International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Outcome Of Extension Block Pinning For Mallet Finger

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Received: 28-09-2025
Accepted: 13-10-2025
Available online: 16-11-2025

ABSTRACT

Background : Mallet finger is a frequent injury to the terminal extensor mechanism of the distal interphalangeal (DIP) joint, often caused by an avulsion fracture of the dorsal base of the distal phalanx. While conservative treatment using splints remains the standard for uncomplicated soft-tissue mallets, surgical fixation becomes necessary in cases with volar subluxation or large articular fragment involvement. Extension-block pinning, introduced by Ishiguro, has evolved into a reliable, minimally invasive technique that ensures accurate joint congruity and early rehabilitation. **Aim**: The objective of this study was to evaluate the functional and radiological outcomes of extension-block pinning in patients with bony mallet finger treated by Department of Orthopaedics at Government Medical College Srinagar. **Methods**: A prospective observational study was conducted between January 2022 and June 2024 on 15 patients (10 males, 5 females) aged 18–55 years (mean = 32.8 ± 9.6 years). Inclusion criteria were acute bony mallet finger with articular surface involvement greater than 30% or displacement more than 2 mm, and absence of previous finger deformity. Under digital block anesthesia and fluoroscopic guidance, a 1.0–1.2 mm K-wire was introduced percutaneously for extension-block fixation, followed by a trans-DIP wire for stabilization. Post-operative immobilization was maintained for 6 weeks, followed by gradual mobilization and physiotherapy. Clinical evaluation was based on Crawford's criteria, measuring extension lag, flexion range, and total active motion. Radiological union, subluxation correction, and complications were assessed. **Results:** All 15 patients achieved radiographic union at a mean of 6.4 ± 1.1 weeks. Mean follow-up was 12.5 months (range 10–15 months). Mean extension lag improved from 27.3° pre-operatively to 4.6° at final follow-up, while mean DIP flexion was 68.2° ± 8.1°. Mean total active motion was 72.8° ± 7.4°. According to Crawford's criteria, results were excellent in 9 patients (60%), good in 4 (26.7%), fair in 1 (6.7%), and poor in 1 (6.7%). Complications included two cases (13.3%) of superficial pin-tract infection managed conservatively and one case (6.7%) of transient nail deformity; no non-union or residual subluxation was observed. **Conclusion:** Extension-block pinning provides excellent functional and radiological outcomes in selected cases of bony mallet finger, with minimal complications and high patient satisfaction. This technique remains a reliable, cost-effective option in the management of displaced mallet fractures, particularly in resource-limited settings such as tertiary hospitals in developing regions.

Keywords*: Mallet finger, bony mallet fracture, extension-block pinning, Kirschner wire fixation, distal interphalangeal joint, functional outcome.*

INTRODUCTION

Injury to the terminal extensor mechanism of the distal interphalangeal (DIP) joint, commonly referred to as mallet finger, typically results from either a tendon rupture or a bony avulsion of the dorsal base of the distal phalanx. Forced flexion or axial loading of the DIP joint is a common mechanism in athletes or during accidental trauma. [1] When a

bony fragment is involved (bony mallet), management considerations change because of articular surface involvement. Conservative treatment using extension splinting may be adequate for small avulsion injuries; however, when the fragment involves more than one-third of the articular surface or when there is volar subluxation of the distal phalanx, surgical fixation is often advocated to restore joint congruity and avoid late sequelae such as arthrosis, extension lag, or swan-neck deformity. [2][3]

The surgical technique of extension-block pinning, originally described by Ishiguro et al., uses a percutaneous Kirschner wire (K-wire) inserted dorsally into the middle phalanx (extension block) followed by stabilization with a trans-DIP K-wire. This method is minimally invasive, preserves the extensor mechanism, allows joint reduction under fluoroscopy, and facilitates early mobilisation. [4] Early case series of this technique reported high union rates and excellent functional outcomes; for example, one retrospective series of 65 patients treated with the extension-block method reported 46% excellent, 32% good, 20% fair and 2% poor results according to Crawford's criteria. [5]

Despite favourable reports, some issues remain unresolved. First, the optimal indications such as fragment size threshold, degree of subluxation, and time from injury to surgery are variably defined across studies. [6] Second, predictors of sub-optimal outcome after extension-block pinning have been noted: older age, delayed surgery, residual articular step-off, and suboptimal wire insertion angle have been associated with poorer results. [7] These observations underscore that while extension-block pinning is widely adopted, patient selection and surgical technique play key roles in outcomes.

In our tertiary hospital setting at Government Medical College Srinagar, we found a lack of region-specific data on extension-block pinning for mallet finger—including during periods of resource constraint and varied follow-up compliance. Therefore, we conducted a prospective observational study of 15 patients treated over an 18-month period (2022–2024) to evaluate the functional and radiological outcomes of extension-block pinning for displaced bony mallet injuries in our population.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted in the Department of Orthopaedics, Government Medical College, Srinagar, between January 2022 and June 2024. The study aimed to assess the functional and radiological outcomes of extension-block pinning in the management of displaced bony mallet finger injuries. Ethical approval for the study was obtained from the Institutional Ethics Committee prior to commencement, and informed consent was taken from all participants.

Study Population

A total of 15 consecutive patients presenting with bony mallet finger were included in the study. The inclusion criteria were:

1. Age between 18 and 55 years.
2. Acute bony mallet finger injury (within 2 weeks of trauma).
3. Radiological evidence of a dorsal avulsion fracture involving more than one-third of the articular surface or displacement greater than 2 mm.
4. Cases with volar subluxation of the distal phalanx confirmed on lateral X-ray view.

The exclusion criteria were:

1. Old neglected mallet finger injuries (more than 3 weeks post-injury).
2. Open fractures or associated tendon lacerations.
3. Comminuted fractures unsuitable for percutaneous fixation.
4. Patients with prior surgery or pre-existing deformity of the involved finger.
5. Patients unwilling to participate or unable to comply with follow-up.

Preoperative Evaluation

Each patient underwent thorough clinical evaluation including history, mechanism of injury, and physical examination of the affected digit for tenderness, swelling, and extensor lag at the distal interphalangeal (DIP) joint. Standard anteroposterior and lateral radiographs were obtained to assess fragment size, displacement, and the presence of volar subluxation. Routine preoperative investigations were carried out as per institutional protocol.

Surgical Technique

All procedures were performed under digital block anesthesia and strict aseptic precautions in the minor operating theatre. The patient was placed supine with the hand resting on a radiolucent hand table. Under fluoroscopic guidance, the DIP joint was flexed to expose the dorsal articular fragment.

A 1.0–1.2 mm Kirschner wire (K-wire) was inserted percutaneously into the dorsal aspect of the head of the middle phalanx at approximately a 45° angle to the long axis of the finger. The wire was advanced until it made firm contact with the fracture fragment, acting as an "extension block." The distal phalanx was then gently extended to achieve

reduction of the dorsal avulsion fragment, and a second 1.0 mm K-wire was passed transarticularly across the DIP joint to maintain the reduction. Proper reduction and wire placement were confirmed in both anteroposterior and lateral fluoroscopic views.

After satisfactory fixation, the wires were bent and cut short outside the skin. A sterile dressing was applied, and a dorsal aluminum splint was used to immobilize the DIP joint in slight extension while allowing movement at the proximal interphalangeal (PIP) joint.

Postoperative Care and Rehabilitation
All patients were discharged on the same day with oral antibiotics and analgesics for five days. Dressing changes were done every 3–4 days, and pin tract inspection was carried out at each visit. Patients were advised to keep the finger elevated and to perform range of motion exercises of the unaffected joints.

The transarticular K-wire was removed after 6 weeks under local anesthesia once radiographic signs of union were observed. Gentle active flexion and extension exercises of the DIP joint were initiated at that time. Full unrestricted hand use was permitted after 8–10 weeks.

Follow-Up and Evaluation
Patients were followed up at 2 weeks, 6 weeks, 3 months, 6 months, and 12 months postoperatively. At each visit, clinical assessment and radiographs were performed. Functional evaluation was based on Crawford's criteria, which assessed the final range of motion and presence of pain or deformity. The criteria were as follows:

* Excellent: Full range of motion and no pain.
* Good: Extension lag less than 10° and no pain.
* Fair: Extension lag 10–25° with or without pain.
* Poor: Extension lag more than 25° or persistent pain.

Radiological evaluation included assessment of bone union, alignment, and articular congruity. Union was defined as the absence of visible fracture line with continuous trabecular pattern across the fracture site.

Statistical Analysis
All collected data were tabulated and analyzed using Microsoft Excel and SPSS version 26.0 software. Descriptive statistics such as mean, standard deviation, and range were used to summarize quantitative variables. Categorical data were expressed in frequencies and percentages.

Functional outcomes (Crawford's grades) were compared with variables such as age, delay in presentation, and fracture pattern. The relationship between continuous variables (extension lag, flexion range, total active motion) and outcome categories was assessed using the Student's t-test. A p-value of less than 0.05 was considered statistically significant.

RESULTS
The present study included 15 patients with displaced bony mallet finger who underwent extension-block pinning at Government Medical College Srinagar between January 2022 and June 2024. All patients completed a minimum follow-up period of 12 months. The outcomes were analyzed clinically and radiologically according to Crawford's criteria and radiographic parameters of fracture union and alignment.

The study group consisted of 10 males (66.7%) and 5 females (33.3%), with an age range between 18 and 55 years and a mean age of 32.8 ± 9.6 years. The dominant hand was involved in 9 cases (60%), while the non-dominant hand was affected in 6 cases (40%). The middle finger was most frequently involved (40%), followed by the ring finger (26.7%), index finger (20%), and little finger (13.3%). The most common mode of injury was sports-related trauma, observed in 8 patients (53.3%), followed by accidental falls in 5 patients (33.3%) and occupational injuries in 2 patients (13.3%) [Table 1].

Table 1: Demographic and Injury Characteristics of Patients (n = 15)

Parameter	Category	No. Of Patients (n=15)	Percentage (%)
Age (years)	18–25	4	26.7
	26–40	7	46.7
	41–55	4	26.7
Mean age ± SD	--	32.8 ± 9.6	--
Gender	Male	10	66.7
	Female	5	33.3
Side of involvement	Right	9	60
	Left	6	40
Affected finger	Index	3	20
	Middle	6	40

	Ring	4	26.7
	Little	2	13.3
Mechanism of injury	Sports injury	8	53.3
	Fall	5	33.3
	Occupational	2	13.3

All patients had a dorsal avulsion fracture involving more than one-third of the articular surface. The mean fragment displacement was 2.6 ± 0.5 mm. Volar subluxation of the distal phalanx was seen in 5 patients (33.3%). No open fractures or comminuted fragments were included in the series [Table 2].

Table 2: Preoperative Radiographic Findings

Radiographic Parameter	Mean ± SD / n	Percentage (%)
Fragment size (% of articular surface)	36.8 ± 5.4	--
Fragment displacement (mm)	2.6 ± 0.5	--
Volar subluxation	5	33.3
Closed fractures	15	100
Comminution	0	0

All fractures achieved radiological union at a mean duration of 6.4 ± 1.1 weeks. The mean preoperative extension lag was 27.3°, which improved to 4.6° at the final follow-up. The mean flexion at the DIP joint was 68.2° ± 8.1°, and the mean total active motion was 72.8° ± 7.4° [Table 3].

Table 3: Postoperative and Functional Outcomes

Parameter	Mean ± SD	Range
Time to radiological union (weeks)	6.4 ± 1.1	5–8
Preoperative extension lag (°)	27.3 ± 5.2	18–38
Postoperative extension lag (°)	4.6 ± 2.8	0–9
Final DIP joint flexion (°)	68.2 ± 8.1	55–80
Total active motion (°)	72.8 ± 7.4	60–85

According to Crawford's criteria, excellent outcomes were achieved in 9 patients (60%), good in 4 patients (26.7%), fair in 1 patient (6.7%), and poor in 1 patient (6.7%) [Table 4].

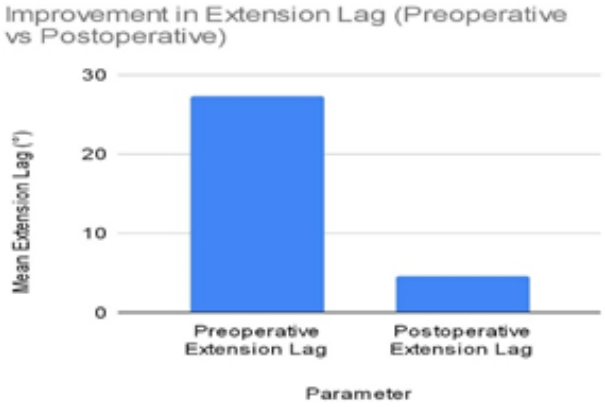
Table 4: Outcome Evaluation Based on Crawford's Criteria

Crawford's Grade	Criteria	No. Of Patients	Percentage (%)
Excellent	Full motion, no pain	9	60
Good	Extension lag <10°, no pain	4	26.7
Fair	Extension lag 10°–25°	1	6.7
Poor	Extension lag >25° or persistent pain	1	6.7

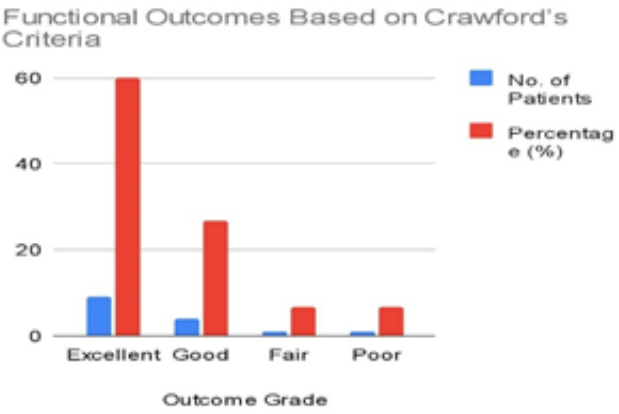
Minor complications occurred in 3 patients (20%), all of which were managed conservatively. Two patients developed superficial pin tract infections that resolved with local care and oral antibiotics. One patient had transient nail deformity that improved spontaneously. No cases of non-union, deep infection, or residual subluxation were noted [Table 5].

Table 5: Complications Observed

Complication	No. Of Patients	Percentage (%)	Management	Outcome
Superficial pin tract infection	2	13.3	Local care, oral antibiotics	Healed
Nail deformity (transient)	1	6.7	Observation	Resolved
Non-union	0	0	--	--
Deep infection	0	0	--	--
Residual subluxation	0	0	--	--



Bar graph: Improvement in Extension Lag.



Bar graph 2: Functional Outcomes Based on Crawford's Criteria.

DISCUSSION

In this prospective series of 15 patients treated with the extension-block pinning technique at Government Medical College, Srinagar, over an 18-month period, we observed favorable radiological union and functional outcomes with a low complication rate. All fractures united at a mean of 6.4 weeks, mean extension lag improved to 4.6°, and 86.7% of patients achieved "excellent" or "good" results as per Crawford G.P. criteria. These findings are consistent with previous reports supporting the efficacy of extension-block pinning in displaced bony mallet injuries [8][9].

The anatomical reduction and stability provided by the technique are the main factors contributing to consistently good outcomes. Han et al. Compared the extension-block pinning method with direct pinning and found both techniques produced acceptable results, with the extension-block technique achieving better cosmetic and functional scores in many cases [10]. Our series demonstrated a mean distal interphalangeal (DIP) joint flexion of 68.2° and total active motion of 72.8°, which aligns with other studies where DIP flexion averaged around 62–65° following percutaneous extension-block fixation [11][12]. Early intervention and uniform surgical technique likely contributed to our improved motion range and minimal extensor lag.

Patient selection plays a crucial role in determining final outcomes. Studies have highlighted that fragment size, delay in surgery, residual joint step-off, fixation angle, and presence of volar subluxation are significant prognostic factors [12][13]. Yildirim et al. Observed that delayed presentation, advanced age, and residual articular incongruity negatively affected postoperative motion and functional outcome [12]. Our study excluded chronic or comminuted injuries and operated only on acute cases (within two weeks of injury), which probably explains our higher rate of excellent and good results.

Complications following extension-block pinning are relatively uncommon but include pin-tract infection, nail deformity, and stiffness. In our study, the complication rate was 20%—two superficial pin-tract infections (13.3%) and one transient nail deformity (6.7%). These results are comparable with those reported in larger case series, such as the study by Dieckmann et al., where 84.2% of cases had no complications and 15.8% had minor issues like superficial infection or nail changes [11]. Strict aseptic technique, early pin removal, and proper postoperative care remain essential to minimize complications [14].

The extension-block technique is especially advantageous in resource-limited setups due to its simplicity, reproducibility, and minimal invasiveness. Compared with open reduction and screw fixation, it avoids soft tissue disruption and reduces

operative time. A randomized trial comparing splinting with extension-block pinning for bony mallet finger fractures found similar functional outcomes, but surgical fixation allowed earlier mobilization and lower rates of secondary subluxation [15]. Therefore, in carefully selected acute cases, extension-block pinning represents a pragmatic and effective treatment strategy.

Nevertheless, this study has limitations. The small sample size (n=15) and single-center design limit generalizability. The mean follow-up of 12.5 months may not fully capture late degenerative changes, such as post-traumatic arthritis or swan-neck deformity. Furthermore, the absence of a non-operative or alternative operative control group restricts definitive comparative analysis. These factors suggest the need for larger, multicenter, randomized studies comparing various fixation techniques and long-term outcomes [16][17].

CONCLUSION

In conclusion, our study reinforces that extension-block pinning is a safe, reliable, and effective surgical technique for treating displaced bony mallet finger fractures. It achieves high union rates, good functional recovery, and minimal complications when applied to properly selected acute cases. Meticulous surgical technique and attentive postoperative care are paramount to ensure optimal results.

Conflict of interest: Nil
Funding: Nil

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