Case Report

A Simple Mini-Fixator for Complex Thumb Fractures

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Abstract

The role of external fixators in hand injuries is well entrenched, especially in complex, comminuted phalangeal, and metacarpal fractures where internal fixation is not always possible. We describe a simple, low cost, lightweight, and "easy to construct and easy to use" mini-fixator which can be used for complex, comminuted, open, or closed thumb fractures for definitive fixation with consistent and predictable outcomes. These self-made mini-fixators can also be used for other phalangeal and metacarpal fractures. This represents a viable, alternative option to commercially available mini-fixators which are costly, not readily available, and complicated to use.

Keywords: Cheap, hand fracture, mini external fixator, phalangeal fracture, self-made

Introduction

Complex injuries of the hand associated with open, comminuted fractures are difficult to treat. When these occur in the thumb which accounts for 40% of hand function, it becomes even more challenging because of the importance of obtaining a good functional outcome. In this context, the use of external fixators has gained traction with good results being reported.[1-3]

Many commercial mini-fixators are available in the market for the treatment of hand fractures, but they are expensive, not readily available, and complicated to use. Self-made, improvised mini-fixators have been described in the literature as alternatives. These are easy to use, cheap, cost-effective, and give predictable results. We describe the usage of a mini-fixator fashioned from k-wires and an insulin syringe used in the treatment of a complex comminuted thumb fracture with excellent functional outcomes.

Case Report

We present a 37-year-old male who had a crush injury of his right thumb sustained at his workplace while operating heavy machinery. He was brought to the Emergency Department of Universal Hospital by emergency medical services. On admission, the patient was conscious, oriented, and had a Glasgow Coma Scale of 15. He complained of pain on the base of his right thumb, open wound over the dorsum of size 3 cm × 2 cm, and reduced range of motion in his right thumb. The distal neurovascular status was intact. X-ray imaging shows an open, complex, and comminuted fracture of the proximal phalanx of the affected thumb [Figure 1].

He was taken to the operating room (OR) after initial stabilization and workup. As the case was done emergently and due nonavailability of a commercial minifixator in the OR, an improvised minifixator was made using an insulin syringe, 1.3 mm, 1.1 mm K-wires, and rubber beading of the syringe plunger. Under fluoroscopic guidance, the fracture was reduced, two K-wires (1.3 mm) were introduced proximal to the fracture site, and one K-wire (1.1 mm) was put distal to the fracture. A fourth K-wire (1.0 mm) was put obliquely across the fracture fragments [Figure 2]. The postoperative period was uneventful. A check X-ray at 3 weeks showed good bony union [Figure 3]. One month later, the minifixator was removed in the clinic, and the follow-up X-ray at 5 weeks showed adequate bony union [Figure 4].

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Figure 1: Preoperative image showing complex, open, and comminuted fracture of the proximal phalanx of the right thumb

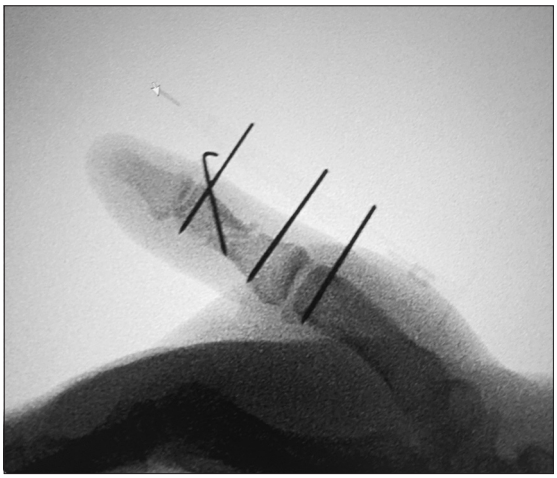

Figure 3: Follow-up of X-ray at 3 weeks showing adequate bone healing and union

Discussion

The treatment of complex, comminuted open fractures of the phalanges is challenging and even more so if extending onto the joint. Open reduction and internal fixation are not ideal in these injuries due to the small size of fracture fragments and the risk of infection and devascularization from the soft-tissue dissection and periosteal stripping. In such a situation, mini-fixators offer an attractive and less invasive option. They maintain reduction by ligamentotaxis, bridge wounds, and allow mobilization of adjacent joints to minimize postoperative stiffness.[1-3] Many commercial and self-made mini-fixators have been described in the literature. This study describes a novel, cheap, and self-made mini-fixator which can be used in treating these injuries and provides a comprehensive review of the literature regarding these low-cost alternatives.

The role of commercially available mini-fixators has been well-established in treating complex, comminuted hand fractures. However, the problem with these fixators is that they are expensive, not readily available, complicated to use,

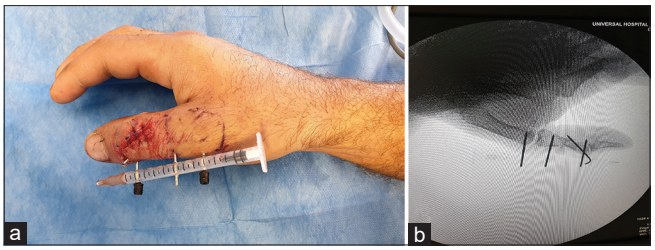

Figure 2: Intraoperative image (a) after reduction and external fixation of the fracture with self-made minifixator (plastic tube-pin construct type) (b) Fluoroscopic image showing the adequate reduction and stabilization of fracture with minifixator

Figure 4: Follow-up of X-ray at 5 weeks after removal of minifixator

technically demanding, and obstruct fluoroscopy visualization due to their bulkiness and radiopacity.[3-6]

To mitigate these problems, self-made minifixators have been described by several researchers. The concept of using an improvised minifixator using K-wires held together by bone cement for the treatment of hand fractures was first described by Crockett.[3] Subsequently, several other designs have been made and the most frequently described is the plastic tube-pin construct. The problems with this construct are–heavy and cumbersome (plastic tube filled with bone cement), discourage early active or passive mobilization of joints, the possibility of pin loosening, or slippage due to small contact area.

McCulley and Hasting described the use of the plastic sheath of an intravenous cannula as a crossbar to hold the pins after fracture fixation. However, the plastic sheath was not long enough to hold the pins rigidly, and often the sheath slipped over the smooth K-wires leading to a loss of fracture reduction and instability.[4]

Thomas *et al*. described a plastic tube cement-pin construct that was quite rigid and stable but may incur an additional cost due to extra raw materials, and the cement may also obstruct fluoroscopy.[5]

Sraj described the pin-locking ball (Jurgan ball) type self-made minifixator, advantages of this construct include–does not require cement or rubber bands, can be used as a static

and dynamic fixator, and allows for readjustment in the postoperative period.[6,7]

Another construct described by Suzuki *et al*. is the rubber band-pin system. These are mainly dynamic fixators made from readily available materials but are difficult to apply, occupy more space, require rubber band replacement in the postoperative period, and are sometimes associated with pin loosening.[7,8]

Henderson *et al*. described a modification of the cement-plastic tube-pin construct wherein a corrugated anesthetic tubing was used as a frame to hold the pins together. The tubing is then filled with cement and the construct is manipulated till the desired reduction is obtained and once the cement sets, rigid fixation is obtained.[9]

Barabas *et al*. described a cement-pin construct without a plastic tube, where two pins are inserted proximal and distal to the fracture. The K-wires are bent to 90° such that they overlap, and acrylic cement is used to bind them together.[10] Another disadvantage of using cement-based fixators is that they require manual stabilization of fracture till the cement sets, handling with cement, can be used only as a static fixator and do not allow modification afterward.[6,7,9]

The ideal minifixator for hand fractures should be low profile, adequately rigid to maintain reduction, readily available, easy to apply and modify, modular, and cost-effective.[7,9,10]

In our study, we did not use any kind of bone cement, although we did not face later loss of reduction due to the loosening of pins. The construct described in this study is a syringe tube-pin type, which was quite stable because of using a small-bore, thick-walled insulin syringe with a limited gap between the tube and pins ("low profile") which prevented slipping and loosening.

The advantages of our minifixator are–less bulky and lightweight, cost-effective, made from readily available materials in the OR, radiolucent (gives good lateral view without obstruction), and can be easily removed in the clinic without local anesthesia. The patient can also be allowed to mobilize adjacent joints and routine activity with care after fixation. This fixator can also be used in various other phalangeal and metacarpal fractures and even in the management of infected hand injuries.[11] The disadvantages of self-made minifixators are loosening of pins with loss of reduction and pin-tract infections. However, studies comparing the outcome of both self-made minifixators and commercial fixators must be done to establish the efficacy of self-made minifixators. Till then, self-made minifixators represent a viable, alternative option with reasonably good outcomes.

Conclusion

The use of this simple, easy to construct, and cost-effective minifixator in the management of complex, comminuted phalangeal, and metacarpal fractures is recommended, especially when commercial fixators are costly, not easily available, and are technically demanding. However, stable fixation and early postoperative mobilization remain the key to obtain predictable outcomes regardless of the technique used.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his name and initials will not be published and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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