

Suzuki Frame as a Treatment Modality for PIP Joint Fractures

Biplab Chatterjee¹, Divyanshu Kumar²

¹Associate Professor, Department of Orthopaedics, Burdwan Medical College, Burdwan, West Bengal.

²Second Year Resident, Department of Orthopaedics, Burdwan Medical College, Burdwan, West Bengal.

ABSTRACT

BACKGROUND

Injuries to the proximal interphalangeal joint (PIPJ) of the fingers are common. They occur most often following an axial impact on an extended finger. There are different modalities of treatment for such fractures like extension block splinting, the Allison's device, the Hynes and Giddings device, ORIF with interfragmentary screw and many others. We have chosen Suzuki frame for treatment of such fractures proposed by Suzuki et al in 1994.

METHODS

We reviewed our 25 consecutive cases of PIPJ fractures treated with Suzuki frame. Clinical and radiological evaluation was done at 2 weeks, 4 weeks and 6 weeks. Total active motion of the PIPJ, radiography and complications if any were noted.

RESULTS

Of 25 cases, radiological union was achieved in 23 cases. Remaining 2 were lost to follow up. Good to excellent result was achieved in 91% cases. None of the patients suffered any sort of infection and were discharged on a single antibiotic (co-amoxiclav). Even the pain score was zero in 21 cases which accounts for 91%. So this procedure gives good results in term of pain and functionality both.

CONCLUSIONS

Suzuki frame for PIPJ fractures is simple, safe, soft tissue sparing, minimally invasive technique giving excellent functional and cosmetic results with minimal complications.

KEYWORDS

Suzuki Frame, Proximal Interphalangeal Joint (PIPJ), Fracture, Invasive Technique

Corresponding Author:

*Dr. Divyanshu Kumar,
Second Year Resident,
Department of Orthopaedics,
Burdwan Medical College,
Burdwan- 713104, West Bengal.
E-mail: divyanshudriftiking@gmail.com
DOI: 10.18410/jebmh/2020/19*

*Financial or Other Competing Interests:
None.*

How to Cite This Article:

*Chatterjee B, Kumar D. Suzuki frame as
a treatment modality for pip joint
fractures. J. Evid. Based Med. Healthc.
2020; 7(2), 87-91. DOI:
10.18410/jebmh/2020/19*

*Submission 17-12-2019,
Peer Review 18-12-2019,
Acceptance 27-12-2019,
Published 11-01-2020.*



BACKGROUND

Before going into treatment modality, let us see the anatomy of PIPJ. The PIPJ is a synovial joint. The base of the middle phalanx carries a facet that is divided by a central ridge into two concavities. The head of the proximal phalanx is correspondingly trochlea-shaped, with the facets on the distal and flexor surfaces. This congruence affords intrinsic stability to the joint, especially in an axially-loaded finger. Fractures of the proximal interphalangeal joint include a wide spectrum of injuries, from stable avulsion fractures to complex fracture-dislocations. Management of complex proximal interphalangeal joint (PIPJ) fracture dislocations is challenging, with the potential of long-term sequelae including pain, stiffness, and functional loss. Several treatment modalities exist, none of which consistently produce good results.¹ Early mobilization is preferred to avoid stiffness and encourage articular cartilage regeneration via restoration of synovial fluid transport.²

Open surgical procedures may stabilize the fracture sufficiently to enable mobilization; however, this may not always be possible due to the fracture pattern. The procedure may be difficult and unforgiving; both patient selection and surgery should be approached with caution.^{1,3,4} Open surgical procedures involve soft tissue dissection known to cause devascularization and contribute to formation of adhesions and further stiffness.³ Dynamic joint distraction to produce ligamentotaxis is a treatment option allowing early mobilization that obviates the disadvantages inherent in an open procedure. Numerous traction devices and modifications have been introduced to restore satisfactory fracture alignment, joint congruency, and early mobilization.

Slade et al. first presented his dynamic distraction external fixation device fabricated from Kirschner (K) wires and rubber bands in 1990 at the 59th Annual Meeting of the American Society for Plastic and Reconstructive Surgery, publishing the design in 2000.⁵ Suzuki et al⁶ and Ruland et al⁷ published their experience with a dynamic skeletal system called the pins and rubber band traction system (PRTS). Various other dynamic skeletal systems have been presented in the literature. Stability of the joint is paramount in determining the appropriate treatment, which should aim to facilitate early mobilisation and restoration of function. Packham et al.⁸ conducted a scoping review that comprehensively examines the applications and outcomes of these systems as well as other traction orthoses and constructs. With skeletal systems, the distraction force exerted between the hook and counter traction pins remains constant as the base for distraction is fixed, whereas any slippage or movement that occurs in orthotic based systems will result in an alteration to the distraction force.⁹

Deshmukh et al modified the design of the PRTS by introducing a wire frame with coils.⁵ Following our recent work, Deshmukh's modification of the PRTS became our preferred method for ligamentotaxis (This modified system

was first reported in the literature by Deshmukh et al in 2004, and a small clinical series was presented.⁵) The frame can be made pre-operation potentially reducing operating times and streamlining the theatre procedures. The modified frame has coils that attach to the counter traction pin, therefore eliminating the need for this pin to rotate in the bone.⁵ Since Deshmukh et al. solo study in 2004, the use of the design appears to have been largely forgotten. The aim of this study is to revisit Deshmukh's frame modification and present our experience. Problems encountered and lessons learnt are discussed, and recommendations are made to avoid pitfalls and optimize patient outcomes.

These injuries to PIPJ are mostly due to axial impact to extended finger. Comminuted intra-articular fractures of the proximal interphalangeal (PIP) joint and the unstable fracture-dislocations of the PIP joint can often be difficult to treat appropriately and frequently lead to long-term pain, joint stiffness, post-traumatic arthritis, and functional deficit.¹⁰⁻¹² In this study the Suzuki frame described by Suzuki et.al in 1994 has been used as the treatment modality for PIPJ injury. Most authors have shown satisfactory results with Suzuki frame.¹³⁻¹⁵

METHODS

25 patients with closed PIPJ was treated by this method by the cited resident from 2018-19 after proper consent. There were 8 females and 17 males with mean age being 26.4 (range 21-48). Maximum fractures were due to axial load to fingers and others due to blunt trauma. We used the technique of closed K wire insertion periarticularly to achieve joint spanning. Post-operatively pin sites were dressed. Patients were followed up for 6 months at 2 weeks, 3 weeks and 6 weeks. Early mobilisation of PIPJ advised after 1 week with guarded movement. Clinical assessment included measurement of TAM (total active motion) at involved finger. TAM is defined as sum of motions at three joints say MCP, PIP and DIP.

Surgical Technique

Patient was positioned supine with arm abducted 90° and hand placed on a side table. Finger block was given to all 25 patients. Scrubbing and standard draping was done. Immediate pre-op Amoxiclav (1.2) was given. 1.2 mm K wire introduced in head of proximal phalanx (axial traction pin) 1.2 mm k wire introduced in head of middle phalanx (hook pin) Axial pin is bent 90° both side of finger so that tip remains around 4 cm distal to fingertip. Hook pin is bent 90° on both side of finger but smaller than axial pin. The bent should be as close as possible to skin to allow good range of motion. Bent hook is created on both the axial and hook pin ends. Rubber band is applied between these two hooks to apply traction. Third k wire is introduced near base of middle phalanx to correct any dislocation and maintain axis of traction.

Post-Op Protocol

Cases were discharged on the next day of admission with single antibiotic coverage ((co-amoxiclav-625) and pain killers (aceclofenac-paracetamol combination). Patients were asked to do active finger movements and lift light objects and do their light household activities. K wire were removed at 4 weeks after a radiograph with light dressing of pin sites.

RESULTS

Demography	Results
Total Cases	25(n=25)
Gender	Male 17, female=8
Injured Digit	Index-12, Little-8, Middle-3, Ring-2
Etiology	Accidents=10, Sporting activity=8, Altercation=4, others=3

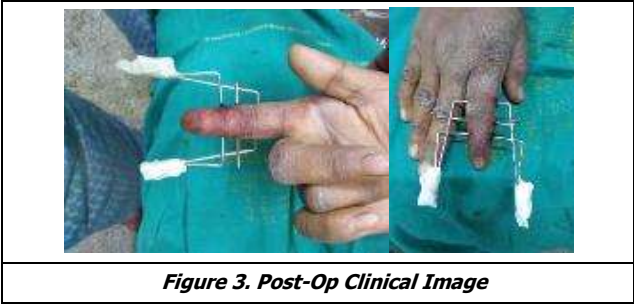
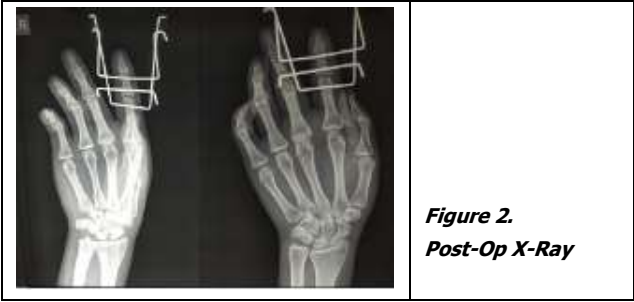
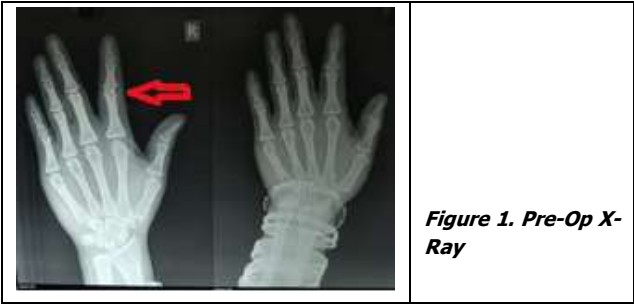
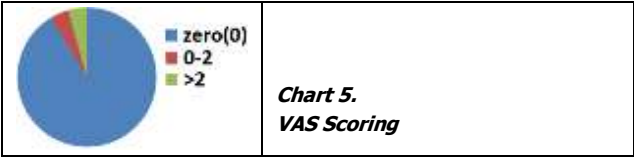
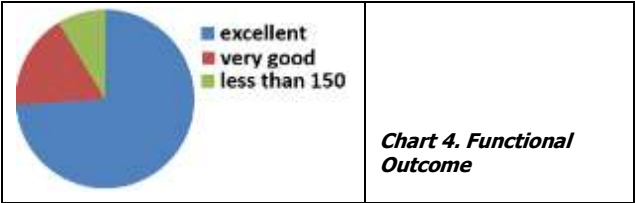
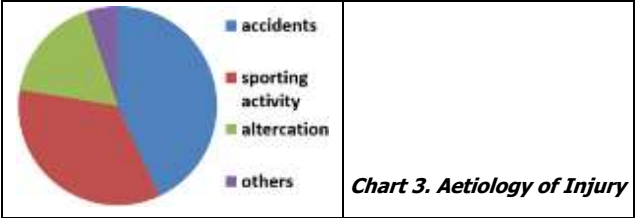
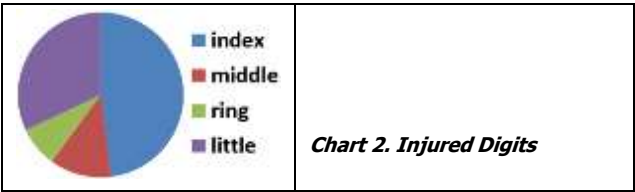
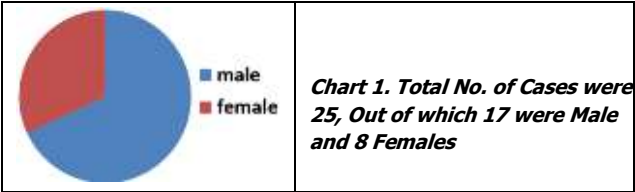
Table 1. Patient Demographics

TAM at the End of 6 Weeks	No. of Cases (n=23)
200-250 degrees(excellent)	17
150-200 degrees(very good)	4
Less than 150	2

Table 2. Functional Outcome Data

VAS Score	No. of Cases (n=23)
0	21
0-2	1
>2	1

Table 3. Pain Scoring on Basis of VAS at End of 6 Weeks



Case 1- 21 yr. old female pt. with rt. sided index finger PIPJ injury being treated with Suzuki distractor on the day of injury itself.

Case 2- 32yr. old female pt. with left sided middle finger PIPJ injury being treated with SUZUKI distractor on the day of injury itself.



Figure 5.
Post-Op Clinical
Image



Figure 6.
Post-Op X-Ray

DISCUSSION

Management of complex proximal interphalangeal joint (PIPJ) fracture dislocations is challenging, with the potential of long-term sequelae including pain, stiffness, and functional loss. Several treatment modalities exist, none of which consistently produce good results.¹ In this study the Suzuki frame described by Suzuki et.al in 1994 has been used as the treatment modality for PIPJ injury. Most authors have shown satisfactory results with Suzuki frame.¹³⁻¹⁵ In the study, patients with digit injury (PIPJ injury) 68% were male and 32% were females. The most commonly involved digit in PIPJ injury is index finger (48%) and least commonly involved is ring finger (8%). The most common cause of PIPJ injury is different mode of accidents (40%) be it RTA or fall or fall of object and the least common being altercation (16%) in cause specific. 17 cases had excellent results at end of 6 weeks in term of total active movement (TAM) that accounts to be 73.9% cases. 4 cases had very good results in term of TAM accounting for 17.3% cases and only 2 cases had poor results which is only 8.6%. So, it can be concluded from the study that 91% cases had excellent to good results. one of the patients suffered any sort of infection and were discharge on single antibiotic (co-amoxiclav). Even the pain score was zero in 21 cases which accounts for 91% itself.

CONCLUSIONS

More males suffered from PIPJ injury. Index finger is the most commonly involved and least common digit to be involved is the little finger. Most common aetiology being accidents and altercation being the most common in cause specific aetiology. TAM is a good modality to look for in follow-up to assess the outcome of procedure. This study shows the TAM to be an excellent to good option in 91% cases. VAS score for pain was also 0 in 91% cases. So, this procedure gives good satisfaction in term of pain and

functionality both. So, this dynamic external fixator technique that is Suzuki frame can be well used safely and happily in cases of PIPJ injury.

REFERENCES

- [1] Keramidas E, Solomos M, Page RE, et al. The Suzuki frame for complex intra-articular fractures of the proximal interphalangeal joint of the fingers. *Ann Plast Surg* 2007;58(5):484-488.
- [2] Salter RB, Simmonds DF, Malcolm BW, et al. The biological effect of continuous passive motion on the healing of full-thickness defects in articular cartilage. An experimental investigation in the rabbit. *J Bone Joint Surg Am* 1980;62(8):1232-1251.
- [3] Stern PJ, Roman RJ, Kiefhaber TR, et al. Pilon fractures of the proximal interphalangeal joint. *J Hand Surg Am* 1991;16(5):844-850.
- [4] de Soras X, de Mourgues P, Guinard D, et al. Pins and rubbers traction system. *J Hand Surg Br* 1997;22(6):730-735.
- [5] Deshmukh SC, Kumar D, Mathur K, et al. Complex fracture-dislocation of the proximal interphalangeal joint of the hand. Results of a modified pins and rubbers traction system. *J Bone Joint Surg Br* 2004;86(3):406-412.
- [6] Suzuki Y, Matsunaga T, Sato S, et al. The pins and rubbers traction system for treatment of comminuted intraarticular fractures and fracture-dislocations in the hand. *J Hand Surg Br* 1994;19(1):98-107.
- [7] Ruland RT, Hogan CJ, Cannon DL, et al. Use of dynamic distraction external fixation for unstable fracture-dislocations of the proximal interphalangeal joint. *J Hand Surg Am* 2008;33(1):19-25.
- [8] Packham TL, Ball PD, MacDermid JC, et al. A scoping review of applications and outcomes of traction orthoses and constructs for the management of intra-articular fractures and fracture dislocations in the hand. *J Hand Ther* 2016;29(3):246-268.
- [9] Nothdurft SH, Hartman J, Park HS, et al. Dynamic distraction of the PIPJ: the importance of the proximal K-wire. In: *Proceedings of the Australian Hand Therapy Association Annual Conference*. Glenelg: Australian Hand Therapy Association 2017: p. 30.
- [10] Agarwal AK, Karri V, Pickford MA. Avoiding pitfalls of the pins and rubber traction technique for fractures of the proximal interphalangeal joint. *Ann Plast Surg* 2007;58(5):489-495.
- [11] Debus G, Courvoisier A, Wimsey S, et al. Pins and rubber traction system for intra-articular proximal interphalangeal joint fractures revisited. *J Hand Surg Eur* 2010;35(5):396-401.
- [12] de Soras X, de Mourgues P, Guinard D. Pins and rubbers traction system. *J Hand Surg Br* 1997;22(6):730-735.
- [13] Keramidas EG, Solomos M, Page RE, et al. The Suzuki frame for complex intra-articular fractures of the

proximal interphalangeal joint of the fingers. *Ann Plast Surg* 2007;58(5):484-488.

- [14] Kiral A, Erken HY, Akmaz I, et al. Pins and rubber band traction for treatment of comminuted intra-articular fractures in the hand. *J Hand Surg Am* 2014;39(4):696-705.

- [15] Majumder S, Peck F, Watson JS, et al. Lessons learned from the management of complex intra-articular fractures at the base of the middle phalanges of fingers. *J Hand Surg Br* 2003;28(6):559-565.