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Dynamic Suzuki frame for the interphalangeal joint fracture: A case report

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Abstract

Proximal interphalangeal (PIP) joint injuries are one of the common injuries of hand. Most common in motor vehicle accidents and sports injury. Various treatment modalities are available to treat such fractures like buddy strapping with or without extension block splint, CRPP, ORIF with interfragmentary screws, Schenck dynamic traction, Hynes and Giddings device and many other modalities. This is one of the challenging fractures as there is high incidence of stiffness, loss of function and deformity leading to disability following the treatment. The pins and rubber traction frame (Suzuki frame) system is one of the novel technique to reduce the disability.

Case: 66 years old male with history of motor vehicle accident, presented with comminuted intra-articular fracture of base of middle phalanx (PIP joint) extending distally to DIP joint of the fourth finger of left hand. We used Suzuki frame for the treatment of the fracture.

Suzuki frame technique is a simple, minimally invasive, soft tissue sparing, cost effective, dynamic external fixation technique, can be done at minimal resource setting, which allows early ROM at PIP and DIP joint, enabling good bone and joint remodeling and good function of the finger, leading to disability free hand with minimal complication rate.

Keywords: Suzuki frame, proximal interphalangeal (PIP) joint, distal interphalangeal (DIP) joint, Intra articular fracture, Dynamic fixation device

Introduction

Proximal interphalangeal (PIP) joint injuries are one of the common injuries in hand [1]. Most commonly seen in motor vehicle accidents and sport injuries. The middle phalanx is subjected to frequent injuries as there is weak soft tissue support.

The objectives of treatment are early mobilization of the PIP joint, minimal soft tissue damage and to prevent stiffness and disability [2].

Various treatment modalities are available to treat such fractures like buddy strapping +/- extension block splint, closed reduction and percutaneous K wire fixation, external fixation devices, open reduction and internal fixation using interfragmentary screws, Schenck dynamic traction, Hynes and Giddings device, the pins and rubber traction frame (Suzuki frame), volar plate arthroplasty and many other modalities.

If the fracture line involves more than 30% of the middle phalanx joint surface or if flexion of > 30 degrees is required for maintaining the reduction, it is considered unstable and requires surgical intervention [3].

The pins and rubber traction frame (Suzuki frame) is one of the novel technique to decrease the disability.

Case Report

History and Examination

66 years old, right hand dominant male, computer operator by occupation, presented to us with history of motor vehicle accident. He had sustained injury to left 4th finger (Fig.1). There was no injury to other fingers, limbs or vital organs. He had no medical comorbidities.



Fig 1: Sustained injury to left 4th finger

On examination there was a laceration of 1cm x 1cm over dorsal surface of PIP joint with underlying PIP joint visible. No active bleeding. Patient was unable to extend the finger actively. Extensor tendon injury was also suspected along with the bony injury.

Investigations



Fig 2: Plain radiograph of the hand revealed comminuted, intra articular fracture of base of middle phalanx of 4th finger extending to DIP joint

Management

With informed consent, under ring block, wound was debrided. There was extensor tendon injury. Cut ends identified and secured. Reduction of fracture done by traction and manipulation. Reduction

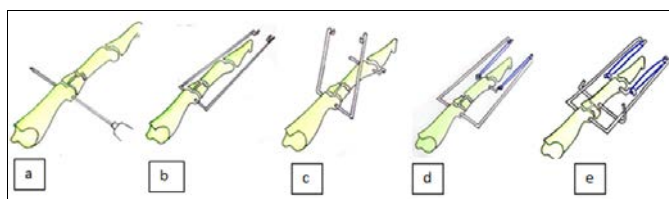


Fig 3: a, Insertion of P1, b-bending P1, c- insertion of P2, d attachment of elastic band, e-insertion of P3

Confirmed under fluoroscopy and it was satisfactory.

Construction of Suzuki frame

The 1st pin [Axial traction pin / P1], 8” long, 1.2mm K wire was drilled transversely through the proximal phalanx head, perpendicular to the phalangeal axis (Fig.3a).

P1 was bent 90⁰ towards the fingertip, 0.5cm away from the skin on both sides of the finger, maintaining 3cm length on either side. The K wire tips were bent to create a hook facing the fingertip (Fig.3b).

The 2nd pin [Hook pin / P2], 6” long, 1.2mm K wire was drilled transversely through the distal part of the middle phalanx perpendicular to the phalangeal axis (Fig.3c)

P2 was bent 90⁰ and further bent to make a hook facing the fingertip. Sterile IV drip set rubber tubing was used as an elastic traction and placed between the hooks (Fig.3d). Reduction checked under fluoroscopy after traction. There was 1mm of joint space visible and found satisfactory.

The 3rd pin [Reduction pin / P3], 6” long, 1.2mm K wire was drilled in the base of the middle phalanx distal to the fracture and slightly dorsal compared to P1 and P2. P3 was brought volar to the bent P1 and P3 was then bent to hook around the P1 (Fig.3e). Reduction checked using fluoroscopy and found satisfactory (Fig.4).



Fig 4: Reduction checked using fluoroscopy and found satisfactory

Extensor tendon repair done by modified Kessler’s method using 4-0 Prolene. Skin sutured (Fig. 5). Finger was kept in extension using finger extension splint.



Fig 5: Final intra operative image

Post-operative period

Extension splint (Fig.6) maintained up to post op 2 weeks (i.e., till skin suture removal).



Fig 6: Post op check radiograph

Range of movements started from post op 14 days and encouraged for active and assisted flexion and extension exercises.

Radiograph on 4 week post op showed signs of healing with good reduction (Fig.7).



Fig 7: Post op 4 weeks

The frame removed on post op 4 weeks and patient was encouraged to perform movements. At post-op 6 weeks, PIP active flexion was 0 - 70 degree and DIP active flexion was 0 - 30 degree. The grip strength was good and was able to hold heavy objects. Radiograph showed good union (Fig 8).



Fig 8 (a): The grip strength was good and was able to hold heavy objects



Fig 8 (b): Radiograph showed good union

Discussion

Study by Swanson *et al.* concluded that hand fractures can lead to deformity due to no treatment, stiffness due to over-treatment, and both deformity and stiffness due to poor treatment [4].

The primary objectives of the treatment is early mobilization of the PIP joint, minimal soft tissue damage, to prevent stiffness and disability, and early return to previous activity. The Suzuki frame restores anatomy, minimizes soft tissue injury, and enables early mobilization.

Static external fixators (JESS, mini ex fix, etc.), traction devices are being used commonly in the treatment of comminuted PIP joint fractures. But, these contribute to joint stiffness and osteoarthritis. To avoid this, early mobilization is necessary. Early mobilization also aids in the repair of damaged articular cartilage.

Stern *et al.* reported that ORIF can achieve anatomical reduction in some cases but extensive soft-tissue dissection around the joint disturbs blood supply and lead to joint stiffness [7].

To overcome these complications, Suzuki *et al.* developed a skeletal traction system for comminuted intra articular fractures of the hand in 1994 [8]. It allows early motion of the affected digits. They published excellent results of seven cases of severe intra articular fractures in the hand. At follow-up (Average 13.1 months), the average ROM of the affected PIP joint was – flexion of 0 - 80 degree and DIP joint was 0 - 40 degree [8]. Deshmukh and Slade published case series suggesting good results from using either the original or a modified version of the Suzuki frame. They reported that capsule ligamentotaxis by the Suzuki frame along with early mobilisation achieves proper articular congruity and healing [9, 10]. Richter *et al.* studied 26 patients with long term follow up of up to 8 years and they found that average ROM at PIP joint to be 0 - 85 degrees of flexion. Initially radiographs showed anatomic reduction with complete joint congruency in 20% of the cases, but on long term there was remodeling of the joint surface in 89% without degeneration of the joint. They concluded that dynamic traction and early ROM is the treatment of choice, as it is comparatively pain-free and good ROM is achieved in the long- term due to the remodeling capacity of the joint surface [11]. Our patient has suffered comminuted intra articular fracture of the base of middle phalanx extending to DIP joint of the 4th finger of the left hand and we have used the Suzuki traction frame to treat it. The traction by the frame and early ROM ensured the capsule ligamentotaxis and good articular cartilage healing and bone remodeling. Good functional result was obtained and patient returned to his previous work by 6 weeks post op.

Conclusion

Suzuki frame technique is a simple, minimally invasive, soft tissue sparing, cost effective, dynamic external fixation technique, can be done at minimal resource setting, which allows early ROM at PIP and DIP joint, enabling good bone and joint remodeling and good function of the finger, leading to disability free hand with minimal complication rate.

Conflict of Interest

Not available

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Not available

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