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Treatment of mallet fracture by extension block pinning

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Abstract
This is a retrospective study reviewing 19 patients with mallet treated by extension block pinning method between 2013-2016. By Wehbe and Schneider and Doyle's classification 13 cases of type IIB, 4 of IIC and 1 case each of IB and IC.15 were treated acutely and 4 subacutely and followed up for a mean period of 20.13 weeks. We obtained 11 excellent results, 4 good result and 4 fair outcomes by Crawford's outcome score. No correlation was noted between the functional outcome when compared with respect to age, sex, acute and subacute cases. We found a statistically significant correlation was found between late removal of k-wire and flexion loss but extension was unaffected by the time of K-wire removal. There was one case with superficial pin tract infection and in 4 cases skin maceration was noted over the dorsal skin. This is a useful technique in management of mallet when presented within 3 weeks duration.

Keywords: Mallet fracture, mallet finger, extension block, distal interphalangeal joint fracture, surgical treatment

1. Introduction
Missed injuries have been referred to as "the trauma surgeon's nemesis [1, 2]. Missed injuries is Mallet finger deformity is usually a result of a sports injury which results in an axial loading or sudden flexion of an extended DIP joint. This leads to an avulsion of the extensor tendon insertion with or without a bony intra-articular fragment of the base of the distal phalanx attached to the tendon [1].

Non-surgical options for mallet fractures are well documented in literature for small fragments which involve less than one-third of the articular surface with satisfactory results using splints, casting or orthosis [2, 8]. Common complications noted with these options were joint stiffness, skin maceration/necrosis, extension lag, swan neck deformity etc. [9].

Surgical treatment by open methods have been described with screws, hook plates, tension band wiring but with risk of complications of skin necrosis, infection, nail growth deformities etc. [10]. In 1998 Ishiguro *et al* described a method of closed reduction and K wire fixation for mallet fractures. This involved using an extension block pin and a transarticular pin to maintain anatomical reduction of the fracture which minimised the risk of the complications noted in open reduction [11].

This is a retrospective study to evaluate the outcomes of treatment of mallet fracture by extension block pinning with respect to range of motion, time of union and complications.

2. Materials and Methods
A retrospective review of 19 cases done in our institution from the year 2013 to 2016 was carried out. Closed mallet fractures involving more than one-third the articular surface of the base of the distal phalanx were included in this study. Open fractures, pure tendon injuries, articular fragments involving less than one third of the articular surface of the base of the distal phalanx and mallet fractures treated by other modalities were excluded from this study.

We subdivided our sample size into 3 groups bases on the time of presentation into acute (presentation within 1 week), subacute (1 week to 4 weeks) and chronic (more than 4 weeks). Based on which we had 15 cases of acute presentation, 4 cases of subacute and none of our cases presented more than 4 weeks from the date of injury. None of our cases presented more

than 4 weeks after the injury.
Radiographic evaluation of was done immediately after fixation, at 6 weeks and 12 weeks. Clinical data of the extensor lag, pain, pin tract infections, nail changes and other complications were documented on follow up. Range of motion was documented during follow up using a finger goniometer.

2.1 Surgical technique
Fixation was carried out mainly under regional anaesthesia. Under fluoroscopy guidance with the DIP joint maximally flexed a 1mm K-wire passed through the extensor tendon to the middle phalanx about 1-2 mm dorsal to the articular surface to act as an extension block. The distal fragment was then reduced by extension with or without dorsal translation. After anatomical reduction was obtained a 2nd axial K wire was passed from the tip of the distal phalanx and it passed transarticular across the DIP joint. Sterile dressing was applied after cutting the k-wires. (Figure 1)

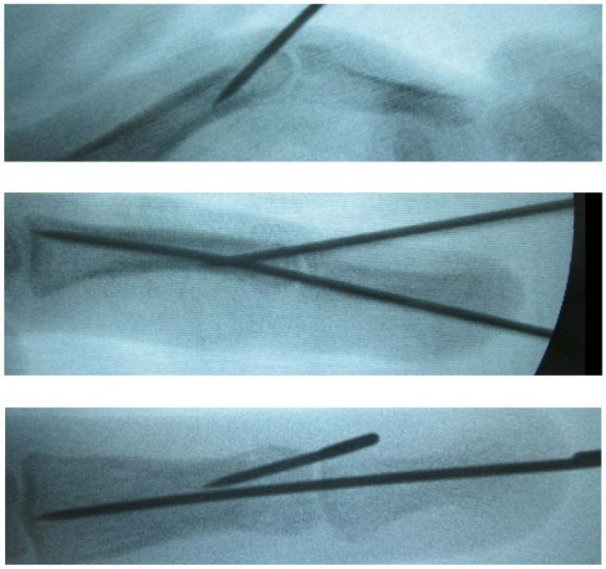

Fig 1: Extension block K wire passed just dorsal to the articular surface of the middle phalanx (top inset). The axial K wire passed from the tip of the distal phalanx across the DIP joint (middle inset). AP view after fixation (bottom inset).

Our post-operative protocol involved the use of a custom-made mallet finger splint for which was worn day and night for 6 weeks and for another 6 weeks only at night. (Figure 2)

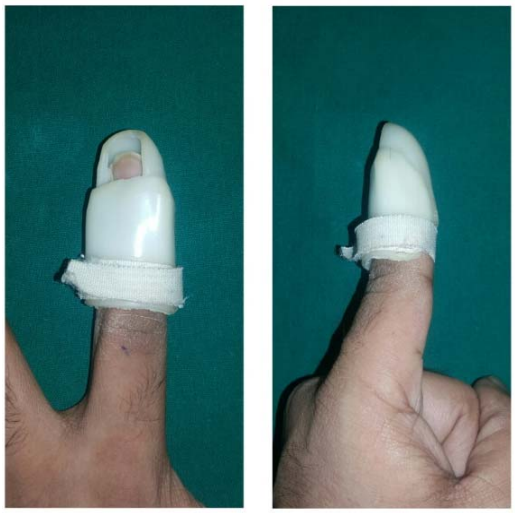

Fig 2: Case of left index finger bony mallet fracture with custom made mallet finger splint

Patients were encouraged to carry out their daily activities with mobilisation of Proximal interphalangeal joint and metacarpophalangeal joints
K wires were removed when fracture healing was noted on radiographs, and rehabilitation of DIP joint was initiated in the form of active / passive mobilisation.

3. Results
Clinical and radiological records of a period of 4 years from 2013 to 2016 were evaluated, which provided 19 cases that satisfied out inclusion criteria. The demographic data revealed an average age of 33.3 years in our sample size with 13 males and 6 females. In our study majority of the cases, 12 out of the 19 were a result of non-sports related trauma. The digits involved were 4 index fingers, 11 middle finger, 3 ring fingers and 1 little finger.

Table 1: Bony mallet fractures.

Sl No.	Age	Sex	Presentation	Aetiology	Digit involved	Classification	Removal of K-wires	Complications	Follow up(weeks)	Crawford score
1	24	M	acute	fall	R M F	IB	6	None	24	Excellent
2	22	M	acute	sports	R I F	IIB	6	None	24	Excellent
3	41	M	8 days	fall	L I F	IIB	6	None	12	Excellent
4	31	F	acute	sports	R I F	IIB	6	None	20	Excellent
5	33	F	acute	fall	RMF	IIB	6	None	12	Excellent
6	47	M	acute	fall	L I F	IIB	4 and 6	5deg Extension lag + skin maceration	14	Good
7	50	M	18 days	fall	L M F	IIB	4 and 8 - late presentaion	5 deg Extension lag + Skin maceration	24	Good
8	29	F	7 days	fall	R R F	IIB	8 weeks- patient presetned late	30 % flexion loss	24	Fair
9	35	M	acute	sports (cricket)	R M F	IIB	6	None	32	Excellent
10	27	M	7 days	fall	R M F	IIC	6	None	12	Excellent
11	28	M	acute	sports(football)	L M F	IIB	4 and 6	Skin maceration	12	Excellent
12	27	F	acute	fall	R L F	IIC	6	5 deg Extension lag	20	Good
13	27	F	21 days	sports (throwball)	L M F	IIB	4 and 8 - late presentaion	10 deg flexion loss + skin maceration	16	Fair
14	26	M	acute	fall	L MF	IC	4 and 6	None	48	Excellent
15	47	M	acute	fall	R R F	IIB	ext - 3 weeks (infection) and 6	50 % flexion loss	16	Fair
16	41	M	acute	sports (cricket)	L R F	IIC	6	None	14	Excellent
17	47	M	acute	fall	R M F	IIB	8- late presentation	15 % flexion loss	24	Fair
18	24	F	acute	fall	L M F	IIC	6	5 deg Extension lag	18	Good
19	27	M	acute	sports (cricket)	L M F	IIB	6	None	20	Excellent

The fractures were classified using both the by the Wehbe and Schneider classification, by which we had 13 cases of Type IIB, 4 cases of IIC and 1 case each of types IB and IC.
The average period of radiological union was 6.4 weeks. The average range of flexion attainted was 75.6 deg.
The Crawford outcome classification was used to evaluate the post-operative functional outcome, according to which we obtained 11 excellent results, 4 good result and 4 fair

outcomes.

Statistical analysis was carried out to asses for any correlation between the clinical outcome and laterality of digit involved, digit involved, other injuries to the hand, gender, age, aetiology, anatomical reduction, time of K wire removal and time of fracture healing.

Fig 3: 27 yr old female sustained a type IIB mallet fracture of the left middle finger during a throwball game and presented 21 days after trauma. Swelling over the dorsum of the middle finger and a mallet deformity are noted.

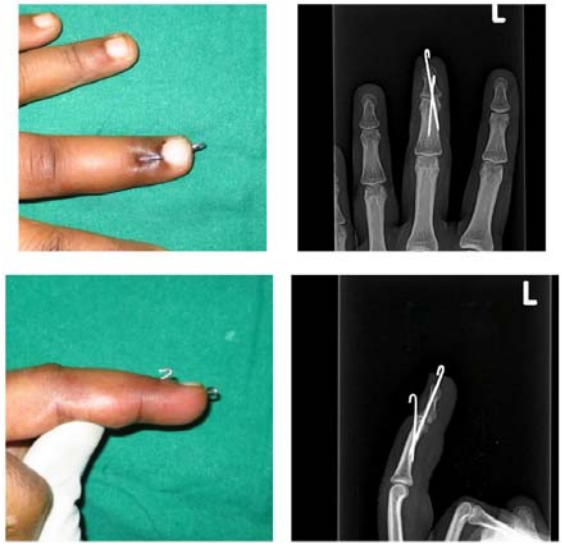

Fig 4: Post-operative images and radiographs of the same patient shown in Figure 3 following extension block pinning. Anatomical reduction of fracture and correction of the volar subluxation noted.

The statistical analysis showed no significant correlation between the functional outcome when compared with respect to age, sex and aetiology to the final functional outcome.

The results of acute and subacute cases were found to be similar when compared against the final range of motion (time of presentation vs flexion – p value 0.272, time of presentation vs extension lag – p value – 1.000; by Fisher's Exact test).

A statistically significant correlation was found between the late removal of k wires and flexion loss (p value – 0.037), but extensor lag was found to be unaffected by the time of removal of K-wires.

One case had superficial pin tract infection. Culture showed Staph aureus sensitive to linezolid who was treated with early removal of K wire and oral antibiotics and local antibiotic ointments. Infection resolved within 1 week and fracture healed in 2 weeks. There were no cases of non-union, malunion, osteomyelitis, osteoarthritis of DIP joint, nail deformities and dorsal tenderness noted in our study.

4. Discussion

The treatment options for a mallet fracture range from conservative methods like splinting to open methods. Conservative management was recommended primarily due to the high complication rates of open methods. But conservative treatment by splinting is also associated with complications such as skin maceration, slough and dorsal tender prominences.

The extension block pinning method as described by Ishiguro in 1988 provides a stable fixation without the complications of open surgical methods.

Several studies have shown the advantages of extension block pinning over other methods for treatment of mallet fractures with many modifications to this technique. Studies have also shown a risk of arthritic changes in the DIP joint if multiple attempts are taken for fixation of the transarticular pin. Another technical point is to pass the extension blocking wire and axial wire in two different planes in the AP plane.

Acute or subacute presentations, that is cases that present within 4 weeks from date of injury do not have a significant difference in post-operative functional outcome when treated by this method.

There were 4 cases in which flexion loss was noted out of which one patient had a superficial pin tract infection and the other 3 presented late for pin removal. Hofmeister *et al* had reported an average flexion of 78^0, whereas the average flexion in our study was 75.6^0 on follow up. Cases in our series we observed loss of flexion in 3 cases that presented beyond 6 weeks for K wire removal, hence we would recommend not retaining the K-wires beyond 6 weeks.

Skin maceration was noted in 4 cases which were managed with early removal of the extensor blocking pin at 4 weeks. Pegoli *et al* reported nail deformities in 2 out of 65 cases and Lee *et al* reported transient nail riding in 3 out of 32 cases in their series, but we did not notice any nail deformities in our study [12, 13].

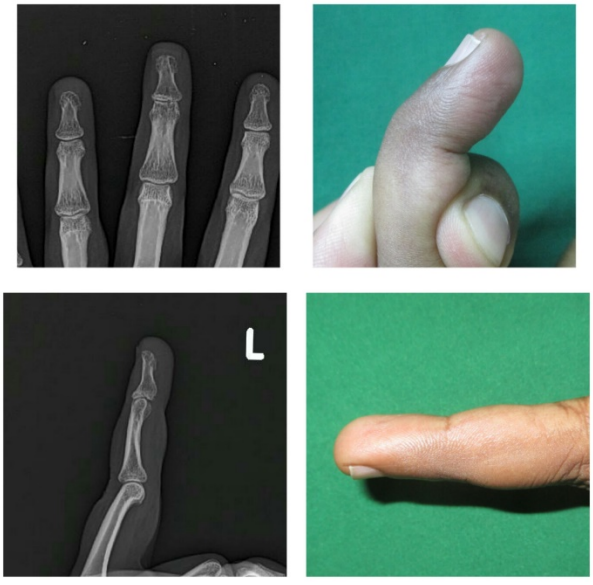

Fig 5: 4 months follow up of the patient shown in Figure 3 and 4. Showing fracture healing and range of flexion and no extensor lag.

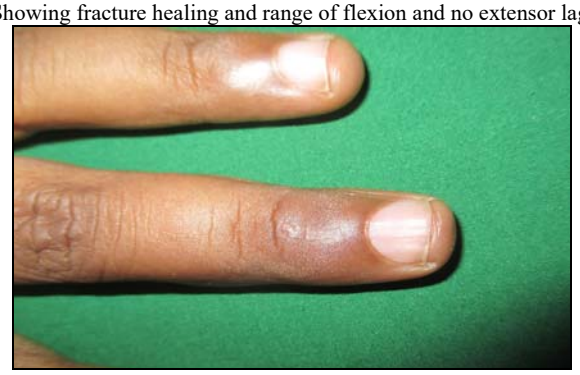

Fig 6: No post-operative scarring over the dorsum of middle finger of patient mentioned in Figure 3, 4 and 5.

5. Conclusions

Extension block pinning is a simple and effective treatment modality for mallet fractures when performed correctly. It provides excellent functional outcome in acute and subacute presentations. It also gives the advantage of treating the fracture as a day care procedure with minimal instruments and no post-operative scars (Figure 6).

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