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Case Report

A Series of Cases of Catastrophic Fingers Treated with a Variety of Dynamic External Fixator

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Abstract

Complex intra-articular phalanx fractures are challenging to treat. The combination of anatomic reduction and stable fixation while preserving the vascularization of bone fragments, followed by early mobilization is the ideal treatment. In our series of cases, two "catastrophic fingers" were treated with an easy-to-build external fixator composed by 1.2 mm Kirschner wires passed through a needle cap. At final follow up, both patients presented a satisfactory ROM, with a good function of the finger. It is considered an acceptable treatment for these types of injuries that require urgent care.

Keywords: Catastrophic Fingers; External Fixator; Hand Trauma; Phalanx Fractures

Introduction

Comminuted intra-articular phalanx fractures with soft tissue damage are challenging hand injuries. Suboptimal treatment of these injuries can lead to complications such as joint stiffness, pain and degenerative arthrosis. The external fixation and reduction with ligamentotaxis are a technique recommended for the treatment of intra-articular complex phalanx fractures, as it allows early mobilization while preserving the vascular supply to the fracture fragments. Nowadays a variety of configurations of external fixators are known, static and dynamic. The vast majority use Kirschner wires (K-wires) with or without elastic bands to produce distraction. The most famous dynamic external fixators are the Suzuki frame [1] and the external fixator by Hynes and Giddins [2]. We propose a variation of dynamic external fixator, composed by materials easily found in an operating theatre.

Objective

Our goal was to evaluate the clinical results of a series of "catastrophic" fingers treated in our center with a dynamic external fixator composed by 4 K-wires passed through a needle cap.

Patients and Material

The first case is a 34-year-old man, otherwise healthy, that arrives at the Emergency Room (ER) with a semi-amputation of the second finger of the non-dominant hand due to an electric saw. He presented a complex wound, with a complete section of Flexor Digitorum Profundus (FDP) tendon, ulnar sagittal band of Flexor Digitorum Superficialis (FDS) tendon, central and lateral sagittal bands of Extensor Indicis (EI) and Extensor Digitorum Communis (EDC) tendon. Also, a complete lesion of the radial neurovascular bundle, with integrity of the ulnar one was detected (Figure 1). A simple x-ray of the hand is performed, showing an intraarticular medial phalanx fracture type IIIC of the Gustilo classification associated with a luxation of the proximal interphalangeal joint (Figure 2). The second case is a 56-year-old man, also otherwise healthy, that arrives at the ER of our Hospital with a crushing of the second finger of the dominant hand due to a car tire. The physical examination revealed also a complex wound of the second finger, which consisted in a partial lesion of the radial sagittal bundle of the EI tendon and FDS tendon associated to a complete section of

the radial neurovascular bundle and integrity of the ulnar one. Radiographical findings showed a comminuted fracture of the middle phalanx type IIIC of the Gustilo classification (Figure 3).

Figure 1: Exterior aspect of the semi-amputation of the finger.

Figure 2: Radiographical findings of the first finger.

Figure 3: Comminuted middle phalanx fracture.

Surgical Technique

Both "catastrophic" fingers were intervened in the same way: The patients were swiftly taken to the operating theater for exploration of the wound and repair of the structures under regional and general anesthesia. Thorough irrigation of the wound with saline solution was undertaken. First and foremost, a fixation of the fracture was performed, using four 1.2 mm K wires that were passed through the cap of an intradermic needle and were assembled as an external fixator. Two wires were passed through the medial phalanx and the other two through the distal phalanx in the first case (Figure 4), while in the second case one K wire was passed through the proximal phalanx, two through the middle phalanx and one though the distal phalanx, to provide more stability (Figure 5). In one case, an interfragmentary K-wire was used to stabilize the fracture. The joint was fixated at a 20° flexion, in both cases. The tendons were repaired using a modified Kessler technique plus an end-to-end repair when needed and a detailed suture of the capsule and skin was performed. Plain postoperative radiographs showed a good reduction of the fracture fragments (Figure 6 and 7).

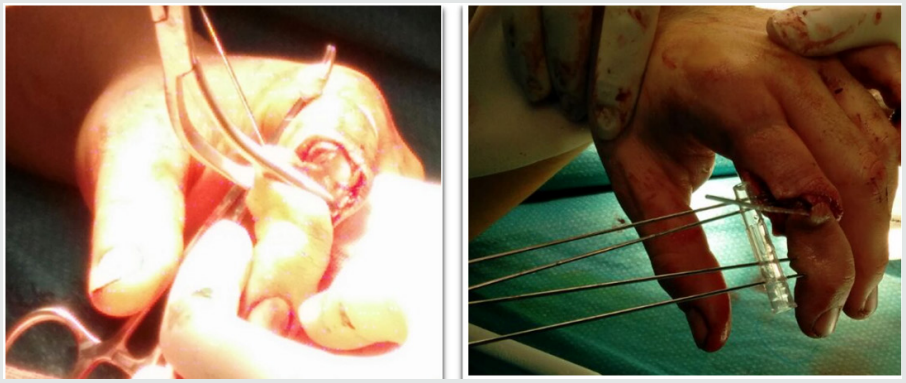

Figure 4: Reduction and fixation of the middle phalanx fracture-luxation of the first case.

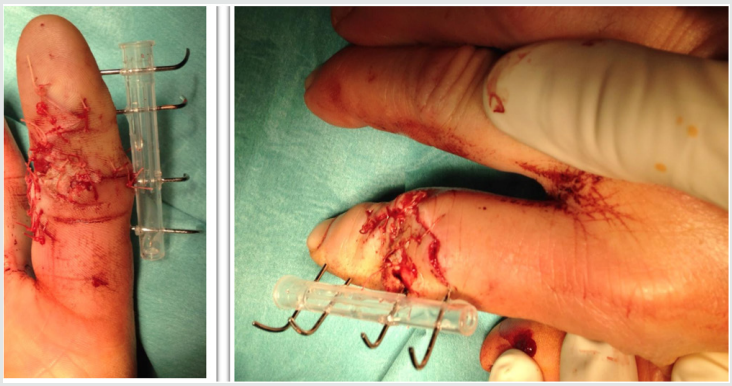

Figure 5: External aspect of the external dynamic fixator.

Figure 6: Radiographical aspect after the external fixation.

Results

The patients were dismissed from the hospital the day after the intervention. Slight passive mobility of the distal interphalangeal (DIP) joint was encouraged from the beginning. The external fixator was removed after six weeks and in both cases a range of movement (ROM) of 0 - 70° of the proximal interphalangeal (PIP) joint was observed. As for the DIP joint, the first case had a ROM of 0 - 60°, and the second case had a ROM of -15 - 30° of the DIP joint, as well as a necrotic zone of 1,5x1 cm on the palmar zone of the finger pad. Subsequently, both patients received intense hospital rehabilitation. The necrotic zone cured satisfactorily with the application of topic Furacine. At 7 months from the injury, complete consolidation of the fracture was observed in the first case. The patient presented an irreducible flexion deformity of 20° of the DIP joints, a PIP flexion of 95°and complete extension (Figure 8 and 9). The second finger presented a PIP flexion of 70°, complete extension, a DIP flexion of 60° but -10° extension (Figure 10). The plain radiographs showed a fracture almost completely consolidated (Figure 11).

Figure 7: Radiographical aspect after the external fixation of the second "catastrophic" finger.

Figure 8: Final radiographical aspect.

Figure 9: Final radiographical aspect.

Figure 10: Exterior final aspect of the second finger, showing complete curation of the necrotic scar.

Figure 11: Final radiographical aspect, showing almost full consolidation of the comminuted fracture.

Discussion

The treatment of complex intra-articular phalanx fractures associated with soft tissue damage is a controversial topic [3]. We consider the external fixation an interesting treatment method due to its easiness to build, with materials that can be found in any hospital, and because it provides a good urgent care of open fractures that present an high risk of infection, in which is better to avoid metal implants to achieve reduction [13]. Various dynamic external fixation devices based on the use of K-wires have been developed that take advantage of ligamentotaxis to provide early mobilization with joint reduction [4]. One highly successful external fixator is the one described by Suzuki et al. [1], that uses the pins and rubbers to provide traction to the fracture. This system is capable of treating a wide range of complex intra-articular fractures involving the hand, including PIP fractures, metacarpophalangeal joint (MCPJ), and first carpometacarpal joint (CMCJ), with good ROM results at final follow up [5-7]. Some variations or this system were described [2-8], using more available materials but nevertheless following the same principles. Our external fixator is more similar to the one described by Crowley et al. [9], that presented a case of a contaminated fracture associated to an FDP avulsion, which presented a ROM of the PIP joint of 15-95° at final follow-up of one year. When a complex phalanx fracture is associated to a tendon lesion, the treatment is more complicated because the fracture needs stabilization as much as the soft tissue damage benefits of a slight passive movement [10]. Is it considered that concentric articular congruity must be achievable via a combination of longitudinal traction and translation to obtain a successful outcome, in these type of lesions [4]. Recent studies were made with actual mini external fixators, showing worse outcomes for open fractures compared to closed ones [11]. Kodama et al. [12] reported the outcome of using the Micro Ortho Fixator® for the treatment of unstable fracture-dislocations of the PIP joint, with good results. On the other hand, these devices are costly and not always available when needed [13,14]. Its architecture and philosophy are similar to other previously described external fixators.

Conclusion

Intraarticular phalanx fractures can cause a lot of morbidity if not treated adequately. Early mobilization is very important to recover function and avoids postoperative rigidity of the finger. External fixation and reduction with ligamentotaxis are considered a good option, as it preserves the vascular supply and allows early mobilization of intraarticular complex phalanx fractures associated with soft tissue damage. The external fixator proposed is efficient, easy to build and cost-effective. It is a good treatment for catastrophic fingers that require urgent care, as shown by the cases presented.

Study Design/Level of Evidence

Therapeutic/IV.

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