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Extension block pining for treatment of bony mallet finger

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Abstract

Background: The goal of this report is to show our results with extension block technique for treatment of mallet fracture. The indications for this technique were the presence of a large bone fragment, and palmar subluxation.

Methods: We retrospectively assessed the results of treatment in 14 mallet fractures which have been treated by extension block technique to determine the range of motion in distal interphalangeal joint and associated complications.

Results: According to the Crawford criteria there were 6 excellent, 4 good and 4 fair results. At an average follow-up period of 19 months, the average extension lag and the average final active flexion of distal interphalangeal joint were 6° and 54° respectively.

Conclusion: We have found that this technique effective and minimally invasive and it does not disrupt the remaining extensor mechanism. This technique requires percutaneous transarticular pin, which does not allow early joint mobilization and requires meticulous pin care with regular dressings. In our opinion, joint transfixation is probably the commonest reason for incomplete restoration of the joint range of motion.

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

Introduction

Mallet injuries are disruptions of the terminal extensor tendon, from the base of the distal phalanx and they can occur with or without a bony fragment [1]. This kind of disruption can result in a characteristic flexion deformity of the distal interphalangeal (DIP) joint [1]. Fracture of the distal phalanx occurs in 25% of mallet traumatic injuries. If a bony fragment accompanies the injury, it will be described as a "Mallet Fracture" [2]. These fractures often are due to axial loading on the tip of the extended finger as they occur when trying to catch a ball [3].

Studies have shown that conservative treatment provides satisfactory results in cases with pure extensor tendon avulsion or fracture-avulsion of less than one third of the distal phalanx [4]. However, treatment of a mallet fracture involving more than one-third of the base of the distal phalanx is still controversial. Kalainov et al [5], Okafor et al [6] and Wehbe and Schneider [3] advocate nonsurgical treatment of these injuries regardless of the size of the fracture fragment, the degree of fracture displacement, or the presence of joint subluxation.

Pegoli et al [7], Damron et al [8] and Yamanaka and Sasaki [9] advocate surgical treatment for avulsion fractures involving more than one-

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third of the articular surface, for persistent subluxation or fragment displacement which cannot be adequately reduced by full extension of the DIP joint in a splint. They believe that articular incongruity eventually will lead to symptomatic arthritis, extensor lag or deformity and thus recommend operative intervention to restore the integrity of the joint.

Numerous surgical techniques for treatment of mallet fractures and their complications have been described. Kang et al. reported that 41% of surgically treated mallet fractures developed postoperative complications such as recurrent extension lags, permanent nail deformities, skin necrosis, pin track infection and osteomyelitis [10]. To decrease these complications, percutaneous procedures have advocated by some authors.

This paper presents the results of the extension block fixation technique which was described by Ishiguro for the first time [7].

Method

Seventeen mallet fractures in 17 patients which were treated by Ishiguro extension block technique at our institution between September 2004 and March 2008 were reviewed retrospectively. The inclusion criteria were

1) Involvement of more than 30% of articular surface of the distal phalanx

2) Closed fractures

3) Absence of comminution

All of the cases were performed consecutively without selection by the same hand surgeon.

Fourteen closed mallet fractures in 14 patients were included in this study. Three closed mallet fractures that were managed similarly were excluded because the patients were lost during follow-up period.

Pre-operative lateral radiographs of the finger were used to determine the presence of palmar subluxation of the distal phalanx, fragment displacement and fragment size. Anterior-posterior radiographs were used to exclude comminution.

Postoperatively, lateral and antero-posterior radiographs were taken immediately after operation, at 3 weeks, 6 weeks and 6 months and patients were followed at the same time with physical examination. Radiographs were reviewed for displacement, fracture size, time of healing, malunion and nonunion. Additionally, clinical data including range of motion, extensor lag, tender dorsal prominences, and complications (nail deformity and skin necrosis) were collected.

Pain was assessed subjectively at follow-up by using a scale from 1 to 4 as follows:

1. no pain,

2. mild pain occasionally or with strenuous work,

3. moderate pain with daily activities which restricts employment,

4. severe pain causing inability to work.

Active and passive ranges of motion were measured by using a goniometer.

The affected finger was also examined for the presence of a dorsal bump, nail deformity, swan-neck deformity, altered sensation, and tenderness.

Function outcomes were determined by using the Crawford's method [2] (Table 1), which uses loss of extension to evaluate outcome.

Surgical Technique

After the digit was appropriately anesthetized via a digital block or Bier's block, the DIP joint was maximally flexed. A 1.2 mm K-wire was introduced under fluoroscopic control through the extensor tendon at a 45 degree angle into the middle phalanx, 1-2mm dorsal and proximal to the fracture fragment. The wire provides an extension block for the bony fragment when the DIP joint was extended. Once the fragment was reduced, a second 1.2 mm K-wire was placed longitudinally from distal to proximal across the DIP joint to maintain extension and reduction (Fig. 1 &2). The K-wires were cut and soft dressing is applied. A postop-

Excellent	Full DIP joint extension, full flexion, no pain
Good	0° to 10° of extension deficit, full flexion, no pain
Fair	10° to 25° of extension deficit, any flexion loss, no pain
Poor	More than 25° of extension deficit or persistent pain

DIP joint = Distal interphalangeal joint

Table 1. Crawford's e criteria for evaluation of mallet fracture treatment

erative volar DIP extension splint was placed to protect the wires and the finger.

The patient was advised to keep the digit dry, and pin care was maintained with povidone-iodine solution twice a day. Patients were allowed PIP joint and MP joint motion postoperatively. No perioperative antibiotics were administrated.

The K-wires were removed after 4-6 weeks once there was radiological evidence of healing without local anaesthesia under sterile conditions as an Outpatient.

A palmar splint was worn at night to immobilize the distal interphalangeal joint for an average of a further 14 days.

Results

Over a period of 3 years and 6 months, 14 displaced mallet fractures with a fracture size of more than 30% of the articular surface; were identified in 14 patients in our institution who underwent the extension block pinning.

The 14 patients, 12 men and 2 women, had an average age of 30.8 (24-37) years at the time of injuries. The average follow-up was 22 (6-32) months. The little finger was the most frequently involved finger (6), followed by the middle (4), the ring (3) and index fingers (1). The injuries were due to physical conflict (6), fall (4) and sport (4). The dominant hand was affected in 11 cases. The average time from injury to op-

Fig 1. Little finger mallet fracture.

Fig 2. Radiography after extension block fixation.

eration was 5 (1-8) days. The average percentage articular surface involvement was 42% (28-54%).

At an average follow-up period of 19 month, the average extension lag was 6° (0°to 17°), and the average final active flexion of DIP joint was 54° (45° to 72°).

According to the Crawford's criteria (Table 1), we obtained 6 excellent, 4 good and 4 fair results. The 2 fair results occurred following an initial poor reduction of the fracture which resulted in a decreased range of motion.

One case developed low-grade infection which required removal of the extension block pin at 3 weeks. The patient was treated with a digital splint and then we removed longitudinal pin at 6 weeks. This patient had fair result according to the Crawford's criteria. She is included in the above results.

Nail ridging occurred in two cases. However, one of these two nail deformities had disappeared by the final follow-up. The other case with nail deformity was lost to follow up after 13 months. Seven digits had a significant dorsal bump.

Ten patients were pain free and the other four had only mild pains during strenuous physical activity.

No case of skin necrosis, sensory loss, reflex sympathetic dystrophy, fragmentation of the fracture, osteomyelitis or pin migration was recorded.

Radiographs obtained at follow-up showed bone union in all cases. An intra-articular step off of less than 1mm was present in five joints. We did not record any sign of degenerative arthritis at final follow up.

All of the patients were able to return to their previous task.

Discussion

Mallet injuries are avulsions of the terminal extensor tendon, from the base of the distal phalanx, with or without a bony fragment. An untreated mallet finger injury may remain painful and the digit may develop a swan neck deformity due to compensatory hyperextension at the proximal interphalangeal joint [11].

The aim of the conservative (nonsurgical) treatment is to hold the distal interphalangeal joint in extension while extensor mechanism heals [3]. Holding the proximal interphalangeal joint in flexion and the distal interphalangeal joint in extension in order to relax the extensor mechanism may allow better approximation of the detached extensor tendon [11].

Nonsurgical treatment has been extensively reported and includes continuous rigid aluminium splinting, plaster casting, prefabricated splints [1] and custom-made orthosis [12]. But these treatments are not entirely benign. Complications, including joint stiffness, skin maceration and necrosis, loss of extension, hyperextension deformity [13], tender dorsal prominence, poor patient compliance, swan neck deformity, and early osteoarthritis [1] have been reported with these kinds of managements. Frequent follow-up evaluation and patient compliance are the fundamentals for nonsurgical treatment [1]. The most bothersome complication of conservative management is a pressure sore over the dorsum of the DIP joint which is due to excessive pressure resulting from hyperextended posture of the joint after splintage.

Surgery is recommended generally for the unstable lesion that is characterized by joint subluxation or an avulsed fragment that involves more than one third of the articular surface to prevent joint deformity, posttraumatic arthritis, and stiffness [2-4]. As the extensor tendon excursion at the DIP joint is only 3 mm, healing of the bony fragment with displacement can cause an extension lag and a swan neck deformity [3].

Numerous open and close surgical techniques have been reported. Open surgical treatment includes, open reduction and K-wire fixation [9], tension band wiring [8], compression pinning [14], pull-out steel wires [4], open re-

duction and 0.8 mm Luhr screw fixation [15], internal suture technique [16], and hook plate internal fixation [17]. Reported complications of open treatment include marginal skin necrosis, recurrent flexion deformity, pin track infection, osteomyelitis, and permanent nail deformity [10].

Bischoff et al reported a 51 mallet fractures series treated with tension band fixation. In their series, 21 of the mallet fractures displayed poor clinical and radiographic results. Postsurgical complications in their patients included skin breakdown, superficial and deep infection, and redisplacement of the dorsal fragment [18].

To decrease the complication associated with open surgical treatment, several authors have recommended percutaneous procedures. One of these is ishiguro's extension block technique. This technique avoids the difficulties of open surgery by performing closed reduction coupled with extension block and fixation of the DIP joints with K-wire. We have found that this technique effective and minimally invasive and it does not disrupt the remaining extensor mechanism, but it is not always possible to reduce fragments which have been considerably displaced and complete reduction is sometimes impossible. This technique requires percutaneous transarticular pin splintage, which does not allow early joint mobilization and requires meticulous pin care with regular dressings.

Not all authors agree as to the significance of achieving anatomical reduction in mallet injuries as substantial remodeling can occur and the DIP joint contributes less to the full arc of movement of the finger than the proximal joints [17].

Using the Crawford criteria Pegoli at all [7] obtained 78% excellent or good results and Hofmeister et al. [1] obtained 92% excellent or good results using extension block-pinning technique, but we obtained 71% excellent or good results.

In our opinion, joint transfixation, even so it is temporary, is probably the commonest reason for incomplete restoration of the articular range of motion and obtaining poor results.

A perceived disadvantage of this technique might be the need for fluoroscopy, but this is common need to all of the closed surgical procedures. Other potential disadvantages include articular cartilage damage leading to secondary osteoarthritis, especially if more than one attempt at pin insertion is needed. However, it is impossible to know whether the initial injury, incomplete restoration of joint congruity or K-wire damage of the articular surface, or a combination of these, is responsible for reported joint fusions and development of osteoarthritis.

Finally, pin track infection and nail deformity may adversely affect the outcome.

We did not compare this technique with others, because we did not use other surgical techniques during this period and this can be one of limitations of our study. Nonetheless, the management of mallet fractures remains controversial because no single treatment modality, whether conservative or surgical, has achieved consistently excellent results in terms of eliminating deformity, stiffness, arthritis and complications.

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