



Wound complications after distal humerus fracture fixation: incidence, risk factors, and outcome

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Background: This study set out to accurately determine the incidence of wound complications after distal humerus fracture fixation, to assess risk factors, and to determine their implications on outcome.

Methods: Eighty-nine distal humerus fractures (mean patient age, 58 years) were treated with internal fixation at an average of 4 days after injury. Mean follow-up time was 15 months (range, 6-72 months). Twenty-nine (33%) fractures were open. Medical records and radiographs were reviewed to determine wound complications. Logistic regression analysis was carried out to determine associated risk factors.

Results: Fourteen patients (15.7%) developed a major wound complication requiring on average 2.5 (range, 1-6) additional surgical procedures. Six patients required plastic surgical soft tissue coverage. All 14 fractures complicated by wound problems united. The final mean range of motion in the major wound complication group was 100° (range, 65°-130°), compared with 100° (range, 10°-140°) in those with no or minor wound problems. Grade III open fractures and the use of a plate to stabilize the olecranon osteotomy were identified as significant risk factors for development of major wound complications.

Conclusions: The incidence of major wound complications after fixation of distal humerus fractures is substantial. The presence of a grade III open fracture and the use of an olecranon osteotomy stabilized with a plate are significant risk factors for major wound complications. Fracture healing rates and functional elbow range of motion do not appear to be affected by major wound complications when they are handled with proper soft tissue coverage techniques.

Level of evidence: Level IV, Case Series, Treatment Study.

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Keywords: Wound complications; distal humerus fracture fixation

Open reduction and internal fixation are indicated for most distal humerus fractures to allow early mobilization and to optimize functional outcome.^{1,4,12} Recent improvements

in surgical technique and the availability of modern peri-articular plates have translated into more predictable internal fixation of distal humerus fractures.^{17,22} However, these injuries are complicated to treat because of the frequency of intra-articular comminution, poor bone quality, and difficulties with surgical exposure.¹² Furthermore, soft tissue damage in combination with the thin surrounding soft tissue envelope at the elbow joint places these injuries at risk for major postoperative wound complications.⁶ Wound complications can lead to significant morbidity with the need for

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Table I Key features of minor and major wound complications

Minor complications	Major complications
No further surgical procedure required Superficial wound infection resolved with oral antibiotics Minor wound dehiscence managed with local wound care	At least one further surgical procedure required Major wound infections requiring irrigation and débridement Wound dehiscence requiring irrigation, débridement, delayed closure, or soft tissue coverage

further surgical procedures, can possibly influence the outcome of the initial treatment, and are associated with increased health care costs. In addition, in the setting of fracture fixation, this complication may delay rehabilitation that is necessary for optimal elbow function.¹⁸

The incidence of infection after fixation of distal humerus fractures has been documented. In spite of the well-known problem of wound problems in general associated with these injuries, it is surprising to learn that there is no published literature directly addressing wound complications after distal humeral fracture. The aims of this study were to review the incidence of wound complications after distal humerus fracture fixation, to determine risk factors, and to assess their implications on outcome.

Methods

Using our institutional trauma registry database, we identified 89 consecutive patients who sustained a distal humerus fracture treated with open reduction and internal fixation between 2004 and 2010. Exclusion criteria were skeletal immaturity, pathologic fractures, patients treated with total elbow arthroplasty, and fractures managed nonoperatively. A detailed review of patients' medical and operative notes was performed to record patient demographics, details related to the fracture and its treatment, postoperative course including acute and delayed complications, and clinical outcome at final review including range of motion. Radiographs of all patients were carefully evaluated for evidence of bone union, failure of fixation, and implant and heterotopic ossification formation. In the early postoperative stage, patients were seen within the first 2 weeks of surgery and thereafter as required, depending on clinical concerns and overall progress. Patients were observed for a mean of 15.3 months (range, 6-72 months).

In relation to the surgical wound, patients were initially categorized into 1 of 3 groups: no wound complications identified, minor wound complications occurred (such as superficial wound infection or minor dehiscence that resolved with oral antibiotics and local wound care), and major complications developed (requiring return to the operating room for irrigation, débridement, delayed closure, or soft tissue coverage). [Table I](#) highlights the key features of minor and major wound complications. The diagnosis and type of infection were verified from microbiology records.

Patient demographics

The mean age of the patients at the time of fracture was 58.4 years (range, 18-97 years); there were 45 men and 44 women. Fifty

fractures (56%) were the result of a low-energy fall from a standing height; 19 (21%) occurred after a high-energy fall from a height; and 20 (22%) were the result of a high-energy impact, such as a motor vehicle collision. Twenty-nine fractures (33%) were open; by use of the grading system of Gustilo and Anderson, 7 were grade I, 11 were grade II, and 11 were grade III. The fractures were classified according to the updated Orthopaedic Trauma Association fracture and dislocation classification compendium: 16 were graded A, 7 B, 15 C1, 16 C2, and 35 C3. Fractures were treated at a mean of 3.8 days (range, 0-15 days) after injury. Twenty-one open fractures underwent a staged treatment strategy, whereby the wound was managed with initial urgent irrigation and débridement followed by definitive fixation at a separate sitting.

Surgical technique

Intravenous antibiotic prophylaxis was used and a midline posterior incision performed in all cases. The ulnar nerve was identified and mobilized in all cases, and it was transposed in 61 cases at the completion of the procedure. The surgical approaches used were as follows: 53 patients had a trans-olecranon osteotomy, of which 35 were stabilized with a precontoured olecranon plate, 13 with large fragment screw fixation, and 5 with tension band wiring; 25 patients underwent a tricipital window approach; 6 patients had a triceps tongue approach; and 5 patients had a triceps-reflecting anconeus pedicle¹³ approach. Of the 29 open fractures, 17 were exposed through an olecranon osteotomy; 12 osteotomies were fixed with a plate and 5 with an intramedullary screw. Seventy-four patients (83%) underwent a double parallel plating technique. The remaining fractures were fixed with either 90/90 plating or a single plate. In all cases, the implants used for fixation included anatomic precontoured elbow plating systems.

Statistical analysis

Statistical analysis was performed to determine if there was any significant difference in patients who had major wound complications requiring operative management compared with those who did not. Thus patients with no or minor complications were grouped together. Continuous variables (including age, tourniquet time, time from injury to definitive surgery, and Injury Severity Score) were compared by an independent *t*-test. Categorical variables included sex, smoking history, diabetes, drain use after surgery, wound closure, presence of an open fracture, whether staged surgery was performed, Orthopaedic Trauma Association classification of grade 13-C3, and use of an olecranon osteotomy approach fixed with a plate. These variables were compared with the use of χ^2 analysis. The level of significance was set at $P < .05$. Risk analysis was then performed by logistic regression analysis.

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