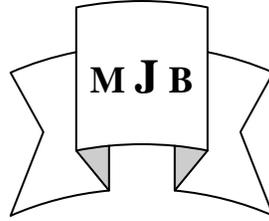


The Evaluation of Use Tenodesis Procedure with Fixation of Distal Interphalangeal Joint in Extension Position by Kirschner Wire in Management of Delayed Mallet Finger

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Abstract

Objective :To evaluate the validity of tenodesis with fixation of distal interphalangeal (DIP) joint in extension position by kirschner wire(k. wire) in management of delayed cases of mallet finger .

Methods: This study was conducted on 30 patients in Al-Diwanyia teaching hospital who were complaining from dropping of distal phalanx (mallet finger) and presented after 10 days from the time of injury ,they underwent surgery by tenodesis procedure and fixation of DIP joint in extension position by k. wire .The time of study was between 2008 and 2010 and followed up for a period for 1 year. The patients were evaluated according : Sex and age, whether the injured hand was right or left ,the finger that commonly injured, average delay before presentation ,type of trauma, extensor lag at presentation and radiograph :x-ray AP and lateral views for injured finger to see If there is bone avulsion or volar subluxation of distal phalanx .We excluded the open injuries with soft tissue loss and injuries associated with fractures greater than one third of articular surface from the study.

Conclusion: We conclude that delayed cases of mallet fingers can be managed with tenodesis procedure with fixation of DIP joint in extension position by k. wire with no joint problems like(stiffness or deviation),accepted flexion ability ,negligible extension lag and good patients satisfaction at 1 years follow up.

Key wards : mallet, k.wire, delayed.

تقييم استخدام خياطة الوتر مع الجلد واستخدام واير كيسنر في معالجة اصبع مالت المتأخر

الخلاصة

هذه الدراسة هي دراسة تقييمية لمرضى مصابون باصبع (مالت) اي سقوط السلامة الاخيرة من اصابع اليد نتيجة لشدة خارجية .اجريت هذه الدراسة في مستشفى الديوانية التعليمي للفترة ما بين شباط/٢٠٠٨ وكانون الاول/٢٠١١ شملت ثلاثون مريضاً ٢٠ ذكر و ١٠ انثى ، اعمارهم تتراوح ما بين ١٥ و ٤٠ سنة.تم علاج المرضى باستخدام عملية جراحية تدعى (tenodesis) اي خياطة الوتر الباسط لطرف الاصبع سوية مع الجلد مع تثبيت المفصل ما بين السلامة البعيدة والوسطى ب كيسنر واير(كي واير). تم الاستنتاج بان استخدام هذه الطريقة مقارنة بطرق جراحية وغير جراحية اخرى افضل وذلك بسبب قلة حدوث المضاعفات التي تحصل في مثل هذا النوع من الاصابات مثل تصلب المفصل او انحراف عظام المفصل كذلك شاهدنا قدرة مقبولة على عمل حركة الانقباض مع فقدان جزء قليل جدا من القدرة الكاملة على الابطاس في المفصل م ا بين السلامة البعيدة والوسطى.

Introduction

The term mallet finger (fig.1) has long been used to describe the deformity produced by disruption of the terminal extensor mechanism at the distal interphalangeal (DIP) joint [1,2,3,4]. Patients often present with a history of hyper-flexion of the DIP joint and the joint is flexed at rest and

there is an inability to actively extend the distal phalanx [5]. Mallet finger can result from a closed or open tendon injury over the DIP joint and small fragment of distal phalanx may be avulsed [6] fig(2). It is a common disability that causes discomfort and inconvenience to the patient [7].



Figure 1 Mallet finger.



Figure 2 fracture fragment where the extensor tendon attach.

Anatomy

The terminal extensor tendon is a thin flat structure measuring approximately 1 mm thick and 4-5 mm wide. It inserts onto the dorsal lip of the distal phalanx. The tendon attaches to the dorsal part of the capsule and inserts into a ridge distal to the articular cartilage from one collateral ligament to the other [8]. Powered by the lumbrical and interosseous muscles, the dorsal mechanism flexes the metacarpophalangeal joints and extends both the proximal and distal inter-phalangeal joints (PIP and DIP). Warren et al, in

their study noted an area of deficient blood supply in the distal digital extensor tendon area and suggested that this zone of avascularity might have implications in the cause and treatment of mallet finger [9].

Pathophysiology

With a disruption of the dorsal mechanism at the DIPJ, the entire power of extension is directed to the PIPJ. Over time, and especially if the volar plate is lax, this concentrated extension force results in PIPJ hyperextension and a swan-neck deformity (the DIP joint rests in an abnormally flexed position and the

PIPJ rests in a hyper-extended position). This deformity frequently causes a functional deficit. Therefore, even if a mallet finger is not particularly symptomatic from a functional or cosmetic perspective, treatment of the mallet injury may preclude development of this swan-neck deformity [10].

Diagnosis: [11]

Acute Stage: less than 10 days of injury

- Patient report and inability to extend their finger actively.
- Extensor lag of DIP, extent depends on severity.
 - o Ecchymosis over the dorsum of the DIP joint.
 - o Painful, swollen fingertip.
 - o Possibility of hypertension of the PIP joint.
- Radiographs, AP, lateral, oblique, to rule out avulsion

Classification

Doyle and others [5] have classified mallet finger injuries into four distinct types. Type I injuries are closed injuries with attenuation or disruption within the substance of the extensor tendon. These may be associated with a small bone fragment (<20% of the articular surface) attached to the tendon. Type II injuries are open injuries that occur after direct laceration of the distal

extensor tendon insertion. Type III injuries are also open injuries but occur after abrasion or avulsion of the soft tissues overlying the extensor tendon at its distal insertion. Type IV injuries involve the distal phalangeal bone and are sub-classified into three groups: (a) transphyseal fractures in children;(b) hyperflexion injuries involving 20% to 50% of the articular surface; and (c) hyperextension injuries that usually involve 50% of the articular surface, with associated volar subluxation of the distal phalanx.

Treatment

Divided into conservative and surgical treatment [10] :
 Conservative:(fig3), The primary goal in all methods of treatment is restoration of the continuity of injured tendon with maximum recovery of function. Although various treatment protocols have been proposed, splinting of the distal inter-phalangeal joint in extension for 6 to 8 weeks has been the gold standard with minimal morbidity in the majority of patients with closed mallet injury. This can be achieved by thermoplastic stack (mallet) splints or plaster cast splints. With this duration of immobilization patient compliance remains an important outcome factor.

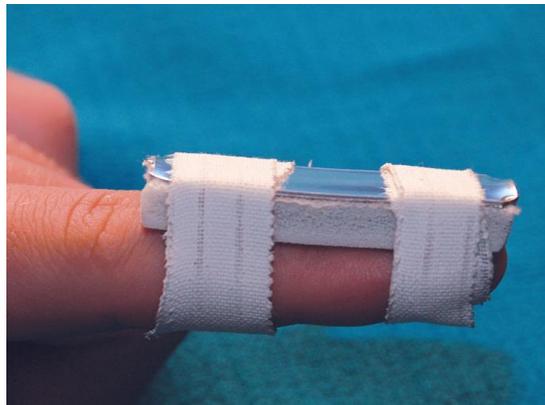


Figure 3 conservative treatment of mallet finger by splinting DIP joint in extension position.

Surgical:

It is advocated for acute and chronic mallet lesions in patients who have failed non-surgical treatment, are unable to work with the splints in position, have a fracture involving more than one third of the joint surface or have an open mallet injury .Fresh lacerations of the extensor mechanism of the DIP joint with mallet deformity are repaired by a running suture 4.0 or 5.0 synthetic material, which re-approximates skin and tendon simultaneously. This finger is immobilized in a stack splint with DIP in extension. K wire fixation across the DIP joint in extension with PIP joint in extension is also an option .In chronic injuries tenodesis followed by splinting or a tenotomy of the central slip is usually performed .If pain and impairment persist despite previous surgical corrective attempts, an arthrodesis of the DIP joint should be performed [12].

Patients and Methods

Thirty patients with mallet finger ,20 patients were male and 10 were female with average age between 15 and 40 years were treated in Al.Diwaneya teaching hospital between 2008 and 2010 and the follow up was continue for a period of 1 year .

The patients were studied clinically and evaluated according to:

1. Sex and age of the patients .
2. Whether the injured hand was right or left .
3. The finger that commonly injured .
4. Average delay before presentation(all the patients involved by this study presented after 10 days from the time of injury).
5. Type of trauma, whether blunt or by sharp object (looking for lacerated

wound in the dorsal surface of DIP joint).

6. Extensor lag at presentation .

7. Radiograph :x-ray AP and lateral views for injured finger to see If there is bone avulsion or volar subluxation of distal phalanx .

We included only type 1 and type2 according to Doyle classification [5] in this study i.e closed injuries with attenuation or disruption within the substance of the extensor tendon with or without a small bone fragment(< one third of the articular surface) attached to the tendon and open injuries that occur after direct laceration of the distal extensor tendon insertion and we excluded the open injuries with soft tissue loss and injuries associated with fractures greater than one third of articular surface from the study.

Treatment:

The patients were treated surgically under digital block by 2% lidocaine , we excise a small skin ellipse over the dorsal surface of DIP joint and the defect was repaired by a running suture 3.0 nylon, which re-approximates skin and tendon simultaneously (tenodesis) ,with fixation of DIP joint by kirschner wire(k. wire) leaving the PIP joint free, we gave oral antibiotics with simple analgesia and discharged the patient at the same day of surgery and instructed the patient to do hand elevation . The k.wire was removed after 6 week and active flexion exercises were commenced immediately.

Follow up:

During the 1st 2 months we saw the patients every 10 days looking for:

1. position of k.wire .
2. Signs of dorsal skin infection and maceration.

The stitches were removed after 2 weeks while k.wire were removed after 6

weeks, asking the patients to do free movement after that time.

After removal of k.wire we follow the patients as a visit every 1 month and we did assessment for the following points:

1. Pain during movement of the joint.
2. Persistent of extension deficient at DIP joint (extensor lag).
3. Flexion of DIP joint .
4. stiffness of DIP joint .
5. Nail deformity .
6. Deviation of the joint .
7. Development of swan neck deformity.
8. X-ray of the joint to see if there is degenerative changes .
9. Patient satisfaction .

Results

Table1 The finger that commonly injured

Finger	No.	Percent
Little	12	40%
Ring	7	23%
Index	5	17%
Middle	3	10%
Thumb	3	10%
Total	30	100

The mean time before presentation was 17 days range 10-30 days ,while the mean extension lag was 35 degree range 30 – 40 degree .

In the early period of follow up we found only 3 patients (10%) developed wound infection and simple maceration in the dorsal surface of DIP joint area ,those patients treated with oral antibiotics and the problem subsided within 7 days .

The total number of patients involved in this study were 30 patients, 20 patients were male (67%) and 10 patients were female (33%) with male to female ratio (2:1) .

The mean age of patients was 24 years range 15-40 years .

The right hand was commonly involved (67%) while the little finger was the most common finger that injured (40%).

The cause of injury was blunt trauma in 15 patients(50%) and sharp trauma in the other 15 patients (50%)

Only 3 patients (10%) presented with fracture that involved less than one third of joint surface.

After 6 months of follow up we found the mean of extension lag of DIP joint was 2,8 degree range (0 – 10) degree, while the mean of flexion ability of this joint was 64 degree ,range (40 -90) degree.

The chronic complications those were encountered in the follow up are showed below in table 2

Table 2 chronic complications

Complication	No.	Percent
Pain	3	10%
Joint stiffness	0	0
Nail deformity	3	10%
Joint deviation	0	0
Swan neck deformity	1	2%
Joint degenerative	0	0

After one year of follow up, 27 patients (90%) were satisfied and happy from the result except three patients (10%) were unsatisfied ,the 1st one was complaining from pain during movement of the joint ,the 2nd one was complaining from nail deformity and the 3rd one was complaining from swan neck deformity .

Discussion

Mallet finger is one of the commonest hand problems that presented to outpatient of hand- surgery clinic, and there is some controversy in the management of patients who came late i.e when they past the acute stage ,some surgeon prefer surgical option and others non-surgical option (splint of DIP joint in extension position).

Handoll HHG [13] and Hunter J [14] suggested that Surgical procedures are more often performed when the injury past the acute stage of 10 days, while B Okafor [15] show that delay in initiating conservative treatment(splint) of mallet finger did not affect significantly the DIP joint movement or extension lag.

The mean time of presentation of Our patients was 17 days and all of them treated surgically by tenodesis with fixation of DIP joint by kirschner wire. The right hand was involved in (67%) of our patients and the little finger was the most common finger that injured (40%), while Alejandro Badia[16] found that all the treated mallet fingers were in

the right hand and W.A.T Robb[17] found in his study , the ring finger is the most common finger that injured.

Several publications on mallet injuries have advocated non-operative treatment, Wehbe M A [18] and Niechajev IA [19] were found that no difference in the amount of extensor lag after splinting as compared with that after surgery . C. Mauffrey [10] had been reported a persistent extension deficit of approximately 10 degrees after conservative treatment in 40% to 70% of patients .

Scott F [20] reported that Splint treatment was successful in restoring active extension (with no more than 10° extensor lag) in 17 of 21 patients in the early group (within 2weeks of injury) and 15 of 19 patients in the delayed group(after 4 weeks of injury) ,neither the presence or absence of dorsal lip fracture less than one third of the articular surface affected the final outcome and the splinting was as effective in the delayed treatment population as it was in the early treatment population.

After 6 months of follow up we found that the mean of extension lag of DIP joint was 2,8 degree range (0 – 10) degree and when we compared our study with above studies ,we found P. value of our study =0.2071 ,while C. Mauffrey< 0.001 and Scot = 0.0128 ,i.e regarding extension lag, there is no significant

difference between our study and other above studies.

Ulusoy [7] found by using pull-in suture technique in management chronic mallet injuries , the mean flexion of DIP joint was 74 degree ,while the mean of flexion ability of our patients was 64 degree, when we compared the results of Ulusoy with our results P.value = 0.0011 ,i.e (there significant difference regarding flexion ability of DIP joint).

Schneider noted that three of nine surgically treated mallet fingers developed complications; however, it is difficult to draw conclusions from such small numbers. In nonsurgical studies several authors have listed rates of splint-induced skin complications varying from 0 to-18% [21].

Bischoff et al [22] reported on 51 mallet fractures treated with tension band fixation. In their series 21 of the 51 bony mallet injuries displayed poor clinical and radiographic results. Postsurgical complications in their patients included skin break down, superficial and deep infection, and re-displacement of the dorsal fragment. They recommend caution when using tension band fixation. Contrary to Bischoff's experience, Damron and Engber [23] obtained good results in 18 patients at a follow-up time of 8.2 years with the tension band technique. Mallet deformity was absent in 89% of the patients and the range of motion of the DIP joint averaged 1° of hyper-extension to 69° of flexion.

In the early period of follow up we found only 3 patients (10%) developed wound infection and simple maceration in the dorsal surface of DIP joint ,those patients treated with oral antibiotics and the problem subsided within 7 days .

Peter J. Steru [24] found that 16% of surgically treated patients had an unsatisfactory results and the most major complication was nail deformity (18%) , while there is 10% of our patients developed nail deformity, P. value =0.103 i.e there is no significant difference from Peter J.

Doyle JR [25] and Hamas RS[26] have been shown that mallet finger due to intra-articular fractures of the base of the distal phalanx involving more than 30% of the joint surface require surgical fixation to obtain precise reduction to avoid osteoarthritis and stiffness while Pulvertaft [27] noted that 60% of mallet fingers had satisfactory results after splintage and that a further 20% would improve in due course .

Ferrari[28] suggest the use of this tenodesis for treating acute lesions especially in young people, whatever finger has been injured. The reason why this author himself is not capable of giving a significant opinion on the validity of the method in the treatment of chronic mallet deformity is the small number of patients treated .

After one year of follow up, three of our patients (10%) had an unsatisfactory results ,one of these patients was complaining from swan neck deformity and there is no bone avulsion or volar subluxation in the distal phalanx of this mallet finger , while Kalainov [29] found when using non-surgical method in treatment of mallet finger ,only patients with palmar subluxation of distal phalanx may develop swan neck deformity.

Conclusion

We conclude that delayed cases of mallet fingers that caused by closed injuries without intra-articular fracture and mallet finger that caused by open

injuries that occur after direct laceration of the distal extensor tendon insertion can be managed with tenodesis procedure with fixation of DIP joint in extension position by k. wire with no joint problems like (stiffness or deviation), accepted flexion ability ,negligible extension lag and good patients satisfaction at 1 years follow up.

The reason why we are not capable of giving a significant opinion on the validity of this method in management of mallet finger with intra-articular fractures or avulsion of bone is small number of patients with bony mallet fingers that involved in this study.

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