

Definitive Fixation of Hand and Wrist Fractures in the Emergency Department

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Amentor—now in his 60s—related his experiences as a resident. On call as a second-year resident, he would often be alone at a busy trauma center with no backup. When a case came in, he would quickly read about it in the library, then manage it in the emergency department (ED) if possible, or, if necessary, take the patient to the operating room (OR).

In the era of improved patient care, increased supervision, and decreased autonomy, this is not the reality anymore.¹ In theory, more reliable patient care is the result; however, the pendulum may have swung too far.

There are a number of injuries that are amenable to definitive fixation in the ED, but not as limited an array of injuries as we have perhaps grown accustomed to. Hand injuries are among the most common orthopedic injuries seen in the ED, with fractures of the metacarpals and phalanges constituting nearly one-half of all hand injuries.²

The authors recently attended an excellent instructional course lecture on “The Lost and Found Art of Percutaneous

Pinning in the Hand and Wrist” at the annual conference of the American Academy of Orthopaedic Surgeons.³ The presenters itemized a comprehensive list of fractures and simple dislocations of the hand, which could be simply, safely, effectively,

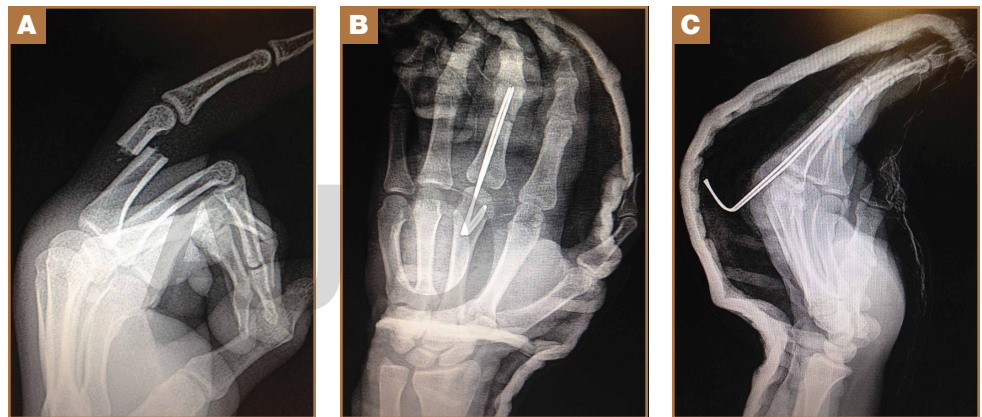


Figure 1. Percutaneous fixation of subacute (1-week-old) shortened middle-finger proximal phalangeal fracture. (A) Lateral injury radiograph and (B) anteroposterior and (C) lateral postreduction radiographs.

and definitively managed through percutaneous pinning techniques. A significant number of unstable fractures of the phalanges and metacarpals can be treated in the ED under mini-C-arm fluoroscopy without an admission and trip to the OR.^{3,4}

Most phalangeal and metacarpal fractures are nondisplaced or minimally displaced and stable, and can often be handled with a combination of closed reduction, buddy-taping, and splinting.⁵ The indications for percutaneous versus internal fixation depend on a number of factors, including bone quality, degree of comminution, quality of the soft-tissue envelope, articular involvement, acuity of presentation, and goals for motion.^{6,7}

Many simple injury patterns involving unstable fractures or dislocations may be definitively managed in the ED with percutaneous pinning (eg, injuries that are unstable with closed reduction alone but that do not necessitate soft-tissue dissection). These include but are not limited to bony mallet injuries, unstable transverse or oblique fractures or fracture-dislocations of the phalanges and metacarpals, carpometacarpal fracture-dislocations, and underlying fractures that need protection of nail-bed repairs, soft-tissue flaps, or extensor tendon injuries

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(Figures 1, 2).^{7,8} The techniques for specific fracture types are beyond the scope of this article but are readily available.^{5,6}

There are certain situations that undoubtedly warrant surgery in the OR, such as neurovascular injury necessitating microvascular repair, flexor tendon laceration, severely comminuted or segmental fractures, irreducible dislocations, and fractures with severe soft-tissue injury or contamination not amenable to primary irrigation, débridement, and closure at bedside.^{4,7,8}

You might ask, “Why would one treat an operative injury in the ED and not formally in the OR?,” and we submit that there are a number of reasons.

First, and most important, with increasing health care costs and decreasing reimbursements, physicians are faced with providing safe but economical care. Percutaneous Kirschner wire (K-wire) fixation is dramatically more cost-effective when performed in the ED than in the OR. The cost of a procedure performed in either setting is similarly dependent on a variety of factors, generally including complexity of the patient or procedure, costs of supplies and pharmacologic agents, fixed versus variable overhead costs, and the professional fees of providers and ancillary personnel.^{9,10}

While the patient is not charged per hour in the ED, it is estimated that ORs in the United States cost, on average, \$62 per minute, ranging from as low as \$22 to as high as \$133 per minute.⁹ Additionally, the number of personnel involved in running an OR exceeds those for a similar procedure performed in the ED, considering (at a minimum) the orthopedic surgeon, anesthesiologist, scrub and radiology technicians, and nursing personnel required before, during, and after an operation.

While analgesia and procedural sedation can be performed similarly in either setting, it is our experience that patients are managed much more often in the ED with local anesthesia under direct care of only the orthopedic provider, whereas intravenous sedation and general anesthesia are far more commonly implemented in the OR. There are exceptions for pediatric patients or those who are unable to tolerate the procedure under only local anesthesia. Local anesthesia or even intravenous conscious sedation entails less risk as well as lower associated drug costs.¹¹

The difference in risk is especially true for sicker patients undergoing minimally invasive procedures.¹¹ Although administration of adequate procedural analgesia grows increasingly difficult the more proximal the injury, the hand and the fingers are easily and reliably anesthetized with well-placed wrist or digital blocks, with infrequent complications.¹² Application of a lidocaine/bupivacaine mixture provides up to 6 to 8 hours of analgesia. A small tourniquet alternative, such as the finger of a sterile glove or phlebotomy tourniquet, applied to the base of the finger or the wrist additionally provides a relatively

bloodless field and effectively acts as a Bier block.

Percutaneous pins are much more forgiving than rigid internal fixation. If the initial placement of a pin is unsatisfactory, the pin can be reinserted at little cost.¹² Conversely, it may not be possible to reposition a misplaced screw or screw with inadequate purchase and still maintain adequate fixation. While percutaneous pin fixation is not as rigid as screw fixation, the degree of stability provided is adequate for the small forces affecting the hand in most cases. Accordingly, there is a very low incidence of fibrous union or nonunion.^{13,14} With an increasing appreciation of soft-tissue handling over the past few decades, another significant advantage of K-wire fixation is the obviation of soft-tissue dissection, preserving the biology to maximize healing and minimize adverse sequelae.¹²

Percutaneous fixation has been shown to achieve functional outcomes comparable to open reduction with internal fixation of operative phalangeal and metacarpal fractures, without soft-tissue disruption, scarring, or implant irritation, and with minimal risk of infection.^{3,13,15,16} Ultimate range of motion after percutaneous fixation is comparable, if not superior, to that of internal fixation, despite the initial advantage of rigid internal fixation secondary to decreased scarring and lack of indwelling hardware.^{16,17}

While the risk of infection, perhaps the primary concern with percutaneous fixation, has been cited as high as 7%, osteomyelitis is exceedingly rare (<0.5%).^{3,13,14} Furthermore, pins are often left in place for 3 to 6 weeks, and infection has been found to occur most often at a mean of 10 weeks.^{7,13} Infection can also be mitigated by intelligent pin placement, relief of residual tension, and splint immobilization.^{4,15} Pin loosening has similarly been reported in up to 4% of cases in large retrospective studies, occurring at an average of 8 weeks, by which time most pins would have been extricated.¹³ Other complications related to impaling adjacent neurovascular or tendinous structures have also been cited but are rare.¹³

A 12-month prospective study of 75 patients specifically evaluating the outcomes after closed reduction with percutaneous fixation of unstable hand fractures in the ED reported only 6 complications at final follow-up.⁴ Complications were all minor, with no cases of nonunion, delayed union, malunion, pin-tract infection, pyarthrosis, or cellulitis, even in the setting of open fractures. Three patients required revision in the OR for pin migration, initial malreduction, and bone loss in the setting of comminution, respectively. The authors credited their low complication rate to supplementary immobilization.

In conclusion, many unstable simple fractures and dislocations of the hand and wrist can be safely and effectively treated in the ED. While it may seem daunting for a junior resident who is unfamiliar with percutaneous techniques, the authors advocate learning from a more senior mentor. The only ad-



Figure 2. Percutaneous fixation of unstable small-finger carpometacarpal fracture-dislocation.

ditional training required is an understanding of how to apply this skill set in a different setting.

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