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Extension block pinning in subacute/late bony mallet finger injuries

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ABSTRACT

Objective: Mallet finger is inability to fully extend a finger due to the disruption of the extensor mechanism integrity at the distal interphalangeal (DIP) joint level. Cases with DIP joint subluxation, and avulsion fractures involving more than 30% of the DIP joint surface are candidates for surgery. Subacute/late cases have poor outcomes. Investigating the success of extension block pinning in subacute/late bony mallet finger cases is aimed.

Methods: Patient demographics, the rate of DIP joint involvement in plain X-rays, subluxation status of DIP joint, the time between injury and operation, the duration of the operation, complications in post-operative follow-up, extensor lag and healing status of bone were reviewed. Patient outcomes and relation with operative delay and joint subluxation were analyzed.

Results: Mean rate of DIP joint involvement of study group was 43.4 ± 6.12%. Half of the study group (n=7) had DIP joint subluxation. Mean time from injury to operation was 29.78±20.4 days. Six patients' time from injury to operation was longer than 5 weeks. Study group had statistically significant improvement after surgery. Preoperative mean extensor lag was 15.71° ± 7.30° and postoperative mean extensor lag was 5.57° ± 8.89°($p<0.001$). At long term follow-up, technique has proven to be successful (excellent+good) in 78.5% of patients. Operating in late period (>5 weeks) and presence of subluxation did not alter the outcome ($p=0.353$ and $p=0.149$, respectively).

Conclusion: Extension block pinning technique is a fast, easy-to-apply technique with minimal morbidity. Although it has more limited results in chronic cases, it can be used safely in the majority of cases requiring surgery.

Key words: *Bony mallet finger, extension block pinning, extension lag, mallet finger, surgery*

Introduction

The term "Mallet finger", defines inability to fully extend a finger due to the disruption of the extensor mechanism integrity at the DIP joint (DIPJ) level. If an avulsion fracture involving a fragment of distal phalanx occurs, commonly used nomenclature is "bony mallet finger". As a result of this injury, the function of actively extending the DIPJ is impaired. These injuries can occur during sports, work related activities or routine home activities [1]. Any laceration harming both skin and extensor mechanism at DIPJ may cause mallet finger. However, the majority of these cases are caused by closed injuries where the skin cover is intact [2]. It has been reported that mallet finger injuries are more common in young male patients, and the incidence rises in women with advancing age [3,4]. Thumb and index

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fingers are effected rarely, and different patient series has reported that little finger or middle finger are most commonly involved [5-7].

Treatment of mallet finger injuries is important for restoration of function and preventing the patient from chronic joint deformities (eg. swan neck deformity) [8]. Both conservative and surgical treatment methods have been proposed. While early surgical treatment was recommended in most of the cases in the first half of the 20th century, publications in the second half of this century have put forward the use of conservative approaches. Graham Stack presented the patients treated with conservative treatment in 1962 at the Paris Hand Meeting, using a splint, which would later be called by his own name, and highlighted the success of conservative treatment [9,10]. Crawford, used Stack splint on 151 patients and described the technique as highly effective in 1984 [11]. In the same year, Wehbe and Schneider reported that surgical treatment had no superiority over conservative treatment, yet, complications could be more serious with patients underwent surgery [12]. Even though different types of splints have been proposed ever since [13,14], no obvious superiority of a single splint could be demonstrated [15].

Although conservative treatment is accepted as "standard of care" in most of the cases today, there are exceptions to this situation [16]. These include cases that do not benefit from or comply with conservative treatment, cases with DIPJ subluxation, and avulsion fractures (bony mallet fingers) involving more than 30% of the DIPJ surface. In the event of these, conservative treatment may be inadequate and surgical treatment may come to the fore. Among the surgical treatments proposed to date, a wide variety of techniques and appliances have been proposed, such as external fixators [17], hook plate fixation [18], mini screws [19,20], K-wires [21] and pull out wires [22]. The common aim of all proposed techniques is restoring joint surface smoothness, proper reduction of the fracture and maintaining stable fixation. However, there are other factors that affect recovery. Preserving soft tissue integrity and periosteal vascularity is also effective. If one reminds that majority of these injuries are closed injuries, he/she can understand that closed techniques, if anatomical reduction and fixation could be provided, may be more advantageous in the healing process.

Extension block pinning is one of the closed surgical treatment methods [23,24]. In this method, while the DIPJ is held in flexion, a 0.9 to 1.4 mm K-wire is passed in an oblique axis (40°-45° to the finger axis) proximal to the avulsed fragment. Then, the DIPJ is fully extended and another K wire is inserted trans-articularly through the distal phalanx-DIPJ-middle phalanx axis (Figure 1). Thus, the avulsed fragment is reduced and compressed between the K wire passed first and the dorsal distal phalanx in forced extension (Figure 2). In addition to the short operative time, this technique brings the advantages of preservation of periosteal circulation and soft tissue cover.

Despite its widespread use and success, extension block pinning technique is questionable in late mallet injuries. Ishiguro, as the pioneer of the technique, considers late mallet fracture a "contraindication" and does not recommend it on fractures older than 5 weeks [25]. These fractures has been reported to have excess scar tissue around the injury that prevents closed reduction [26]. Attempts to debride this scar before putting K-wires also has been proposed to overcome this limitation [27].

In this study, it was aimed to investigate the benefit of patients who were operated with extension block technique in subacute (2-5 weeks) and late phase (>5weeks) after injury.

Patients and Method

Following the permission of the Local Ethics Committee (application number: E20-271), adult patients who were operated for bony mallet finger between January 2017 and June 2019 at our institution were included in the study. Pediatric patients, patients operated acutely within the first 2 weeks after injury, patients

Figure 1. (A) Preoperative x-ray view of fracture. **(B)** Early postoperative x-ray view of extension block pinning. **(C)** Late postoperative (8 months) x-ray view. **(D)** Late postoperative view.

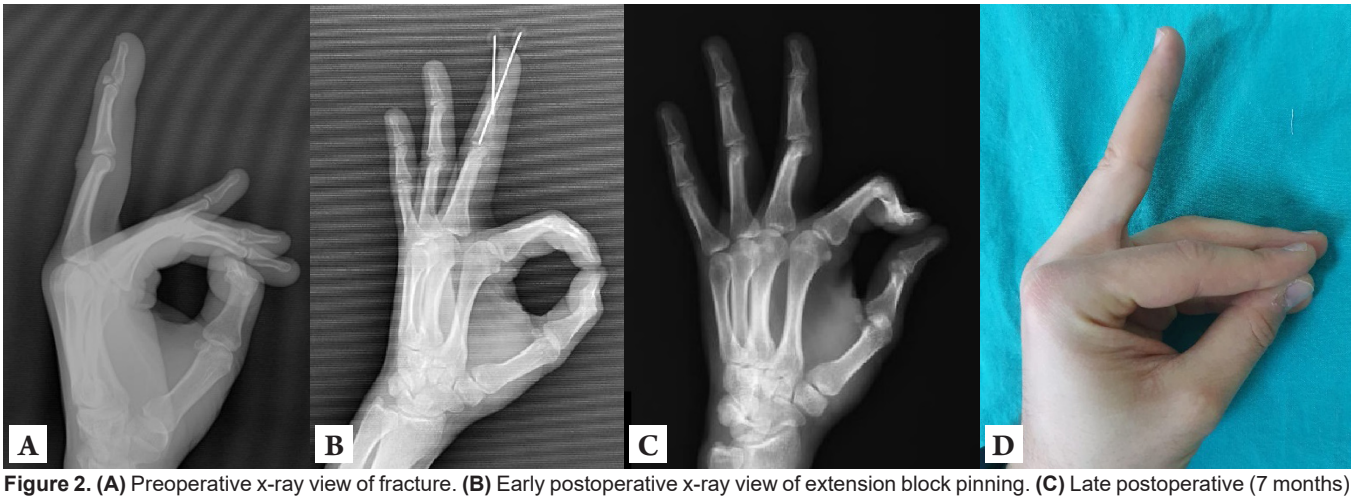

Figure 2. (A) Preoperative x-ray view of fracture. **(B)** Early postoperative x-ray view of extension block pinning. **(C)** Late postoperative (7 months) x-ray view. **(D)** Late postoperative view.

with accompanying injuries, open mallet fractures and patients without a follow-up period of at least 6 months were excluded from the study. Informed consent was obtained from the patients enrolled in the study.

Patient demographics, etiology of injury, the rate of DIPJ involvement in plain X-rays, subluxation status of DIPJ, the time between injury and operation, the duration of the operation, complications in post-operative follow-up, extensor lag and healing status of bone were reviewed. Injuries were classified according to Doyle Classification [28] and Wehbe-Schneider Classification [12]. Crawford Assessment Scale [11] was used for interpretation of outcome following treatment. Following descriptive analysis, postoperative benefit from the surgery of study group was analyzed using Wilcoxon signed rank test. Patients' outcomes operated in subacute period (2-5 weeks) and late period (>5 weeks) was compared using Mann-Whitney U test. Effect of presence of subluxation on initial exam on outcome was analyzed using Mann Whitney U test. Statistical analysis of the findings was performed using IBM SPSS Statistics for Windows v.22.0 (IBM Corp, Armonk, NY). The level of statistical significance was set at $p < 0.05$.

Results

Study included 14 patients treated with double K-wire extension block pinning technique. Ten of the patients were male (71.4%) and rest (28.6%) were female. Mean age of the patients was 27.64 ± 10.91 years (range: 18-55 years) and median age was 24 years. Four, 3, 1 and 5 DIP joints were involved in 2nd, 3rd, 4th and 5th fingers, respectively. Three patients suffered from sports injuries, five patients were involved in work-related accidents and rest (n=6) were injured at home. Mean rate of DIP joint involvement of study group was 43.4 ± 6.12% (range: 34%-53%) (Table 1). Half of the study group (n=7) had DIPJ subluxation (Table 2). Mean time from injury to operation was 29.78±20.4 days (range: 14-90) and median was 20 days. Six patients' time from injury to operation was longer than 5 weeks. Mean operative time was 46±11.7 minutes (range: 28-74 minutes). In early postoperative period, one patient had pin tract infection resolved with iv. ampicillin+sulbactam. One patient had DIP joint stiffness following K-wire extraction responded to physiotherapy. None of these complications occurred in late treatment (>5 weeks) group. Study group had statistically significant improvement after surgery. Preoperative mean extensor lag was 15.71° ± 7.30° and postoperative mean extensor lag was 5.57° ± 8.89°(p<0.001). At long term follow-up (> 6 months), technique has proven to be successful (excellent+good) in 78.5% of patients according to Crawford Classification (Table 3). Operating in late period (>5 weeks) and presence of subluxation did not alter the outcome, based on extensor lag measurements in the study group (p=0.353 and 0.149, respectively). However, one patient operated 90 days after injury with for 30° extensor lag had no benefit from surgery. Another patient operated 56 days after injury had a residual 15° extensor lag.

Table 1. Patient data according to Doyle's classification.

Type	Definition	n
I	Closed injury, small avulsion fracture may or may not be present	-
II	Open injury(superficial)	-
III	Open injury(reaching tendon level)	-
IV	Mallet fracture	-
IVa	Physical injury of distal phalanx (pediatric)	-
IVb	Involving 20-50% of joint surface	11
IVc	Involving >50% of joint surface	3

Table 2. Patient data according to Wehbe and Schneider's classification.

	n
Type I (No joint subluxation)	
Subtype A(<1/3rd of articular surface)	-
Subtype B(1/3rd-2/3rd of articular surface)	7
Subtype C(>2/3rd of articular surface)	-
Type II (Subluxation of DIP joint)	
Subtype A(<1/3rd of articular surface)	-
Subtype B(1/3rd-2/3rd of articular surface)	7
Subtype C(>2/3rd of articular surface)	-
Type III (physis of the distal phalanx involved)	
Subtype A(<1/3rd of articular surface)	-
Subtype B(1/3rd-2/3rd of articular surface)	-
Subtype C(>2/3rd of articular surface)	-

Table 3. Patients outcomes according to Crawford assessment scale for mallet finger.

	Extension lag	n
Excellent	0°	8
Good	0° - 10°	3
Fair	10° - 25°	2
Poor	>25°	1
Total		14

Discussion

Although there is a consensus that mallet finger injuries can be treated with conservative methods without the need for surgery, it is also reported that surgery is required in selected cases [29]. These conditions are patient's incompatibility with conservative treatment, failure of conservative treatment, involvement of more than 30% DIPJ or subluxation of DIPJ [30].

The surgical method to be recommended in these injuries should minimize soft tissue damage, be easy

to apply, and can achieve successful results. There are a number of closed and open techniques for reduction and fixation. Open surgical techniques, such as hook plate fixation, seems to have relatively low success rates such as 54.8% (excellent + good) despite successful reduction rates [31]. We think this limitation is due to the denuding of the periosteum during the procedure. Cost disadvantage, high complication rate and necessity to remove plates in the long run are among other limitations. Technically, performing hook plate fixation is more difficult than extension block pinning. And even though it provides earlier mobilization and safe reduction, patients outcomes are not at desired level [18,32].

Direct pinning of the avulsed fragment to distal phalanx also has been proposed. Even if it provides excellent reduction and fixation, this technique also has limitations. Direct pinning can cause fragmentation of avulsed segment, especially if the fragment is too small and closed approach is preferred. If open approach is used for direct pinning, soft tissue problems can be encountered [33,34]. The success rates of these techniques were shown to be similar with extension block pinning [35].

Although the pull-out wire technique is a technique with a 92-100% success rate reported, it is the most difficult technique to apply among the proposed techniques, at least in our experience [22,36]. Yet, successful results in late injuries have also been reported [37]. Our opinion is that it is more appropriate to use in late-stage mallet finger injuries rather than primary cases.

Extension block technique stands out as a reliable method with its ease of application, steep learning curve, extremely limited disturbance of soft tissue and successful results [23,25,38]. Although the success rates of the presented patient series seem lower than those previously presented (85-92%), it may be hypothesized that the reason for this was the inclusion of chronic injuries (>5 weeks)[23,39]. In the first article discussed use of extension block technique, late injuries were reported to be a contraindication [25]. Pegoli suggested open curettage of scar tissue in late cases and gave the success rate as 50% [27]. Percutaneous curettage has also been proposed and in this case, the success rate has been reported as 71% [40]. Although no such procedure (curettage) was performed in our own series, the success rate in this group was determined to be 60%. Proponents of this technique have advocated the use of it in chronic cases [41]. However, we think that the pull-out wire technique can be among the options in late/chronic cases.

Despite its valuable results, it is obvious that our study has some limitations. The most important and first striking of these is the limited number of patients. We aimed to interpret efficacy in subacute/late cases and this choice surely limited our study population. Another limitation of this study is its retrospective nature. Obviously, prospective studies are needed for routine use of this technique in late cases. Extending the follow-up period more than 6 months would also clarify long term success. Although acknowledging these limitations, we believe that the study is valuable in terms of bringing up the use of the technique in late cases to discussion.

Extension block pinning technique is a fast, easy-to-apply technique with minimal morbidity. Although it has more limited results in chronic cases, it can be used safely in the majority of cases requiring surgery.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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