Original Article

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Study of Clinical outcome of Proximal Interphalangeal Joint Fractures Treated with Suzuki Frame

Pratyay Mukherjee[1], **Arijit Saha**[2], **Debajyoti Sarkar**[3]

[1]Junior Resident, Department of Orthopaedics, Burdwan Medical College, Bardhaman, West Bengal, India, [2]Senior Resident, Department of Orthopaedics, Jangipur SSH, Murshidabad, West Bengal, India, [3]RMO-CT, Department of Orthopaedics, Burdwan Medical College, Bardhaman, West Bengal, India.

Abstract

Background: Proximal interphalangeal (PIP) joint injuries are very common and occur frequently after a direct axial trauma to extended finger. Different modalities of treatments are available in this type of injury such as extension block splinting, the Hynes and Giddings device, ORIF with interfragmentary screw and many others. In present study Suzuki frame has been chosen for treatment of such fractures proposed by Suzuki et al in 1994. The aims & objectives is to describe the clinical outcome of treatment of proximal interphalangeal (PIP) joint fractures by dynamic Kirschner wire fixator in the form of Suzuki Frame. **Subjects and Methods:** We reviewed our 16 consecutive cases of PIPJ fractures treated with Suzuki frame. Regular clinical and radiological evaluation was done at 2 weeks, 4 weeks, 6 week and 12 weeks follow up. Visual Analogue Score(VAS), Range of motion of the PIPJ, Average Michigan hand Score were calculated and complications if any were noted. **Result:** Average Michigan hand questionnaire was 86.31% (range from 71%-94%). The average PIP ROM 96.25° (Range 70°-120°). VAS Score improved from average pre-op 8.25 to 0.5 in post-operative period. No angular deformity or instability noted at the end of follow up. Pin tract infection reported in two patients. **Conclusion:** The Suzuki Frame is easy to apply, safe, soft tissue sparing, minimally invasive technique. It can reduce and maintain reduction of unstable proximal interphalangeal joint fractures and allow immediate post-operative PIP joint motion with minimal complications.

Keywords: Fracture, Proximal Interphalangeal Joint Fractures, Suzuki Frame

Corresponding Author: Pratyay Mukherjee, Junior Resident, Department of Orthopaedics, Burdwan Medical College, Bardhaman, West Bengal, India.
E-mail: praty1205@gmail.com

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Introduction

Proximal interphalangeal (PIP) joint injuries are very difficult to treat for the hand surgeons.[1] A wide spectrum of injuries are included in fractures of the proximal interphalangeal joint ranging from stable avulsion fractures to complex fracture-dislocations. Main goal of the treatment is to make the PIP joint painless, stable and mobile at the same time.[2,3] Treatment options available for such fractures include Closed reduction and extension block pins.[1,2] Open reduction and internal fixation of PIP joint fractures and osteochondral hemi-hamate autograft arthroplasty.[3–6] Ideal treatment should include anatomical fracture alignment along with proper joint congruity as well as early initiation of range of motion. Dynamic external fixation of PIP joint fractures acts via indirect fracture reduction, maintainance of fracture alignment and allowing early joint movement ultimately results in excellent functional outcome.[7–9] In 1990 Slade et al. presented his dynamic distraction external fixation device fabricated from Kirschner (K) wires and rubber bands at the 59th Annual Meeting of the American Society for Plastic and Reconstructive Surgery and the design was published in 2000.[10] Suzuki et al,[11]and Ruland et al,[12] published their work with a dynamic external fixator system known as the pins and rubber band traction system (PRTS).

Subjects and Methods

Study design: Institution based prospective study.

Study Area: Department of Orthopaedics, Burdwan Medical College and Hospital.

Study Population: 16 cases.

Study duration: January 2019 to March 2020.

Inclusion criteria:

- Closed fracture
- Fracture <3wks

Exclusion Criteria:

Open fracture with cut tendons or neurovascular injuries

Fracture >3wks

Parameters to be studied:

- Visual Analogue Scale Score (VAS SCORE
- Proximal Interphalangeal joint Range of Motion(PIP ROM
- Michigan Hand scores[13]

Surgical Technique:

Patient placed on supine position with arm in 90° abduction with the help of a side table. Digital nerve bock anesthesia is used with 10 ml combination of (5 ml lidocaine 2%, 5 ml bupivacaine 0.25%).Co-amoxiclav (1.2gm) was given pre-operatively. 1.2 mm K wire was passed into the head of proximal phalanx (acts as axial traction pin) and 1.2 mm k wire was passed into the middle phalanx (acts as hook pin). Both pins are bent to 90° on either sides. Hook pin is kept smaller than axial pin. At the ends of both the pins bend hooks are created. Traction was applied with the help of rubber bands application between these two hooks.

All patients were encouraged for early range of motion. Patients were followed weekly till K wire removal done at 4wks and pin tract care with light dressing. Radiological evaluation was done at 2^{nd}, 4^{th}, 6^{th} and 12^{th} wk. Visual analogue scale (VAS) for pain is used to determine the subjective satisfaction. PIP ROM and The Michigan hand questionnaire was used for evaluation of the results using the Suzuki Frame.

Results

Mean age of the study population is 40.93 years (Range 29-56yrs) and 75% patients were male. 50% among all patients were injured by accidents and 43.75% due to sports injury.5 of them injured index finger, 8 middle finger, 2 ring and 1 little finger. Preoperative VAS score was average 8.25(Range 7-9) which comes down to 0.5(Range 1-2) after 3months.

Average PIP ROM at 3month was 96.25° (Range 70°-120°). At 3 month follow up Michigan Hand score shows average 86.31% (Range 71-94%).

Discussion:

Complex proximal interphalangeal joint (PIPJ) fracture dislocations are very difficult to manage with potential long-term sequelae including pain, joint stiffness, and functional loss. It

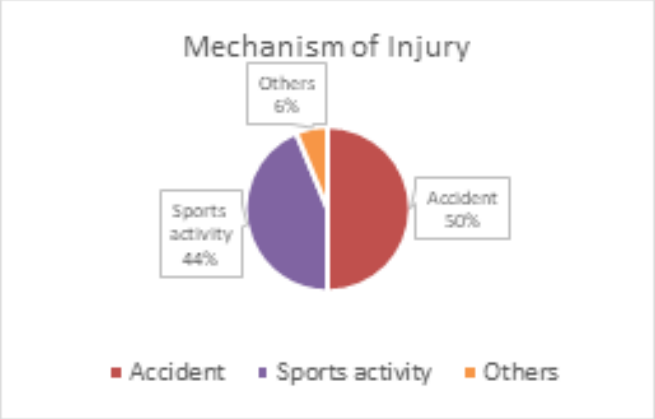

Figure 1: Mechanism Of injury

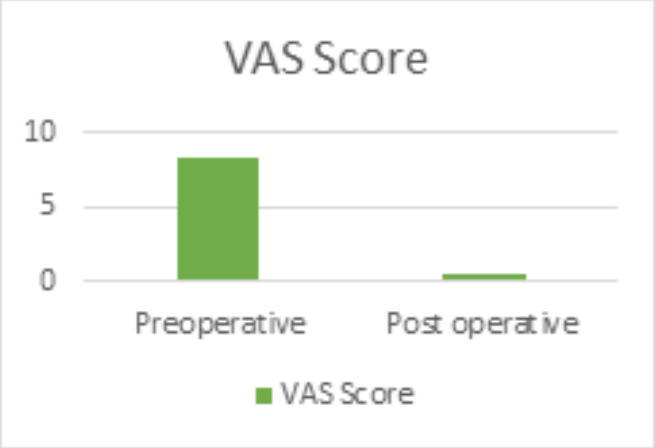

Figure 2: VAS Score

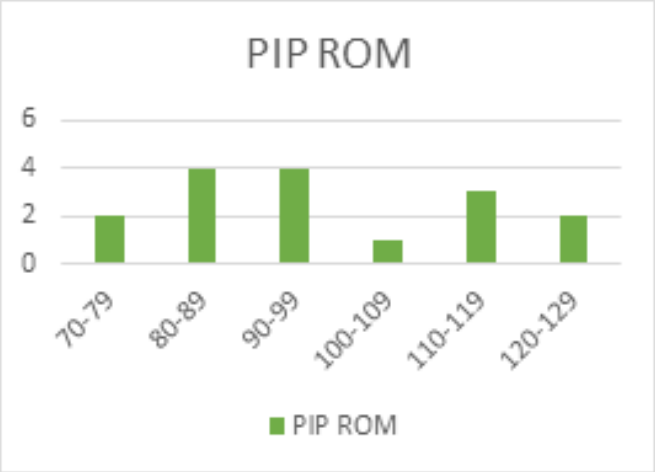

Figure 3: PIP ROM at 3month

Table 1: Result Summery

No.	Age	Sex	Mechanism of injury	Injured digit	Side	VAS score (pre op)	VASSco (post op)	PIP ROM (at 3 month)	Michigan hand score	Compli-cations
1	38	F	Accident	Middle	R	9	0	100°	87%	None
2	29	M	Sports activity	Index	R	8	1	95°	90%	None
3	40	M	Sports activity	Ring	L	9	0	85°	82%	Pin tract infection
4	45	M	Accident	Middle	R	7	1	75°	79%	None
5	52	M	Accident	Middle	L	8	0	115°	90%	None
6	34	M	Sports activity	Index	R	8	0	120°	94%	None
7	27	F	Others	Little	R	9	2	70°	71%	None
8	47	M	Accident	Middle	L	7	1	85°	80%	None
9	56	M	Sports activity	Index	R	8	0	95°	88%	Pin tract infection
10	37	M	Accident	Middle	R	9	0	110°	91%	None
11	33	F	Accident	Middle	R	9	1	85°	81%	None
12	49	M	Sports activity	Ring	L	8	0	120°	94%	None
13	45	M	Accident	Index	R	8	0	110°	92%	None
14	41	F	Sports activity	Middle	R	8	1	95°	90%	None
15	33	M	Accident	Middle	L	9	1	85°	84%	None
16	49	M	Sports activity	Index	R	8	0	95°	88%	None

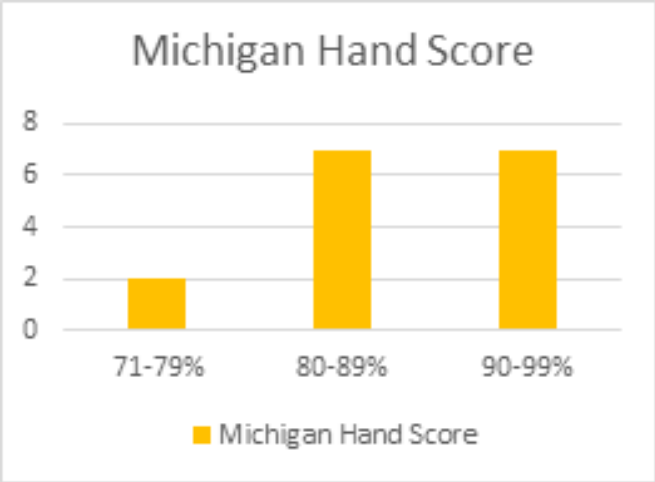

Figure 4: Michigan Hand Score at 3 mont h

Figure 5: Pre Op

has been seen that fractures involving >30% of articular surface is at risk of instability and >50% involved fractures are nearly unstable. Though several treatment modalities exist, none of them can consistently produce satisfactory outcome. In this study the Suzuki frame described by Suzuki et.al in 1994 has been used as the treatment modality for PIPJ injury. For a fixator to be successful a congruent traction must be obtained by a continuous traction and/or translation. Salter et al.[14] in 1981 proved that continuous active and passive movements is necessary in healing of hyaline cartilage. They concluded that, immobilization of any joint interfere with the normal distribution of synovial fluid and nutrition of articular car-

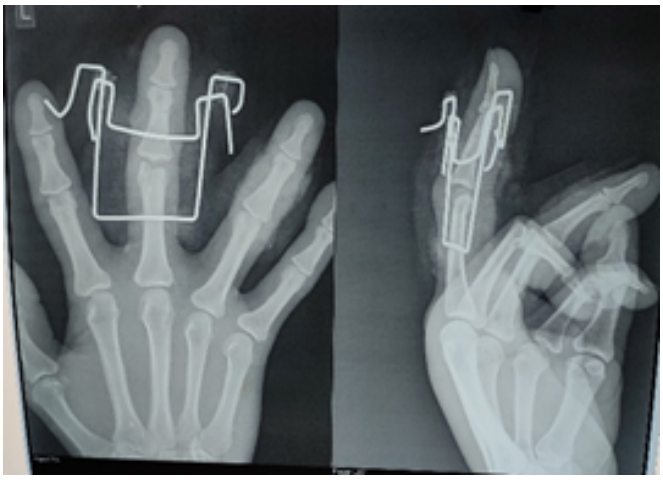

Figure 6: Post Op

Figure 7: 6 weeks follow up flexion

tilage. Stern et al.[15] in 1991 concluded that ORIF can achieve anatomical reduction in some cases but should be approached cautiously. Blood supply of smaller fragments may get hampered from extensive soft tissue dissection leading to stiffness. Dynamic fixator can provide ligamentotaxis, maintaining the proper reduction of PIP joint fractures and give results which are radiologically and clinically comparable or even better than those obtained by ORIF.

In present study post-operative average PIP ROM gained was 96.25° which is quite similar to Inanami et al.[16] study over seven PIP joint fracture-dislocations with dynamic finger fixator, the average PIP joint ROM was 88 degrees in 21 months follow up. Allison,[17] in 1996 reported average PIP joint ROM 77 degrees after treatment of 14 patients. Asal Fouad Galal Hegazy, Mahmoud Seddik, Hesham Safwat, Mohamed Negm and Ibrahem El-sebaey,[18] did a similar study in 2016 where average PIP ROM was 93°. Average Michigan Hand Score in our study is 86.31% which is comparable with the study of Asal Fouad Galal Hegazy, Mahmoud Seddik, Hesham Safwat, Mohamed Negm and Ibrahem El-sebaey,[18] where average score was 88%. Post-operative VAS score in our study is 0.5which is comparable with the study of B Chatterjee, D Kumar,[19] where 91% patients pain score comes down to zero and others had 1-2.

Conclusion

Dynamic external fixator in the form of Suzuki Frame is a good technique to treat unstable PIP joint Fracture. It is inexpensive and quite easy to apply with the help of K-wires and rubber band. Concentric traction has been maintained with this technique results in healed fracture with acceptable post-operative range of motion. It can be conclude that Suzuki Frame has given very satisfactory results with a very low rate of complication.

Figure 8: 6 weeks follow up extension

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