Transolecranon distal humerus fractures are high-energy, traumatic injuries<sup>1</sup>. The mechanism of injury is an axial load of the distal humerus through the olecranon resulting in both distal humerus and olecranon fractures (Figure 1). The distal humerus fracture is usually intra-articular and multi-fragmentary and the olecranon fracture can extend to the coronoid or proximal ulnar diaphysis<sup>2</sup>. The incidence of this fracture pattern is unknown. This is likely because there is no specific classification scheme for this injury.

Outcomes of transolecranon fracture-dislocations<sup>3-6</sup> and isolated distal humerus fractures<sup>7-15</sup> have been described in the literature. The purpose of this study was to review the outcomes and complications associated with transolecranon distal humerus fractures.

### Materials and Methods

To identify relevant publications, we searched PubMed, including



**Figure 1:** Radiographs of a transolecranon distal humerus fracture. The AP (a) and lateral (b) views of the elbow demonstrate the multi-fragmentary distal humerus and olecranon fractures. The AP (c) and lateral (d) views of the elbow show internal fixation of the distal humerus and olecranon that went on to fracture nonunion secondary to infection.

studies from 1990 to February 2021. The literature search was limited to studies since 1990 to ensure findings reflected modern clinical practices and implants. We searched for terms “transolecranon fracture”, “distal humerus fracture”, “olecranon fracture”, “proximal ulna fracture”, and “transolecranon distal humerus fracture”. The following were the inclusion criteria: 1) the study population included pediatric or adult patients with transolecranon distal humerus fractures, 2) outcome measurements were obtained through clinical exam (e.g., range of motion) or questionnaires (e.g., Disabilities of the Arm, Shoulder, and Hand), 3) complications, if any, were reported for the study population. If a study had a subpopulation that met the inclusion criteria, the study was included. One reviewer applied the inclusion criteria to the studies gathered from the PubMed search, determined which studies to include in the review, and extracted the data from each study. Data that was extracted included patient demographics, injury characteristics, outcome measurements, and complications. Descriptive statistics were reported as means and range for continuous variables and as counts and percentages for categorical variables for patient demographics, outcome measurements, and

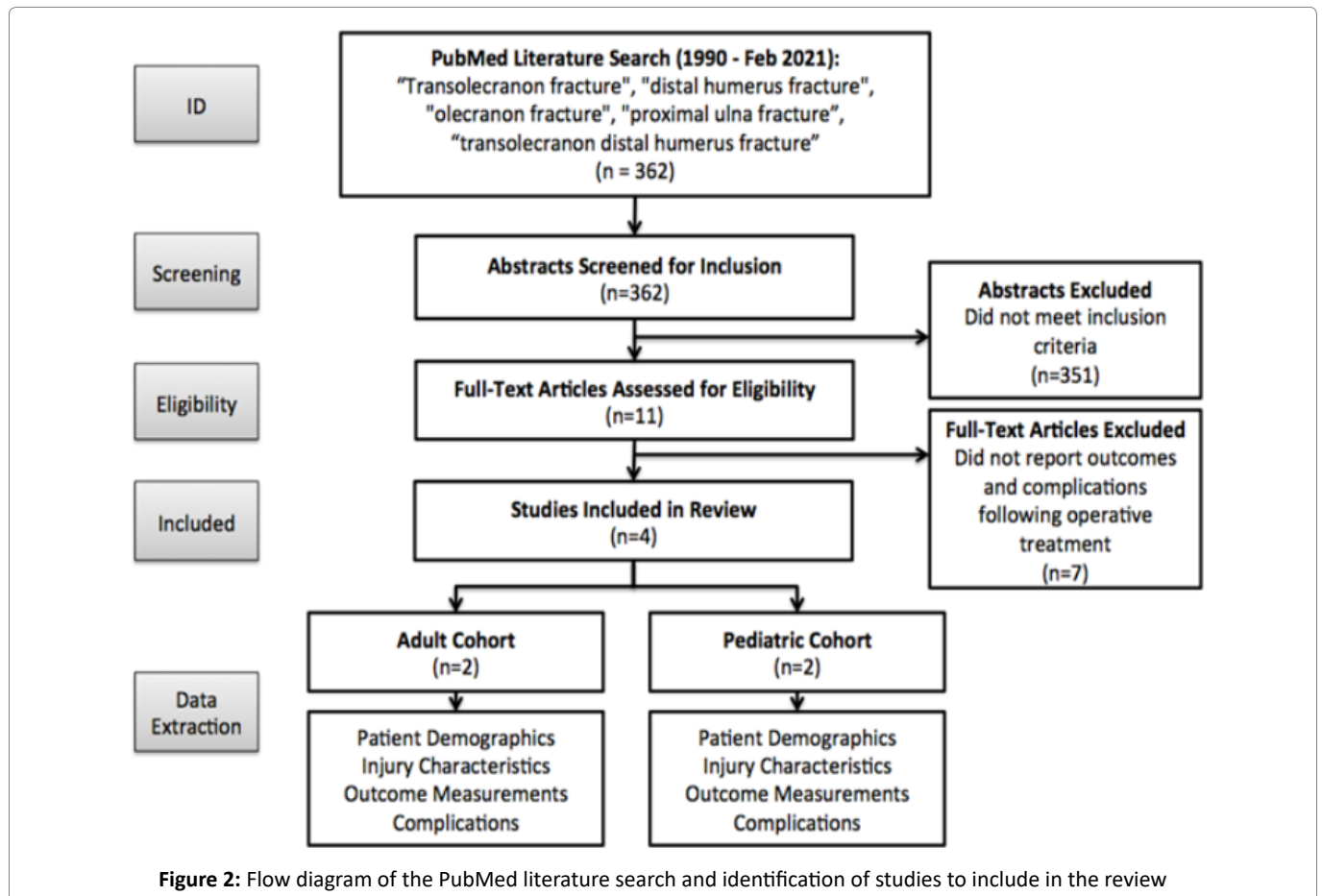
complications. The Oxford Centre for Evidence-Based Medicine was used to assess the level of evidence for each included study<sup>16</sup>.

## Results

The search for relevant studies was initiated in February 2021 (Figure 2). Four studies met inclusion criteria for data extraction and were level 4 evidence<sup>16</sup>. There was one case series<sup>1</sup> and one case report<sup>17</sup> of adult patients with transolecranon distal humerus fractures. There was one case series<sup>18</sup> and one case report<sup>19</sup> of pediatric patients with transolecranon distal humerus fractures. There were two case series that had three total patients with transolecranon distal humerus fractures<sup>3,6</sup>. However, they did not report outcomes or complications of this subpopulation and were not included in this review.

## Adult Cohort

Cho et al. (Cho)<sup>1</sup> had a case series of 16 adult patients and Sun et al. (Sun)<sup>17</sup> had a case report of 2 adult patients with transolecranon distal humerus fractures (Table 1). Among the two studies, the average age was 46 years (range 20 – 92 years) with 11 females (61%). The dominant



extremity was fractured in 7 patients (39%). Thirteen patients (72%) had high-energy mechanisms of injury. Seven patients (39%) were polytrauma patients. Twelve of the fractures (67%) were open with five being grade III open injuries<sup>20</sup>. Fractures of the distal humerus were classified using the AO/Orthopaedic Trauma Association (OTA) classification<sup>21</sup>. Seven patients (39%) had C-type fractures. Eight patients (44%) had B-type fractures. Three patients (17%) had A-type fractures.

All patients eventually underwent open reduction internal fixation as definitive treatment for their fracture except for one patient in Cho's case series. The average clinical follow-up among the 18 adult patients was 16.6 months (range 3.4 - 52.4 months). In Cho's cohort<sup>1</sup>, the average extension-flexion arc was 74 degrees (range 0 - 125 degrees) and average pronation-supination arc was 156 degrees (range 120 - 180 degrees). Cho<sup>1</sup> reported Disabilities of the Arm, Shoulder, and Hand (DASH) scores for 10 patients. At an average of 3.8 years from the date of injury, the average DASH score was 40.2 (range 4.2 - 76.5). Sun<sup>17</sup> did not have patient-reported outcome measurements. However, they did report range of motion of the elbow for their two patients at the final 2-year follow-up. One patient had active range of motion of 15 to 135 degrees extension-flexion, and the second patient

had active range of motion of 7 to 133 degrees extension-flexion.

Complications were observed in 15 adult patients (83%) among the two studies. Cho<sup>1</sup> reported elbow stiffness, defined as an arc of elbow flexion/extension less than 100 degrees, in 11 patients (61%). Three patients (17%) underwent contracture release. Seven patients (39%) developed deep infections and underwent surgical debridement and intravenous antibiotics. All infections were successfully treated with surgical debridement and antibiotics. Wound dehiscence occurred in 4 patients (22%). Two patients (11%) underwent flap reconstruction with a bipedicle flap and a posterior interosseous island flap. Eight patients (44%) had an ulnar nerve palsy post-operatively and two patients (11%) underwent additional surgery for the ulnar neuropathy. The remaining six patients (33%) had resolution of their ulnar nerve palsy with conservative management. Heterotopic ossification (HO) that was clinically relevant and causing functional limitations, based on Hastings and Graham classification<sup>22</sup>, was present in 7 patients (39%). Four patients (22%) developed post-traumatic arthrosis and one patient (6%) underwent additional surgery with excision of osteophytes. There were 7 patients (39%) with fracture nonunion, 5 of the olecranon and 2 of the distal humerus. Two patients

**Table 1:** Summary of Studies in the Review

**Adult Cohort**

Study	Number of patients	Average Age (years)	Intervention	Elbow Range of Motion	Outcome Measure	Number of complications (%)
Cho et al.	16	45	15 ORIF 6 External Fixator 5 Both	Avg flexion arc = 74° (range = 0-125°) Avg pronation/supination = 156° (range = 120-180°)	DASH	15 (94%)
Sun et al.	2	56.5	2 ORIF	1 pt 15-135° flexion 1 pt 7-135° flexion	N/a	0 (0%)

**Pediatric Cohort**

Study	Number of patients	Average Age (years)	Intervention	Elbow Range of Motion	Outcome Measure	Number of complications (%)
Sharma et al.	8	4.1	5 Non-operative 3 ORIF	7 pts with <0-5° loss of motion 1 pt with 10° loss of motion	Flynn's Criteria	1 (12.5%)
Farooq et al.	1	4.5	1 ORIF	Flexion/Extension = 0-130° Pronation/Supination = 70°/80°	N/a	0 (0%)

Avg = Average; DASH = Disabilities of the Arm, Hand, and Shoulder; ORIF = Open Reduction and Internal Fixation; pt(s) = patient(s)

(11%) underwent repair of the nonunion. Overall, eleven patients (61%) underwent more than 1 surgery to manage their injuries. Sun<sup>17</sup> did not report any complications among their two patients at final 2-year follow-up.

**Pediatric Cohort**

Sharma et al. (Sharma)<sup>18</sup> had a case series of 8 pediatric patients and Farooq et al. (Farooq)<sup>19</sup> had a case report of 1 pediatric patient with transolecranon distal humerus fractures (Table 1). Among the two studies, the average age was 4.1 years (range 3 – 7 years) with 3 females (33%). Mechanism of injury was reported for one patient in Farooq’s case report<sup>19</sup>, which was high-energy. All patients had a distal humerus lateral condyle fracture with an olecranon fracture. Two patients (22%) had displaced lateral condyle and olecranon fractures and underwent open reduction and internal fixation with Kirschner wires. Two patients (22%) had displaced lateral condyle fractures and non-displaced olecranon fractures and underwent open reduction and internal fixation with Kirschner wire (n=1) or screw fixation (n=1) of the lateral condyle fracture only. Five patients (56%) had non-displaced olecranon and lateral condyle fractures and underwent non-operative treatment with immobilization.

The patient in Farooq’s case report<sup>19</sup> followed up for 6 months after operative fixation of the displaced olecranon and lateral condyle fractures. The patient had

0 degrees elbow extension and 130 degrees elbow flexion with 70 degrees pronation and 80 degrees supination at final follow-up. There was union of the fractures and no complications. Sharma’s case series<sup>18</sup> of 8 patients had 7 excellent results and 1 good result based on Flynn criteria<sup>23</sup>. The range of motion of the patients were not reported in the study. The patient, who underwent operative fixation of displaced olecranon and lateral condyle fractures, had 10 degrees loss of terminal extension. Otherwise, there were no complications.

**Discussion**

Transolecranon distal humerus fractures are complex injuries, especially in the adult population. This review illustrated the paucity of literature about this challenging elbow injury. There were 4 total studies (2 adult and 2 pediatric cohorts) evaluating the outcomes and complications of transolecranon distal humerus fractures<sup>1,17-19</sup>.

Among the adult population, transolecranon distal humerus fractures were associated with high-energy mechanisms of injury with extensive soft tissue disruption. In this review of transolecranon distal humerus fractures, there was a complication rate of 83% in the adult cohort. Elbow stiffness of less than 100 degrees arc of motion was the most common complication (11/18, 61%). Infection, nonunion, and heterotopic ossification occurred in about



40% (7/18) of the patients. The nonunion rate may have been high due to the high rate of open fractures, articular injury, and soft tissue disruption. Use of radiation and NSAIDs for heterotopic prophylaxis may be considered for all patients without contraindications, or selectively in patients with elevated risk, such as those with open fractures and traumatic brain injury. Sixty-one percent of the patients (11/18) underwent more than one surgery. These complications were higher than isolated olecranon fractures, distal humerus fractures, or transolecranon fracture-dislocations<sup>2,3,6,8,13,15,25</sup>. Also, distal humerus fractures and elbow fracture-dislocations are known to be a common source of post-traumatic elbow arthrosis due to greater severity of articular surface injury<sup>3,24</sup>. There were 4 patients (22%) who developed post-traumatic arthrosis. This may have been an underestimate as the radiographic follow-up in the two studies was less than 1 year. The average DASH score of 40 illustrated the everyday impairment adult patients experienced as a result of this injury.

Among the pediatric population, transolecranon distal humerus fractures had better outcomes. The patients in this review were not polytrauma patients, did not have open fractures, and had average age of 4. Therefore, the mechanism of injury was likely lower energy and did not have extensive soft tissue injuries unlike the adult cohort. Five patients were treated non-operatively for non-displaced fractures and four patients were treated with operative fixation. One patient had displaced olecranon and lateral condyle fractures and underwent operative fixation. He had 10 degrees loss of terminal extension. Otherwise, there were no reported complications. These outcomes were similar to isolated olecranon and lateral condyle fractures in the pediatric population<sup>26,27</sup>.

There were limitations of this review. The strength of the review was dependent on the quality of the included studies. The review only had case series and case reports, which are level 4 evidence<sup>16</sup>. The review only included retrospective studies, so there were inherent weaknesses, including loss to follow-up, differences in surgical technique, and post-operative rehab between the studies. The patient follow-up among the studies were inconsistent with some patients lacking long-term follow-up. All the studies in the review did not provide the same outcome measures. The studies in the review were published over a 12-year span (2009 to 2021) and may represent different surgical procedures. However, this is not a significant limitation. The two adult studies<sup>1,17</sup> were published in 2019 and 2021 and used modern implants for fixation of distal humerus and olecranon fractures in adults. The two pediatric studies were published in 2009 and 2016. The pediatric fractures were treated non-operatively or operatively with Kirschner wires or screw fixation, which

is the same surgical procedure that would be performed today.

Transolecranon distal humerus fractures are complex elbow injuries. In adult patients, they have high rates of elbow stiffness, infection, nonunion, and functional limitations. Surgeons and patients should be made aware of the high rates of complications and loss of elbow function. On the other hand, pediatric patients have good outcomes and minimal complications that are similar to isolated olecranon and distal humerus fractures in children. Future research on transolecranon distal humerus fractures need to focus on the adult population. There needs to be higher level of evidence studies evaluating post-operative rehab protocols to improve elbow stiffness, wound management and antibiotics to reduce infection rates, and fixation strategies to increase union rates.

### Conflicts of Interest

Blaine T. Bafus has the following disclosures:

American Society for Surgery of the Hand: Board or committee member

Polynovo LTD: Stock or stock Options

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