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Case Report

Repurposing the Suzuki frame: a novel approach for neglected proximal interphalangeal joint intra-articular fracture management

Sunil Patidar[1], Ankit Kumar Kayathwal[1]*, Aashish Raghu[2]

[1]Index medical college, Indore, Madhya Pradesh, India
[2]NMC Royal Family Medical Centre, Abu Dhabi

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***Correspondence:**
Dr. Ankit Kumar Kayathwal,
E-mail: ankitkayathwal2303@gmail.com

ABSTRACT

Neglected intra-articular fractures of the proximal interphalangeal (PIP) joint pose significant challenges due to joint stiffness, malalignment, and compromised function. Traditional management often yields suboptimal outcomes, especially in delayed presentations. We report a novel application of the Suzuki frame-conventionally used for distal interphalangeal (DIP) joint injuries-in the treatment of a neglected PIP joint intra-articular fracture in a young male patient. The fracture was managed using a dynamic external fixator constructed with K-wires and rubber bands, allowing controlled distraction and early mobilization. A modified Suzuki frame was applied across the PIP joint, achieving stable fixation and facilitating gradual distraction. The construct enabled early range-of-motion exercises while maintaining reduction. Radiological and functional outcomes were assessed over a 12-week follow-up. The patient demonstrated excellent clinical recovery, with restoration of joint alignment, pain-free range of motion, and return to pre-injury activity levels. Radiographs confirmed satisfactory fracture healing and joint congruity. This case highlights the versatility of the Suzuki frame in managing complex PIP joint injuries, especially in neglected cases. The technique offers a minimally invasive, cost-effective, and function-preserving alternative that warrants further exploration in larger cohorts.

Keywords: Proximal interphalangeal joint, Intra-articular fracture, Suzuki frame, Dynamic external fixation, Neglected fracture, K-wire, Hand trauma

INTRODUCTION

Intra-articular fractures of the PIP joint are complex injuries that can lead to significant functional impairment if not managed promptly and appropriately. Neglected cases, in particular, pose a therapeutic challenge due to joint stiffness, malunion, and compromised range of motion. Traditional treatment modalities for chronic PIP joint injuries often involve arthrodesis or open reduction with internal fixation, which may not restore optimal joint function.[1]

The Suzuki frame, originally described for dynamic external fixation of DIP joint injuries, has demonstrated efficacy in maintaining joint alignment while permitting early mobilization.[2] Its design-utilizing K-wires and elastic bands-allows controlled distraction and stabilization, promoting functional recovery in acute settings.

However, its application in neglected PIP joint fractures remains underexplored.

This report presents a novel adaptation of the Suzuki frame for treating a neglected intra-articular fracture of the PIP joint in a young male patient.

By repurposing this dynamic fixator, we achieved excellent clinical and radiological outcomes, suggesting a potential role for this technique in managing delayed presentations of PIP joint trauma.

CASE REPORT

A 28-year-old right-handed male presented with a neglected intra-articular fracture of the PIP joint of the right ring finger, sustained six weeks prior during a sports-related trauma. Initial management consisted of traditional immobilization without reduction, resulting in persistent pain, swelling, and restricted range of motion.

Clinical evaluation

On examination, the affected digit exhibited fusiform swelling, tenderness over the PIP joint, and a flexion deformity. Active range of motion was severely limited, with an extension lag of 30° and painful passive movement. Grip strength was reduced compared to the contralateral hand. Neurovascular status was intact.

Radiographic assessment

Pre-operative radiographs revealed a displaced intra-articular fracture at the base of the middle phalanx with joint incongruity and early signs of fibrosis (Figure 1). Such neglected injuries are known to result in poor outcomes if not addressed with dynamic stabilization

Surgical technique

Given the chronicity and intra-articular nature of the fracture, a modified dynamic external fixator based on the Suzuki frame principle was employed. Originally designed for DIP joint injuries, the Suzuki frame utilizes two transverse K-wires and elastic bands to create controlled distraction and stabilization across the joint

In this case, two 1.2 mm K-wires were inserted percutaneously across the proximal and middle phalanges. Elastic bands were applied to generate dynamic traction, allowing gradual mobilization while maintaining reduction. Weekly adjustments were made to optimize alignment and encourage joint remodelling. open reduction and internal fixation was performed, minimizing soft tissue disruption.

Post-operative management

The patient was encouraged to begin active-assisted range-of-motion exercises from post-operative day 3. The fixator was maintained for six weeks, followed by removal and initiation of formal hand therapy. Early mobilization is critical in preventing joint stiffness and promoting cartilage remodelling

Follow-up and outcome

At 6 weeks, radiographs showed progressive healing and improved joint congruity (Figure 2). At 12 weeks, the patient demonstrated near-complete restoration of PIP joint function with minimal residual stiffness. Final radiographs confirmed fracture union and anatomical alignment (Figure 3).

Clinical photographs at follow-up showed improved finger contour, full extension, and functional grip (Figure 4-6). The patient returned to full occupational and recreational activities without limitations.

This case highlights the versatility of the Suzuki frame in managing neglected PIP joint injuries, offering a minimally invasive, cost-effective, and function-preserving alternative to traditional methods.

Figure 1 (A and B): Pre-operative X-ray-AP and the lateral views.

Figure 2: Post-operative X-ray.

Figure 3 (A and B): Follow-up X-ray at 6 weeks.

Figure 4: Clinical image at 6 weeks.

Figure 5 (A and B): Xray follow up at 12 weeks.

Figure 6 (A and B): Clinical image at 12 weeks.

DISCUSSION

Neglected intra-articular fractures of the PIP joint present a formidable challenge due to the development of fibrosis, joint incongruity, and stiffness. In such cases, achieving anatomical reduction and restoring function without extensive soft tissue dissection is difficult. Traditional approaches often involve open reduction and internal fixation (ORIF), arthrodesis, or volar plate arthroplasty, each with variable outcomes and potential complications.[3,4]

Dynamic external fixation has emerged as a viable alternative, particularly in acute fracture-dislocations of the PIP joint. The Suzuki frame, first described in 1994, utilizes two transverse K-wires and elastic bands to create controlled distraction across the joint, allowing for early mobilization and promoting cartilage healing. While its use is well-documented for DIP and acute PIP injuries its application in neglected intra-articular PIP fractures remains underreported.[6,7]

In this case, we repurposed the Suzuki frame to treat a six-week-old neglected intra-articular fracture of the PIP joint. The construct provided stable fixation, facilitated gradual joint distraction, and allowed early range-of-motion exercises. This approach minimized soft tissue trauma and avoided the need for open reduction, which is particularly advantageous in chronic cases where fibrosis and scarring complicate surgical exposure.

Our patient demonstrated excellent clinical and radiological outcomes, with restoration of joint congruity and functional range of motion. These results align with prior studies that emphasize the importance of early mobilization and dynamic stabilization in preserving joint function.[9,10] Moreover, the simplicity and cost-effectiveness of the Suzuki frame make it an attractive option in resource-limited settings.

This case adds to the growing body of evidence supporting the versatility of dynamic external fixation in hand trauma. It underscores the potential of adapting established techniques to novel indications, particularly in neglected injuries where conventional methods may fall short.[11,12]

Further studies with larger cohorts are warranted to validate the efficacy of this approach and to establish standardized protocols for its use in chronic PIP joint injuries.

CONCLUSION

Neglected intra-articular fractures of the proximal interphalangeal joint remain a formidable challenge due to stiffness, fibrosis, and compromised joint congruity. Conventional approaches such as arthrodesis or open reduction with internal fixation often sacrifice mobility or involve extensive soft tissue dissection, limiting functional recovery. In this case, the repurposed Suzuki frame provided a simple, minimally invasive, and dynamic method of stabilization that allowed controlled distraction and early mobilization. The construct facilitated anatomical reduction, promoted cartilage remodelling, and restored functional range of motion without major complications. Our experience demonstrates that the Suzuki frame, though traditionally used for distal interphalangeal injuries, can be effectively adapted for neglected PIP joint fractures. This technique offers a cost-effective and function-preserving alternative, particularly valuable in resource-limited settings. While the encouraging outcome in this single case highlights its potential, further studies with larger patient cohorts are warranted to validate its efficacy and establish standardized treatment protocols for chronic PIP joint trauma.

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