



Management of closed intra-articular fracture/fracture dislocations at proximal interphalangeal joint of fingers using simple traction frame device

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Received Date: 12/03/2023 Revised Date: 21/04/2023 Accepted Date: 18/05/2023

ABSTRACT

Background: Management of complex proximal interphalangeal joint (PIPJ) fracture dislocations is challenging, with the potential of long-term sequelae including pain, stiffness, and functional loss. Present study was aimed to study management of closed intra-articular fracture / fracture dislocations at proximal interphalangeal joint of fingers using simple traction frame device. **Material and Methods:** Present study was hospital based, prospective, observational study, conducted in patients of closed intra-articular fracture /fracture dislocation at PIP joint of finger, who were managed with traction frame device. **Results:** Among 30 patients, 27 (90 %) male. Majority were of less than 24 years age group (76.67 %). Majority patients (70%) had pre-op range of motion at PIP joint upto 30⁰. Majority patients (86.67 %) had fracture of base of middle phalynx. These patients with fracture base of middle phalynx were having dorsal subluxation at PIP joint and remaining 4 patients involving fracture head of proximal phalynx were having volar dislocation at PIP joint (13.33 %). We have treated 26 patients with traction device and in remaining 4 patients involving fracture of head of proximal phalynx additional limited ORIF was done. Complications observed were malunion (20 %), residual pain (16.67 %), pintrack infection (6.67 %) & deformity (6.67 %). In our study, in 76.67 % of patients we able to achieve movement 60 degree & above comparing with the normal same finger of opposite site. Majority patients were satisfied with treatment given (83.33 %). In our study, according to functional outcome, 5 patients (16.67 %) achieved excellent results, 15 patients (50 %) achieved good results. In remaining patients results were fair (20 %) & poor (13.33 %). **Conclusion:** Use of simple traction frame device in management of closed intra-articular fracture/fracture dislocations at proximal interphalangeal joint of fingers was found to be a safe and applicable technique.

Keywords: Fracture proximal interphalangeal joint, traction frame device, closed intra-articular fracture, clinical outcome.

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INTRODUCTION

The proximal interphalangeal (PIP) joint is a hinge joint that can extend toward the palmar side at large angles, which facilitates its large range of motion (ROM). Thus, damage may cause significant functional loss of hand.¹ Management of complex proximal interphalangeal joint (PIPJ) fracture dislocations is challenging, with the potential of long-term sequelae including pain, stiffness, and functional loss.

Pain, premature degenerative arthritis, stiffness, and persisting subluxation are common sequelae of fracture dislocation of proximal interphalangeal (PIP) joints. The most severe injuries are caused by longitudinal compression force impacting the volar articular surface of middle phalanx against dorsal condyles of proximal phalanx.³

Many surgical approaches with a wide range of technical complexity have been described in the literature including extension block pinning, closed reduction and percutaneous pinning (CRPP), dynamic external fixation devices, open reduction and internal fixation, volar plate arthroplasty, and hemi-hamate replacement arthroplasty.⁴ The application of traction constructs is less invasive than open reduction, utilising percutaneous insertion of two to three K-wires.⁵ Present study was aimed to study management of closed intra-articular fracture / fracture dislocations at proximal interphalangeal joint of fingers using simple traction frame device.

MATERIAL AND METHODS

Present study was hospital based, prospective, observational study, conducted tertiary care Centre. Study approval was obtained from institutional ethical committee.

Inclusion criteria

Patients of Closed intra-articular fracture /fracture dislocation at PIP joint of finger, who were managed with traction frame device, willing to participate in present study

Exclusion criteria

Open fractures

Old fracture more than 2 weeks

Associated multiple injuries in same hand

Study was explained to patients in local language & written consent was taken for participation & study. A detailed history regarding name, age, sex, date of injury, mode of injury, residential address, occupation was recorded. Patients were examined with emphasis on range of motion across PIP joint measured with goniometer. Patients affected hand was x rayed in both true antero-posterior and true lateral view. After anaesthetic fitness, patients were posted for surgery.

Under digital block anaesthesia, a 1.2-1.4-mm K-wire (K1) was placed transversely through the neck of the proximal phalanx when the fracture involved the base of middle phalanx or more proximally in cases where fracture involved the head of proximal phalanx. A second K-wire (K2) of the same diameter was driven through the base of shaft of the middle phalanx but always away from the fracture site. The first wire (K1) was left long enough on both sides so the ends can be bent in a semicircular fashion. Traction was then applied on the middle phalanx so that it engages in the horns of the proximal phalanx K-wire, achieving the desired skeletal traction.

True antero-posterior and true lateral view X-rays were obtained post operatively. When X-ray showed acceptable reduction of fracture dislocation, mobilisation of PIP joint was started on next day. The Patients were reviewed at 1week after starting mobilisation. A note was made of any subjective complaints from patients (pain, pin track infection etc) and encouraged for mobilisation at PIP joint .Patient advised for pin track dressing to avoid infection.

The first follow up was taken at 2 weeks followed by 6 weeks, then biweekly & final follow up was taken at 3 months. Traction device was removed at 6 weeks. Patients assessed both clinically and radiologically, noting any symptoms, deformity of finger if any. ROM across PIP joint and total active ROM of finger.. The outcome measured categorized according Belsky et al ,⁶ criteria as-

Excellent - No symptoms, Pain-free union, No angular/rotational deformity, PIP movement of >100°, total active ROM of >250°

Good - Minimal angular/rotational deformity, PIP movement of >80°, total active ROM of >180°

Fair and Poor - Remaining unchanged

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Statistical analysis was done using descriptive statistics.

RESULTS

In present study, [Table 1] total 30 patients were included. There were 27 (90 %) male and 3 (10 %) female patients in our study. Majority were of less than 24 years age group (76.67 %).

Table 1: Distribution according to age & sex of the subject

Age group (in yrs)	Gender		Total
	Male	Female	
≤ 24	21 (70 %)	2 (6.67 %)	23 (76.67 %)
>24	6 (20 %)	1 (3.33 %)	7 (23.33 %)
Total	27 (90 %)	3 (10 %)	30

[Table 2] Common mode of injury was while playing (80 %), average time between injury and surgery was 9.75 days (range 2 to 14 days) with most of the patients operated in second week (76.67 %). Among majority patients index finger was involved (36.67 %), middle and Ring finger involved in 7 patients (23.33 %) & little finger involved in 5 patients (16.67 %).

Table 2: General characteristics

Mode of injury	No. of patients	Percentage
Playing	24	80 %
Blunt hit	3	10 %
Fall	3	10 %
Delayed (In days)		
≤ 7 days	7	23.33 %
>7 days	23	76.67 %
Finger involved		
Index	11	36.67 %
Middle	7	23.33 %
Ring	7	23.33 %
Little	5	16.67 %

[Table 3] Out of 30 patients, majority patients (70%) had pre-op range of motion at PIP joint upto 30°.

Table 3: Pre-op ROM at PIP joint (in degree) of the subject

Pre-op ROM at PIP joint degree	No. of patients	Percentage
10	8	26.67 %
15	3	10 %
20	5	16.67 %
30	5	16.67 %
40	2	6.67 %
70	7	23.33 %

[Table 4] Majority patients (86.67 %) had fracture of base of middle phalynx. These patients with fracture base of middle phalynx were having dorsal subluxation at PIP joint and remaining 4 patients involving fracture head of proximal phalynx were having volar dislocation at PIP joint (13.33 %). We have treated 26 patients with traction device and in remaining 4 patients involving fracture of head of proximal phalynx additional limited ORIF was done.

Table 4: Fracture management

Fracture management	No. of patients	Percentage
Type of fracture		
Head of proximal phalynx	4	13.33 %
Base of middle phalynx	26	86.67 %
Associated Subluxation/dislocation at PIP joint		
Dorsal subluxation at PIP joint	26	86.67 %
Volar dislocation at PIP joint	4	13.33 %
Surgical procedure		
Traction device and ORIF	4	13.33 %
Traction device	26	86.67 %

[Table 5] There was mean pre-op ROM of 30.31 ± 20.95 degree and mean post-op ROM of 69.06 ± 29.27 degree with mean change of 38.75 ± 25.27 which is highly significant.

Table 5: Pre-op & post-op ROM

Mean \pm Sd	ROM at PIP joint		Mean change \pm Sd	P-value
	Pre-op	Post-op		
	30.31 ± 20.95	69.06 ± 29.27	38.75 ± 25.27	<.001

[Table 6] We were able to achieve complete reduction of the fracture in 50% of the patients with remaining 50% having incomplete reduction. We were able to correct subluxation/dislocation in 16 patients (53.33%) while in remaining patients subluxation component partially corrected. Complications observed were malunion (20 %), residual pain (16.67 %), pintrack infection (6.67 %) & deformity (6.67 %).

Table 6: Post-op status & complications

Post-op status	No. of patients	Percentage
Post-op status of fracture		
Complete reduction	15	50 %
Incomplete reduction	15	50 %

Post-op status of subluxation/dislocation		
Dislocation at PIP joint corrected	4	13.33 %
Subluxation at PIP joint corrected	16	53.33%
Subluxation at PIP joint present	10	33.33 %
Complications		
Malunion	6	20 %
Residual Pain	5	16.67 %
Pin track Infection	2	6.67 %
Deformity	2	6.67 %

[Table 7] In our study, in 76.67 % of patients we able to achieve movement 60 degree & above comparing with the normal same finger of opposite site.

Table 7: Distribution according to % of movement attained compared to the normal finger

% of movement attained compared to normal finger	No. of patients	Percentage
10%	2	6.67 %
20%	3	10 %
45%	2	6.67 %
60%	5	16.67 %
80%	7	23.33 %
90%	4	13.33 %
100%	7	23.33 %

[Table 8] Majority patients were satisfied with treatment given (83.33 %).

Table 8: Patient satisfaction

Patient satisfaction	No. of patients	Percentage
Satisfied	25	83.33 %
Unsatisfied	5	16.67 %

[Table 9] In our study, according to functional outcome, 5 patients (16.67 %) achieved excellent results, 15 patients (50 %) achieved good results. In remaining patients results were fair (20 %) & poor (13.33 %).

Table 9: Functional outcome

	No. of patients	Percentage
Excellent	5	16.67 %
Good	15	50 %
Fair	6	20 %
Poor	4	13.33 %

DISCUSSION

Applying traction to the injured joint has the benefit of ligamentotaxis⁷, a term used to describe the reduction of fracture fragments and realignment of joint surfaces via a distraction force on the ligamentous and volar plate attachments. Interventions that enable both traction and movement of the joint are considered superior to those that only enable traction or only allow movement.⁸

Because open reduction and fixation is difficult and may lead to fragment necrosis, closed reduction including traction systems is favored. These systems allow early mobilization,

whereas the immobilization of the PIP joint results in stiffness with a reduced range of motion due to periarticular scarring.⁹ The use of an external traction fixator is based on reduction through traction of the fracture components and ligamentotaxis within the PIP joint to correct any subluxation of the joint.^{10,11}

A less invasive method than ORIF for the management of PIP joint fractures is the use of traction. A comparative study by O'Brien et al.,¹² examined outcomes of PIP joint fractures of 30-60 % articular surface involvement. One group received a dynamic traction orthosis using skeletal traction via K-wire (n = 17), the other received operative or conservative treatment without traction (n =14). The study reported the mean combined ROM of the PIP and DIP joint was superior in the swing traction group compared to the no-traction group (P = 0.008). Patient ratings of pain level, function and satisfaction were not significantly different between groups

(p-values 0.52, 0.883 and 0.52, respectively).

Bhat NA et al.,¹³ studied 23 patients managed with Suzuki's pin and rubber traction system. The mean ROM at the PIP joint at the final follow-up was 80±12.2 (range: 50-100) degrees. The mean flexion at PIP joint at the final follow-up was 82.72±10.5 degrees and the mean extension at PIP joint was -2.7±4.5 degrees. No case of non-union was observed in the present study. Pin tract infection occurred in 17.39% of cases and was the commonest complication observed. Two patients needed realignment of K-wires for pin displacement. One patient developed osteomyelitis of middle phalanx at three weeks and needed early removal of hardware. The same patient also developed complex regional pain syndrome (CRPS) at two months. One patient developed painful arthritis of PIP joint.

Chatterjee B et al.,¹² studied 25 cases of PIPJ fractures treated with Suzuki frame. 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.

The PIP tends to become stiff after trauma or immobilization due to pain, instability, and capsular and ligament fibrosis. Immobilization for more than 3 weeks may result in permanent loss of mobility, so early mobilization is essential; to this end, the surgeon must determine when the joint is stable enough for mobilization.¹⁵

The optimal outcome from surgical treatment demands an appropriate surgical plan, atraumatic soft tissue handling, and stable fixation to facilitate early motion; however, complications such as non-union, malunion, infection, and stiffness can occur even in the setting of appropriate treatment.¹⁶

CONCLUSION

Fracture dislocation of the proximal interphalangeal joint is a rare injury with multiple possible treatments. Use of simple traction frame device in management of closed intra-articular fracture/fracture dislocations at proximal interphalangeal joint of fingers was found to be a safe and applicable technique. It is a cost-effective alternative to other fixator designs and is associated with a good clinical outcome.

Conflict of Interest: None to declare

Source of funding: Nil

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