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Original article

# Conversion of external fixation to open reduction and internal fixation for complex distal radius fractures



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## ABSTRACT

**Introduction:** Distal radius fractures are common injuries treated in a multitude of ways. One treatment paradigm not extensively studied is initial treatment by external fixation (EF) followed by conversion to open reduction internal fixation (ORIF). Such a paradigm may be beneficial in damage control situations, when there is extensive soft tissue injury, or when appropriate personnel/hospital resources are not available for immediate internal fixation.

**Hypothesis:** There is no increased risk of infection when converting EF to ORIF in the treatment of complex distal radius fractures when conversion occurs early or if EF pin sites are overlapped by the definitive fixation.

**Materials and methods:** Using an IRB approved protocol, medical records over nine years were queried to identify patients with distal radius fractures that had undergone initial EF and were later converted to ORIF. Charts were reviewed for demographic data, injury characteristics, operative details, time to conversion from EF to ORIF, assessment of whether the EF pin sites overlapped the definitive fixation, presence of infection after ORIF, complications, and occupational therapy measurements of range of motion and strength.

**Results:** In total, 16 patients were identified, only one of which developed an infection following conversion to ORIF. Fisher's exact testing showed that infection did not depend on open fracture, time to conversion of one week or less, presence of EF pin sites overlapping definitive fixation, fracture classification, high energy mechanism of injury, or concomitant injury to the DRUJ.

**Discussion:** Planned staged conversion from EF to ORIF for complex distal radius fractures does not appear to result in an increased rate of infection if conversion occurs early or if the EF pin sites are overlapped by definitive fixation. This treatment paradigm may be reasonable for treating complex distal radius fractures in damage control situations, when there is extensive soft tissue injury, or when appropriate personnel/hospital resources are not available for immediate internal fixation.

**Level of evidence:** IV, retrospective case series.

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## 1. Introduction

Distal radius fractures are one of the most common fracture types of the upper extremity [1]. There are several surgical options available to treat distal radius fractures [2], including external fixation (EF), percutaneous pinning, or open reduction and internal fixation (ORIF) with volar and/or dorsal plating. There are advantages and disadvantages to these approaches, such that the American Academy of Orthopaedic Surgeons Clinical Practice Guideline provides an inconclusive recommendation for any one

specific operative method [3]. However, some meta-analyses of randomized controlled studies comparing EF to ORIF for surgical treatment of distal radius fractures suggest that ORIF results in lower DASH scores at 12 months and reduced infection rates [4,5]. Further, when looking at the limited literature available for open fractures of the distal radius, immediate ORIF appears to have a low risk of major complications [6], and planned conversion from EF to ORIF has been shown to require significantly more secondary procedures [7], though the number of reported cases is small and there was no mention of the time to conversion.

Borrowing from damage control principles on the staged treatment of other complex fracture patterns in orthopaedic trauma, such as tibial plateau [8] and pilon fractures [9], EF of complex distal radius fractures may sometimes be an appropriate initial choice of

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fixation. The EF can then be converted to ORIF at a later date once the patient has stabilized, the soft tissue is amenable to the added surgical trauma, and/or appropriate personnel (e.g., surgeon and staff) are available to manage the injury. Prior literature concerning infection for converting femoral and tibial shaft or peri-articular tibia fractures to definitive fixation with either intramedullary devices or ORIF with plates and screws have raised the question of (1) when is the appropriate time to convert and (2) can the definitive fixation overlap the EF pin sites [8,10]? We hypothesized that there would be no increased risk of infection when converting EF to ORIF in the treatment of complex distal radius fractures when conversion occurs early or if EF pin sites are overlapped by the definitive fixation. The purpose of the present investigation is not to discern whether treatment by conversion of external fixation to open reduction internal fixation leads to decreased infection compared to other treatment methods. Rather, starting with the scenario that conversion of external fixation to open reduction internal fixation will be the course of treatment, we investigate factors that may increase the risk of infection using this treatment paradigm.

## 2. Methods

This was an IRB approved retrospective review of the electronic medical records (EMR) of patients who had conversion from EF to ORIF for distal radius fractures at one institution from 2007–2015. Cases were generated by a search of the EMR for patients who had simultaneous codes for EF adjustment or removal (CPTs 20693 and 20694) and ORIF of the distal radius (CPTs 25607, 25608, and 25609). These cases were reviewed to ensure the treatment consisted of patients with distal radial fractures who were initially treated with EF followed by conversion to ORIF.

Where available, data extracted from the EMR included age, gender, mechanism of injury, soft tissue and other related injuries of

the wrist complex, operative details, time from EF to conversion to ORIF, occupational therapy documentation of range of motion and strength at latest time post-conversion, presence or absence of infection during the treatment period, and other complications. Radiographs were reviewed to classify the fracture according to the AO/OTA fracture classification system [11] and to assess whether the EF pin sites overlapped the instrumentation for definitive ORIF.

Fisher's exact testing was performed to determine if open fracture, time to conversion of one week or less, presence of EF pin sites overlapping the definitive fixation, fracture classification, mechanism of injury, or concomitant injury to the distal radial ulnar joint (DRUJ) were significantly associated with the primary outcome of infection. Additionally, for open fractures, Gustilo-Anderson grade I and II fractures were compared to grade III fractures [12,13]. Statistical significance was set at  $P < 0.05$ .

## 3. Results

A total of 16 cases were identified, all of which were patients who sustained distal radius fractures initially treated with EF followed by later conversion to ORIF (see Figs. 1 and 2 for case examples). Seven cases were poly-trauma. There were 10 left wrist injuries. All fractures eventually went on to unite, with two requiring bone grafting at conversion to ORIF and another requiring a staged Masquelet procedure upon conversion to ORIF.

Table 1 shows the demographic data, mechanism of injury, AO/OTA fracture classification, whether the injury was an open fracture and the grade, and other associated soft tissue injuries. The average patient age was  $46.1 \pm 14.7$  (mean  $\pm$  SD) years. There were eight males. Eleven injuries were classified as high energy (fall from more than height, motor vehicle collision, pedestrian struck, and gun shot). Twelve injuries were either AO/OTA 23-C2 or C3 fractures. One case had a forearm compartment syndrome, two had



**Fig. 1.** Case example of a 37-year-old male in a motorcycle accident. A and B show PA and lateral radiographs of the injury. There was a poke hole over the palmar aspect of the wrist. C and D show PA and lateral radiographs of the wrist after external fixation. A complete laceration of the flexor carpi ulnaris tendon was repaired at the same time as irrigation and debridement and placement of wrist spanning external fixator. Seven days later the patient was brought back for conversion of the external fixator to palmar plating. E and F show PA and lateral radiographs at 3-month follow-up. The external fixator pin sites did not overlap the definitive fixation. The patient had a 47° flexion-extension arc and 97° of pronosupination.

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