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Dynamic External Fixation for Proximal Interphalangeal Joint Fracture-Dislocation – A Case Report

KEYWORDS: PIP joint fracture/dislocation, volar base fractures of PIP joint, dynamic external fixation.

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ABSTRACT Fracture dislocations of the proximal interphalangeal joint are most commonly seen in ball playing athletes and are a challenge to treat as they often lead to severe pain, stiffness, and deformity with inadequate treatment. Many treatment modalities have been experimented with and the goals of treatment is to provide a stable, reduced joint with good range of motion and to prevent stiffness. Many authors have quoted dynamic external fixation as one of the best methods for the treatment of such injuries, especially when the patient comes to us with a delayed presentation, as in this case whereby we would like to describe to you our experience with a 3 weeks old fracture dislocation of proximal interphalangeal joint sustained with a cricket ball.

Introduction

Fractures of the base of the middle phalanx can be divided into partial articular fractures of the dorsal base, volar base and lateral base or complete articular fractures that are usually communited and often referred to as "pilon fractures". Pilon fractures are unstable in every direction including axially but fractures of the volar base of middle phalanx can be particularly unstable depending on the percentage of the articular surface involved.[1,2,3] When the volar fragment constitutes greater than around 40% of the articular surface, these fractures tend to become unstable as the volar fragment carries the majority of the proper collateral ligament insertion in addition to the accessory ligament and volar plate insertions. The dorsal fragment and remainder of the middle phalanx will thus sublux proximally and dorsally with displacement being driven by the pull of the FDS and the central slip.[1,4,5] The typical mechanism of injury for dorsal fracture dislocations is a direct force applied to the fingertip with hyperextension and axial loading of the PIP joint, that causes impaction of the volar articular lip of the middle phalanx against the condyles of the proximal phalanx.[1,6,7] These patients therefore present to us with an unstable fracture-dislocation of the PIP joint. These fractures when left untreated or when treated inadequately with PIP joint articular incongruity can lead to severe disability with loss of arc of motion at the PIP joint, stiffness, pain and early post-traumatic arthritis. Other complications include malunion and deformity and/or residual instability.[1,3,5]

Many treatment options have been described with varying results for such fractures, including dynamic extension block splinting[1], dorsal extension block pinning[8], open reduction and internal fixation with pins or lag screws[1,4-7], hemi-hamate arthroplasty, volar plate arthroplasty[1] and dynamic external fixation.[9-11] Early motion of the PIP joint along with traction and stable fixation has provided the best functional results[4,12-13] and therefore an ideal dynamic external fixator should be equally effective at maintaining joint reduction as well as allowing range of motion. The first reference to external fixation for the treatment of PIP joint fracture dislocations was in 1946 when Robertson Cawley and Faris described a triplane external fixation device, using 3 pins, 1 in the proximal phalanx and 2 in the middle phalanx. It used traction on the 3 pins to maintain a reduced joint.[14] As the PIP joint is prone to stiffness with immobilization, Agee[9, 15] developed a technique with K-wires and rubber bands that enabled early range of motion of the injured digit while maintaining a congruent joint i.e. a dynamic external fixator system. Slade et al[10] in 1990 described and used a similar fixator which was inexpensive and easy to apply, consisting of 3 K-wires and dental rubber bands. Gaul and Rosenberg[16] described a simple frame that provided traction without using rubber bands or complicated connecting pieces.

Case Report

A 23 years young adult presented to us with a 3 week old history of sustaining trauma to the left little finger, due to cricket ball injury which was initially treated with splinting. He complained of continuous pain and swelling with severe restriction of movement of the left little finger. On examination, tenderness with crepitus was palpated at the PIP joint of the left little finger with evidence of instability. Radiographs of the hand showed a volar base fracture of PIP joint of the little finger, involving more than 40% of the articular surface with dorsal subluxation. Patient was unable to completely flex his left little finger while making a fist, following which a decision was taken to treat the injury with a dynamic external fixator.(Figure 2(A),(B),(C),(D))

Surgical Technique[16]

- A 1.4-mm K-wire (K1) is placed transversely through the center of the head of the proximal phalanx while under fluoroscopic control. A second K-wire (K2) then is driven through the head of the middle phalanx. (Figure 1A)
- The first wire (K1) is left long enough on both sides so the ends can be bent 90° distally to lie parallel and 1 cm away from the middle phalanx. Two more bends are applied to the proximal phalanx wire: a dorsal bend (>90°) at the base of the distal phalanx and another bend on each end of the pin. The initial dorsal bend is approximately 1 cm distal to K2.(Figure 1B)
- Traction then is applied on the middle phalanx so it is engaged in the horns of the proximal phalanx K-wire, achieving the desired skeletal traction.

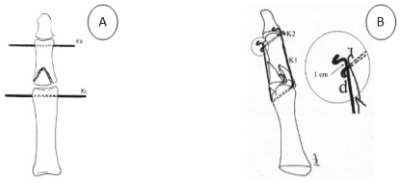

Figure 1 – (A) and (B) Photographic representation of surgical technique

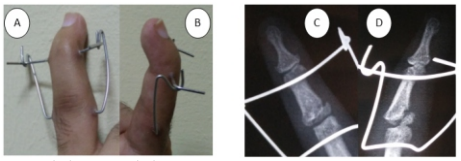

Figure 2 – (A) and (B) Post operative clinical photo following

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fixation of the dynamic external fixator.

X-ray (C) PA view and (D) oblique view - showing reduction with maintenance of joint space and placement of K-wires

Patient was started on immediate active flexion and extension of the PIP joint and discharged with advice to continue the range of motion exercises and pin site care. Patient was re-evaluated at 3 weeks (figure 3A and 3B) and at 5 weeks (figure 4A and 4B) with radiographs. Patient at 3 weeks showed a good active range of motion of about 40 degrees at 3 weeks (figure 3C and 3D). Following removal of the fixator at 5 weeks patient showed good painless active range of motion of 60 degrees at the PIP joint (figure 4C) with a further passive flexion of 30 degrees which was painless (figure 4D).

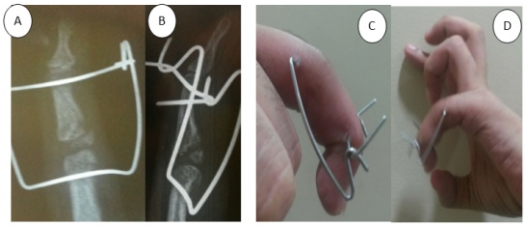

Figure 3 – 3 weeks post external fixation radiographs **(A)** PA view **(B)** Lateral view. Clinical photos showing range of motion at 3 weeks **(C)** and **(D).**

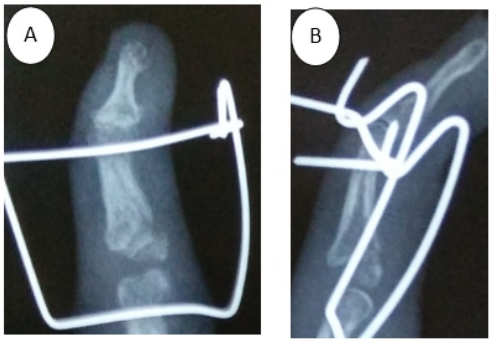

Figure 4 – 5 weeks post fixation (A) PA view and (B) lateral view.

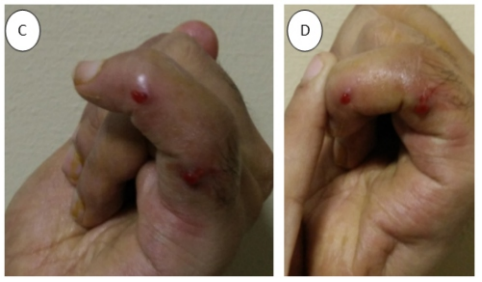

Figure 4 – Clinical photos showing the Active **(C)** and Passive **(D)** range of motion of the left little finger following removal of fixator.

Discussion

Fracture dislocations of the PIP joint are notorious injuries as they are disabling and often lead to stiffness and early arthritis when they are improperly treated or not treated at all.[1,3-7] The aim of the treatment is to provide a stable joint with good range of motion with union and return to normal activity. Several authors have described various fixation techniques and early motion at the PIP joint along with traction and stable fixation have provided the best functional results.[4, 12-13] The dynamic external fixator is an especially useful tool when the patient comes with a delayed presentation[17] as was seen in this case with a 3 weeks old injury.

Conclusion

Dynamic external fixator as applied in this case with a delayed presentation after 3 weeks of injury proved to be an excellent modality of treatment with return of near normal range of motion. It can therefore be kept as an option for treatment of PIP joint fracture dislocation in both the acute and chronic setting, following which further evaluation can be done on its efficacy as a treatment modality with comparison to other methods.

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