SURGICAL TECHNIQUE

Dynamic "Homemade" Digital External Fixators for Proximal Interphalangeal Joint Injuries

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The purpose of this article is to discuss the indications and surgical techniques of "homemade" digital external fixators constructed from easily available and inexpensive hardware (K-wires and dental rubber bands). *(J Hand Surg Am. 2018;■(■):1.e1-e12. Copyright © 2018 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words External fixator, digit, dynamic, proximal interphalangeal joint, fracture, dislocation, K-wire, rubber band.

Online Exclusive

DIGITAL EXTERNAL FIXATORS ARE a means of treating comminuted fractures at the base of the middle phalanx or unstable proximal interphalangeal (PIP) joint fracture dislocations. Although static digital external fixators were first introduced for the treatment of these injuries, they fell out of favor for dynamic digital fixators (Agee, Suzuki, and Slade) that allowed early active motion, which resulted in better clinical outcomes. Multiple configurations are described, including expensive commercially available devices. The purpose of this article is to discuss the indications and surgical techniques of "homemade" digital external fixators constructed from easily available and inexpensive hardware (K-wires and dental rubber bands).

GENERAL INDICATIONS

1. Comminuted volar lip, dorsal lip, or combined dorsal and volar lip (pilon type) fractures of the middle phalanx at the level of the PIP joint.
2. Dynamically unstable PIP joint fracture dislocations with ≥30% of articular involvement of the volar proximal base of the middle phalanx as seen on a true lateral view of the digit. The fracture should be amenable to closed reduction with appropriate alignment before external fixation is performed. If the PIP joint must be flexed greater than 45° with a dorsal blocking orthosis, then the fracture is likely unstable, and dynamic external fixation is a good option.
3. As an augmentation of other treatment options for PIP joint fracture dislocations (volar plate arthroplasty, hemi-hamate arthroplasty, and open reduction internal fixation).

CONTRAINDICATIONS

1. Active infection.
2. Treatment amenable to orthosis (stable volar lip [<30% articular surface] or dorsal lip [<50% articular] fractures with no evidence of subluxation on lateral view x-ray).

SURGICAL ANATOMY

It is critical to understand the digital safe zones to appropriately insert percutaneous digital external fixator pins. The neurovascular bundles and flexor tendons reside in the volar half of the digit. The dorsal aspect of the proximal phalanx is covered by the extensor mechanism. The conjoined lateral bands are over the dorsolateral aspects of the middle phalanx. Pins should avoid these critical areas to prevent tendon entrapment or neurovascular injury. The junction of

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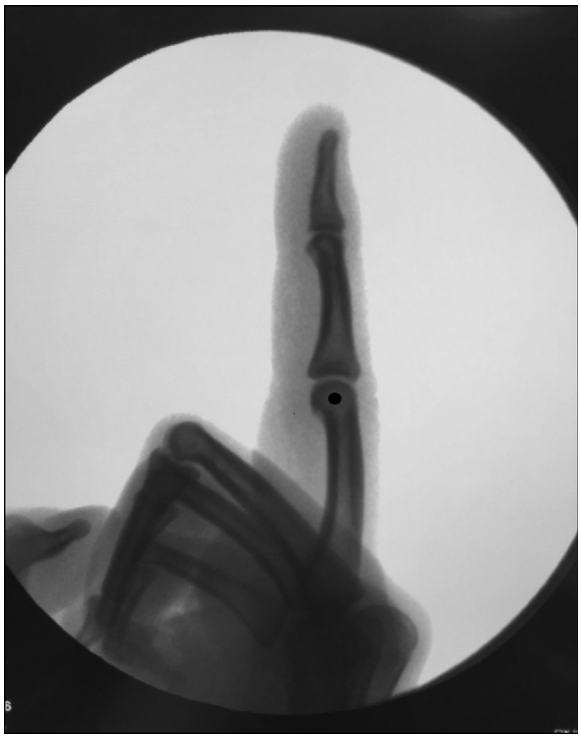

FIGURE 1: Perfect lateral view of the PIP joint. A perfect lateral of the PIP joint is necessary when placing the K-wire in the center of rotation (black dot) on the proximal phalanx head.

the dorsal and middle one-third of the digit, as viewed from the lateral side, is a good general landmark for transverse bicortical pin placement. Dorsal to volar directed pins can be placed in the middle phalanx, but care must be taken to ensure that they do not enter the flexor sheath to avoid flexor tendon injury or attritional rupture. Sometimes mini-open incisions can be used to manipulate fracture fragments, and these anatomical features must be kept in mind.

FIGURE 3: Dental rubber bands.

SURGICAL TECHNIQUES

We will discuss the most popular "homemade" digital external fixator configurations (Agee, Suzuki, Slade, and Metal Only), and explain them in a step-by-step technique using illustrations.

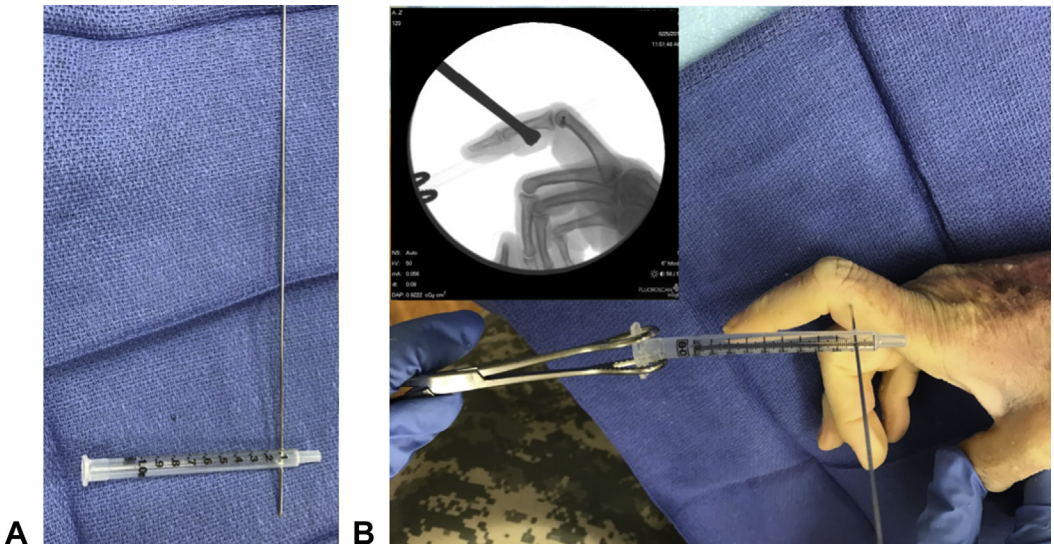

FIGURE 2: Tuberculin syringe as a stabilizing aid for placing the first K-wire. A tuberculin syringe can serve as a rigid, inexpensive radiolucent guide while drilling the first K-wire through the axis of rotation of the proximal phalanx head. **A** The K-wire is drilled through the tuberculin syringe. **B** Then, the tuberculin syringe is stabilized and the K-wire is drilled through the finger while examining its position on fluoroscopy.