Antibiotic Management and Operative Debridement in Open Fractures of the Hand and Upper Extremity: A Systematic Review

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KEYWORDS

• Open fracture • Hand • Distal radius • Debridement • Antibiotics • Infection

KEY POINTS

- Infection rate for open fractures of the hand and upper extremity is low compared with open fractures of the lower extremity.
- Timing of operative debridement in open hand and upper extremity fractures has not been shown to consistently alter infection rates.
- Administration of antibiotics has been shown to lower infection rates in open fractures of the hand and upper extremity.
- We continue to recommend prompt, although not necessarily emergent, debridement and treatment of most open fractures of the upper extremity.

INTRODUCTION

Fractures of the hand and upper extremity constitute a significant disease burden in the United States. Finger, hand, and wrist fractures are estimated to comprise up to 1.5% of emergency department visits.[1] About 5% of these injuries are open fractures[1] and up to 11% of these can potentially become infected.[2] Like all open fractures, open upper extremity fractures are at increased risk for infection compared with their closed counterparts because of the associated soft tissue injury and contamination of deep structures. Existing literature on open fracture infection rates and treatment guidelines have focused primarily on the lower extremity, with limited guidelines available for the upper extremity.

Open fractures of the hand are thought to be less susceptible to infection than other open fractures likely because of the increased blood supply to the area.[2,3] Also, upper extremity injuries of the hand are more amenable to local analgesia than lower extremity injuries thereby facilitating earlier bedside debridement and washout. Current evidence for all open fractures shows that antibiotic use and the extent of contamination are predictive of infection risk, but time to debridement is not.[4] With this in mind, is it still necessary to take the

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patient with an open upper extremity fracture to the operating room as urgently as a lower extremity fracture? And if so, in what circumstances? To guide management, we reviewed the available literature on open fractures of the hand and upper extremity to determine infection rates, based on the timing of debridement and antibiotic administration.

METHODS

A comprehensive literature review was performed to identify all studies on antibiotic management and timing to debridement after open fractures of the upper extremity. Searches for the terms "open fracture" and "upper extremity," "phalangeal," "hand," "distal radius," "forearm," "elbow," "humerus," and "shoulder" were performed using the search engines PubMed, Medline, Google Scholar, UpToDate, Cochrane Reviews, CINAHL, and Scopus (from inception to October 2016). Reference sections of relevant articles were reviewed to identify further relevant trials. Inclusion criteria for our systematic review were all studies (level I-V) that reported on infections rates in upper extremity fractures related to antibiotic protocols and timing of debridement. Studies that included lower extremity open fractures were only included if they also involved relevant open fractures of the upper extremity. Exclusion criteria were non–English language articles, nonhuman studies, retracted papers, and studies that did not comment on infection rates. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria were followed throughout the study. Data were abstracted in duplicate by two authors (WJW, CJL).

RESULTS

A combined total of 14 studies met our inclusion criteria. A PRISMA flow diagram is found in Fig. 1, detailing our literature search, with included and excluded studies. Results are reports by anatomic area and subdivided by antibiotic management and timing of operative debridement.

OPEN HAND FRACTURES

Antibiotic Management

Routine use of antibiotics in managing open fractures of the fingers and hand is not consistent between providers as with open fractures of other long bones (Table 1). There is a noticeable paucity of objective literature to either support or refute their importance. Sloan and colleagues[5] analyzed distal phalangeal fractures prospectively and found a 30% increase in the incidence of infection when antibiotics were not used. Patients were randomly allocated to one of four treatment groups: (1) no antibiotics; (2) cephradine (a first-generation cephalosporin), 500 mg orally four times a day for 5 days; (3) cephradine, 1 g intravenously preoperatively and then 500 mg orally four times a day for 5 days; or (4) cephradine, l g intravenously preoperatively and l g orally postoperatively. After the first 40 patients were enrolled, three proven cases of infection had occurred, all of which were in the no antibiotic group. There was a significantly higher infection rate than for those treated with antibiotics ($P = .02$) and it was believed that it would be unethical to continue this group. No difference between remaining groups treated with antibiotics was found to be significant. Similarly, Ng and colleagues[6] performed a retrospective review that included 70 patients with open fractures of the hand and found that there was a significant difference between infection rates of those who received and did not receive intravenous antibiotics ($P = .0072$). Administration of intravenous antibiotics in the emergency department was the most significant factor in preventing infection. Intravenous antibiotics were administered early (authors report "in the emergency room" but no specific time frame) in 53 (75.7%) patients. Seventy-seven percent of these patients were given intravenous 1 to 2 g of cefazolin. Five patients received 600 mg of clindamycin, three received 100 mg of gentamicin, and four patients received the antibiotics at an outside hospital and therefore did not have documentation as to the type or dosage. The overall infection rate was 11.4%. Additionally, a more recent meta-analysis reporting on infection risk in open hand fractures found that with all patients pooled, antibiotic use was significantly ($P = .0057$) associated with lower risk of infection, with a 4.4% infection rate in the antibiotic group versus a 9.4% rate in the control group.[7] Use of antibiotics varied between studies in the meta-analysis, but all studies using antibiotics used either a cephalosporin or a penicillin derivative. Finally, Capo and colleagues[8] also support early antibiotic administration. They reported an infection rate of 1.4% following a study of 145 cases of open hand fractures with a mean delay of less than 4 hours from injury to first antibiotics administration. The two patients that developed infections were successfully managed with a 5-day course of cephalexin.

However, after a prospective trial including 91 operatively treated open phalangeal fractures, Suprock and colleagues[9] reported no difference in infection rate with early use of oral antibiotics in fractures that have been aggressively irrigated