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Hand Tips & Tricks: External Fixation of the Hand

Introduction

Within orthopaedic surgery, external fixation constructs are used as transitional or final treatment options when stabilizing fractures or correcting deformity. In hand and upper extremity surgery, similar utilization and fixation principles of external fixation apply as in the lower extremity, though they are employed more commonly for highly comminuted fractures with bone loss or periarticular instability. External fixation is often used for hand fractures secondary to gunshot injuries, which result in comminution and severe soft tissue damage due to the energy transferred by the ballistic projectile. Further, external fixation, especially with dynamic properties, has been used for proximal interphalangeal (PIP) joint fracture dislocations and condylar fractures of the proximal or middle phalanx. Here, we review the indications, technique, and outcomes of hand external fixation with an in-depth discussion on management of gunshot-induced hand injuries.

Indications for Hand External Fixation

The principle of external fixation relies on ligamentotaxis, in which bony structures are brought into and maintained in alignment by tensioning the surrounding soft tissues, ligaments, and tendon.¹ One main indication for external fixation is to stabilize open fractures or fractures with infection or segmental bone loss to allow for soft tissue inflammation to abate before definitive fixation and soft tissue coverage. In addition, dorsal fracture dislocations of the PIP joint are especially amenable to external fixation. The goal of external fixation in those injuries is to keep the PIP joint concentrically reduced, which can be achieved using static or dynamic external fixators.² Other indications include maintaining length stability in fractures with segmental bone loss and in bony nonunion of the phalanges or metacarpals.¹ When there is concern for development of infection (e.g., contaminated wounds, comminuted fractures due to gunshot injuries), external fixation can be combined with the placement of internal

antibiotic delivery devices to reduce infection risk.³

Hand fractures caused by gunshot injuries represent a unique class of open fractures in which management controversies abound. The standard of care for all high-energy gunshot wounds or any-velocity gunshot wounds associated with severe soft tissue compromise, unstable fractures, or intra-articular fractures is surgical debridement and fixation, which can include external fixation in highly comminuted fractures or in cases with severe soft tissue compromise (Figure 1). Antibiotic prophylaxis should be administered. Notably, the risk of infection after gunshot wounds is somewhat dependent on the timing between injury and treatment. One study noted that a delay of greater than 6 hours was associated with a higher incidence of infections.⁴ In contrast, low-energy gunshot injuries with minimal soft tissue injury and stable/extra-articular fractures may be managed with local wound care. The need for antibiotic prophylaxis in these patients is controversial.⁵

Technique

Here, we describe the technique for hand external fixation using a classic syringe fixator, which is a low-cost and effective method that is universally available.⁶ Alternatives to the syringe external fixator exist. In some circumstances, the 1-mL syringe may not provide enough length to span the fracture, pins of larger diameter and in multiple planes may be required to better fixate the fracture, a more rigid construct is desired, or forces other than straight distraction applied to the bone are required that cannot be enacted with a straight, firm syringe. It is in these circumstances that modifications can be made to the original technique. Longer or wider syringes can be used (3 mL, 10 mL, etc.) which allow for longer constructs and the ability to have pins slightly out of plane rather than all parallel. Flexible rubber catheters (e.g., “red rubber” or Foley catheters) can be helpful when the desired plane of fixation is not linear, as they are able to be pulled and

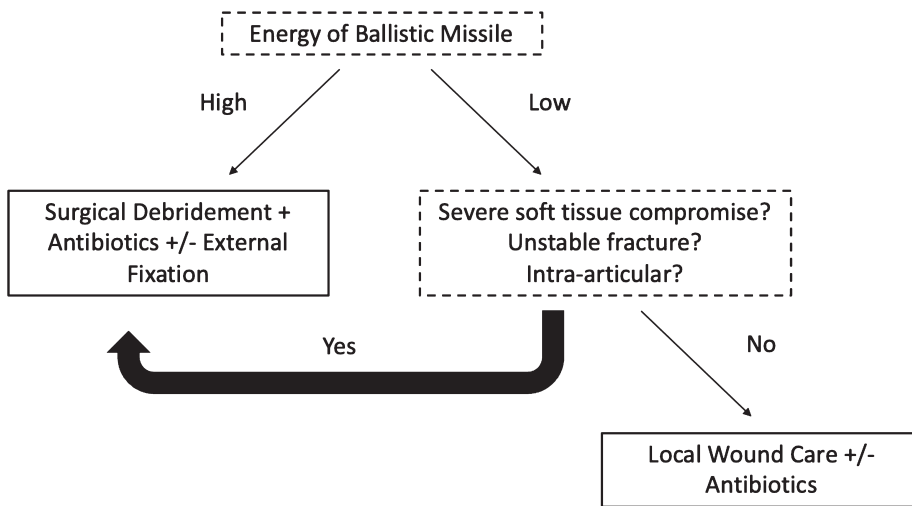


Figure 1. Management of gunshot injuries to the hand.

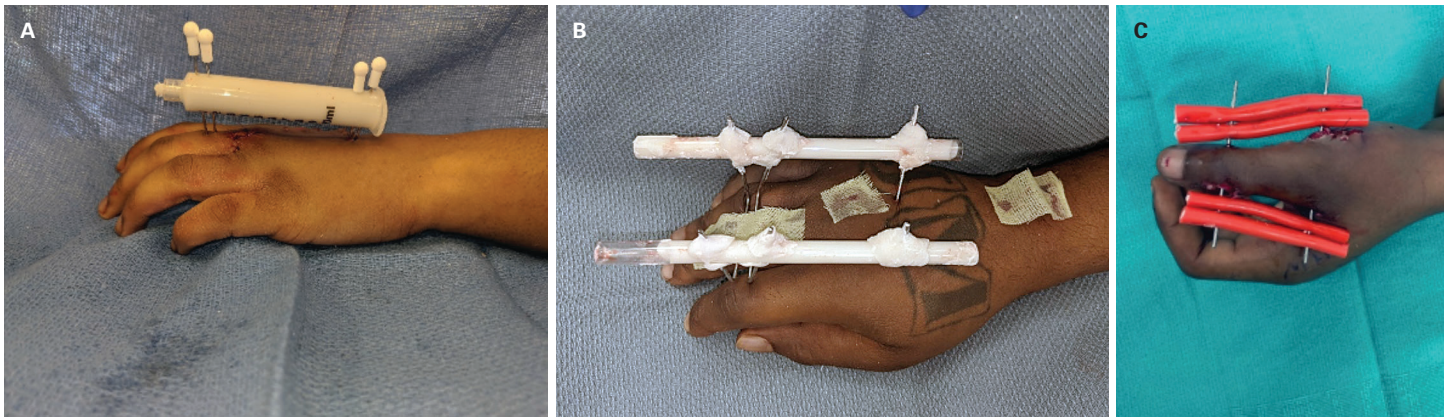


Figure 2. Hand external fixation devices. (A) and (B) Rigid external fixator devices with cement augmentation; (C) Flexible rubber catheter fixator with cement augmentation to provide rigidity. Images courtesy of Andrew D. Sobel, MD.

stretched to accommodate the desired fracture reduction planes. They can also be easily stacked to increase construct rigidity. Whereas cement can be added to syringe fixators as a low-cost means to increase construct rigidity, this is a mandatory step when using rubber catheters as they do not have enough rigidity alone to hold the fracture reduction.

Outcomes After Hand External Fixation

Intra-articular hand fractures have been shown to have worse outcomes including worse grip strength and motion compared to extra-articular fractures after external fixation,⁷ which may be more related to articular involvement than choice of fixation. In a study of external fixators used for comminuted intra-articular hand fractures, patients achieved an active range of motion of up to 55 degrees at the metacarpophalangeal (MCP) joint and 80 degrees at the PIP joint after external fixator removal. The authors used both static and dynamic external fixation strategies.⁶ Another study on dynamic external fixator use in dorsal fracture subluxations or pilon fractures at the PIP joint found that patients achieved 86 degrees of PIP joint

motion at final follow-up.⁸ In a series of 15 intra-articular PIP fractures, dynamic external fixation with distraction achieved over 85% restoration of grip strength and resulted in only one case of secondary fracture displacement.⁹ Another study of 34 patients with PIP joint fracture dislocations treated with dynamic external fixation with distraction resulted in 88 degrees of PIP joint motion, 60 degrees of distal interphalangeal (DIP) joint motion, and no loss of reduction at final follow-up.¹⁰ Other studies have shown similarly acceptable results.¹¹

The incidence of complications following external fixation of the hand are relatively infrequent. A study of K-wire use in the hand and wrist found that major complications occurred in only 3% of pins, which included infection requiring drainage, malunion or nonunion requiring surgical repair, or fracture through the pin track. The incidence of minor complications, which included pin loosening and superficial infections, was 12%.¹² Pin-track infections can occur, which can usually be treated with oral antibiotics alone. The incidence of septic arthritis or osteomyelitis is rare.¹³

Conclusion

Hand external fixation is a safe and effective method for treating highly comminuted hand fractures or hand fractures with severe soft tissue compromise. Inexpensive external fixators can be fashioned using K-wires, syringes, catheters, cement, and other readily available materials. Outcomes after hand external fixation are generally good with few complications.

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