SCIENTIFIC ARTICLE

Open Fractures of the Distal Radius: The Effects of Delayed Debridement and Immediate Internal Fixation on Infection Rates and the Need for Secondary Procedures

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Purpose There are few clinical data evaluating the outcome of surgery for open distal radius fractures based on treatment method. Specifically, the major contributing factors to infection are largely unknown. The purpose of this study is to determine the effect of early versus delayed debridement and the choice of initial external versus internal fixation on infection rates and the need for secondary procedures.

Methods Thirty-two patients with open distal radius fractures were identified from a database. Ten debridements were early (<6 h after hospital admission), and 22 debridements were delayed (>6 h after hospital admission). There were 10 treating surgeons for the 32 patients in this study. Based on the attending surgeon's preference and experience, 20 fractures were treated with external fixation, 7 with plating, and 5 with planned staged conversion from external fixation to plating. The cohort included 19 grade I, 11 grade II, and 3 grade IIIA open injuries.

Results There were no infections, regardless of the time to debridement or the use of immediate plating. Other complications requiring secondary procedures occurred more frequently in patients treated with a planned staged conversion from external fixation to plating than in the patients treated with either external fixation or plating.

Conclusions We did not encounter infections for grade I and grade II open distal radius fractures, and infections do not appear to be related to either the time to debridement or the initial type of fracture fixation. Plating might be safe at the initial debridement, but temporary external fixation with a staged conversion to plating increases the risk of complications, which necessitates corrective secondary procedures. *(J Hand Surg 2011;36A:1131–1134.*

Type of study/level of evidence Therapeutic III.

Key words Delayed, distal, fixation, open, radius.

There are few studies evaluating the outcomes of open distal radius fractures based on treatment strategies. In their study of 18 patients, Rozental et al suggested that infection is common and poor outcomes correlate with the grade of injury.[1] Grade I injuries behaved like closed injuries, whereas increasing rates of infection were seen with grade II and grade III injuries. However, in a larger study of 42

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patients by Glueck et al, infection was uncommon and correlated to the degree of wound contamination. Deep infections occurred in only 3 patients: 1 grade II and 2 grade III injuries.[2] These 2 papers leave many questions unanswered. Specifically, neither study examined the effect of the timing of debridement or the use of initial internal fixation on infection rates.

Data from the treatment of open long bone fractures suggest that early debridement (<6 h from the time of injury) does not reduce the rate of infection. However, it is a common practice to debride early.[3,4] In addition, immediate internal fixation of open fractures after thorough debridement is a common practice for both open lower and upper extremity fractures.[5,6]

We retrospectively reviewed the data contained in a database to determine the effect of the time to debridement and the type of fixation (external vs internal) on infection rates and other complications. We hypothesized that neither the timing of operative debridement nor the choice of fixation method would affect infection rates.

METHODS

The medical data for all orthopedic trauma patients who came to the emergency department at Boston University Medical Center from January 2003 to December 2009 were entered into an orthopedic trauma database at our tertiary-care medical center. Forty patients with 41 open distal radius fractures, AO/OTA[14] 23A (extra-articular), 23B (partial articular fracture), and 23C (complete articular fracture) were identified in this database.

Using a protocol approved by our institutional review board, we retrospectively reviewed the medical records. To be included, a patient had to be older than 18 at the time of injury and show radiographic healing or receive at least 6 months of follow-up care. The patient's hospital record had to be complete and needed to include the following: arrival time at the emergency department, time the patient first received intravenous antibiotics, time of operative procedure, duration of postoperative antibiotics, and pre-fixation and post-fixation radiographs. A patient was defined as having a postoperative infection if they required additional postoperative intravenous or oral antibiotics or surgical debridement related to their distal radius injury.

Thirty-two patients, ranging in age from 22 to 96 years, met our inclusion criteria. The injury mechanisms included falls from a standing height for 24 patients, motor vehicle accidents for 7 patients, and an assault for 1 patient. Nine of the patients experienced additional injuries. Two patients had non-insulin-dependent diabetes and 1 had insulin-dependent diabetes. The average follow-up time of treatment for the 32 patients was 34 weeks (range, 8 wk to 4 y).

Injury characteristics

For the 32 patients in our study, 19 patients had Gustilo and Anderson grade I, 11 patients had grade II, and 2 patients had grade IIIA open injuries. Twenty-one patients had an associated distal ulna fracture, of which 4 were fractures of the ulnar styloid. Three patients had ipsilateral carpal injuries: 2 scaphoid fractures and 1 scapholunate dissociation. No patients had associated nerve injury. One patient had a brachial artery injury.

Operative management

The treating surgeons selected the initial fixation procedure based on their training, experience, and preference. Ten attending orthopedic surgeons, of whom 2 were fellowship-trained hand surgeons and 2 were fellowship-trained trauma surgeons, were involved in the treatment of these patients.

Antibiotic protocol

Ten of the patients received intravenous antibiotics before their arrival at our hospital. This was confirmed on transfer records. The remaining 22 patients received their initial intravenous antibiotic treatment upon arrival at our hospital. Patients received a first-generation intravenous cephalosporin or equivalent medication if they had a penicillin allergy. Patients seen initially at our institution received intravenous antibiotics at an average of 48 minutes from arrival (range, 5 min to 3 h, 36 min). The patients continued to receive intravenous antibiotics until they were taken to the operating room and for at least 24 hours after the initial debridement.

Statistical analysis

Statistical comparison of continuous variables was performed with *t*-tests. Statistical comparison of dichotomous variables was performed with the Fisher's exact test (http://www.langsrud.com/fisher.htm). The level of significance was set at $P<.05$.

RESULTS

Timing of debridement

For the 32 patients in our study, the average time from arrival at our hospital to the operating room was 15 hours, 4 minutes. Ten patients went to the operating room within 6 hours of arrival. For the remaining 22 patients, the average time from arrival at our hospital to the operating room was 20 hours, 8 minutes (range, 7–125 h). The reasons for delay included the need for

medical stabilization for 9 patients and a shortage of operating room space in 11 instances. No patient developed an infection through the time of their last clinic visit.

Fracture fixation

At the time of initial debridement, 20 fractures were treated with external fixation, 7 with plating, and 5 with planned staged conversion from external fixation to plating with or without retention of the external fixation. The 3 groups were comparable in age, fracture pattern, and grade of open injury ($P>.05$).

Complications and additional procedures

No patients had an infection or nonunion through the time of their last clinic visit. Among the 7 fractures treated with plate fixation at the initial irrigation and debridement, 1 required a tenolysis of flexor pollicis longus adhesions and plate removal for thumb stiffness 11 months after the index procedure.

Among the 20 open fractures treated definitively with an external fixator, 4 required secondary procedures, which included revision for secondary fracture at a pin site, revision for distal radial ulnar joint malreduction, removal of a symptomatic broken half pin, and an ulnar shortening for a symptomatic radius malunion.

Three of the 5 patients treated with staged conversion from external fixation to plating required additional procedures. One patient required a flexor tenolysis, removal of a broken half pin, and a distal ulna resection for radioulnar synostosis. A second patient required an intra-articular osteotomy for a malunion after plate fixation, as well as a secondary tenolysis and plate removal for finger stiffness. A third patient required a flexor tenolysis for finger stiffness.

DISCUSSION

Within the limitations of our retrospective study, our findings suggest that infection is uncommon for grade I and II open distal radius fractures, despite delay in time to formal operative debridement (>6 h) or use of initial internal fixation. In addition, we observed that conversion from initial external fixation to plating can lead to more soft tissue scarring and increased complications.

The current literature investigating open distal radius fractures is limited, but the findings are generally consistent between studies. Our results are consistent with these studies, with some notable differences. In our study, time to debridement, especially for grade I and grade II injuries (the majority of cases in our study), did not affect infection rate. This finding was also seen by Yang et al who found no infection in 12 grade I distal radius fractures debrided more than 12 hours after presentation.[7] Glueck et al also reported few infections in their series: 3 of 42 open fractures of the distal radius. The timing of debridement was not specifically evaluated, but they found that contamination of the wound was the most important risk factor for infection and not the grade of injury.[2]

Rozental et al did not examine the relationship between time to debridement and infection. However, they did find a high rate of deep infection/osteomyelitis (5 of 18 fractures)[1]. Three of the 5 infections occurred with grade III injuries, which are not well represented in other series. As in our series, most of the grade I injuries in Rozental's study had few complications.

Neither the Yang nor the Rozental open distal radius studies compared treatment outcomes with respect to fixation type. Recent literature supports similar results in terms of infection and complications for closed fractures treated with either internal or external fixations.[8–10] Furthermore, others have shown no difference in infection rates of other open long bone fractures, including the forearm, treated with external or internal fixation.[11–13] Our finding of equivalent results on infection regardless of treatment modality is consistent with these findings.

Although we saw no increase in infection rate, we did find a significantly higher complication rate, primarily related to soft tissue scarring and stiffness in patients treated with staged conversion from external to internal fixation. Our cohorts, although not statistically different in fracture pattern or grade of open injury, are small, and the results are subject to bias. The poor outcomes in this group might represent a selection bias of higher grades of injury. In addition, we had only 2 patients with a grade III open injury. Therefore, it is difficult to generalize our results for all types of open distal radius fractures. Finally, the time from injury to operative debridement should theoretically be based on the exact time the injury occurred. However, as this is a retrospective study, we must rely on the data available, which is limited to the hospital record of the time the patient arrived at our institution or an outside facility. Nonetheless, our findings indicate that patients who have an open fracture of the distal radius treated by external fixation followed by plating will have greater scarring and soft tissue complications requiring secondary procedures.

According to this study, our sample of patients indicates that treatment of grade I and II open distal radius fractures results in a higher rate of complication than a similar closed injury.[9] However, the complication rate

is low. Definitive treatment of open distal radius fractures by external fixation or plating at the time of initial irrigation and debridement can occur with confidence, as infection is uncommon regardless of fixation type or time to debridement. However, staged conversion of external fixation to plating can lead to soft tissue scarring and necessitate additional secondary procedures.

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