



Open reduction and K-wire fixation of mallet finger injuries: mid-term results

Çekiç parmakta açık redüksiyon ve K-teli ile internal tespit: Orta dönem takip sonuçları

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Amaç: Çekiç parmak yaralanmasında kapalı redüksiyonun başarılı olamadığı hastalarda uygulanan açık cerrahi tedavinin orta dönem sonuçları irdelendi.

Çalışma planı: Çalışma distal falanksın proksimal dorsal yüzünde kopma kırığına bağlı çekiç parmak yaralanması olan 34 hasta (26 erkek, 8 kadın; ort. yaş 27; dağılım 21-37) alındı. Doyle sınıflamasına göre, tüm hastalarda tip IVb yaralanma vardı. Kapalı redüksiyonun başarılı olamaması nedeniyle, tüm olgulara açık redüksiyon ve K-teli ile tespit uygulandı. Dört hafta distal interfalangeal eklem ekstansiyon ateli ile takip edilen olgularda, altıncı haftada tespit materyalleri çıkarılarak rehabilitasyona başlandı. Son kontrollerde olgular radyografik olarak Doyle, klinik olarak Crawford ölçütlerine göre değerlendirildi. Ortalama takip süresi 18 ay (dağılım 11-34 ay) idi.

Sonuçlar: Radyografik değerlendirmede tüm hastalarda kaynama elde edildi. Otuz bir hastada (%91.2) anatomik redüksiyon sağlandı. Crawford ölçütlerine göre 27 hastada (%79.4) mükemmel, dört hastada (%11.8) iyi, üç hastada (%8.8) orta sonuç elde edildi. İyi sonuç alınan hastalarda ortalama 5° ekstansiyon yetersizliği, orta sonuç alınan hastalarda ise ortalama 10° fleksiyon kısıtlılığı vardı. Diğer hastalarda distal interfalangeal eklem hareket açıklığı tamdı. Hiçbir hastada eklemde subluksasyon, eklem aralığında daralma ve dejeneratif değişiklik saptanmadı.

Çıkarımlar: Çekiç parmak deformitesinde anatomik redüksiyon şarttır. Kapalı redüksiyonun sağlanamadığı olgularda açık redüksiyon ve K-teli ile internal tespit tekniği düşük komplikasyon oranı ve kolay uygulanabilirliği nedeniyle tercih edilebilecek bir yöntemdir.

Anahtar sözcükler: Kemik teli; parmak yaralanması/cerrahi; kırık tespiti, internal/yöntem; el deformitesi, edinsel/cerrahi.

Objectives: We evaluated mid-term results of surgical treatment of mallet finger injuries in patients in whom close reduction was not successful.

Methods: The study involved 34 patients (26 males, 8 females; mean age 27 years; range 21 to 37 years) with mallet finger deformity due to avulsion fracture of the proximal dorsal lip of the distal phalanx. According to the Doyle classification, all injuries were type IVb. Following unsuccessful attempts of closed reduction, the patients were treated with open reduction and K-wire fixation. Cast immobilization of the distal interphalangeal joint was employed for four weeks and rehabilitation was started after removing the K-wires in the sixth week. Radiographic and clinical assessments were made according to the Doyle and Crawford criteria, respectively, after a mean follow-up period of 18 months (range 11 to 34 months).

Results: Radiographic union was achieved in all the patients and an anatomic reduction was obtained in 31 patients (91.2%). According to the Crawford criteria, the results were excellent in 27 patients (79.4%), good in four patients (11.8%), and moderate in three patients (8.8%). Patients with a good result had a mean extension loss of 5°, and those with a moderate result had a mean flexion loss of 10°. The remaining patients had full range of motion of the distal interphalangeal joint. None of the patients developed joint subluxation, narrowing of the joint space, or degenerative changes.

Conclusion: An anatomical reduction is essential in mallet finger deformities. Open reduction and internal K-wire fixation can be preferred due to its low complication rate and ease of application in patients whose mallet deformity cannot be treated by closed reduction.

Key words: Arthroscopy/methods; rotator cuff/injuries/surgery; rupture/surgery; tendon injuries/surgery.

Osseous mallet finger injury happens too often with distal interphalangeal joint's becoming hyperextended and distal phalanx base's dorsal lip being fractured as a result of vertical pushing down to the tip of the finger. Fracture is in triangle form and is inclined to come apart as it is in the adherence area of extensor tendon. Not any closed reduction may be obtained as a result of the fact that the part is angled and turns. Due to the difficulties in following up the closed reduction stably in cases, more often primer surgical treatment application may be required. In the study, we indicated long term outcomes of one mm K-wire fixation of fracture with open reduction and K-wire fixation in distal interphalangeal joint in osseous mallet finger deformity in patients.

Material and method

34 cases (26 males, eight females) applying with post-traumatic osseous mallet finger injury complaint between the years of 2004-2006 were admitted to the study (Figure 1a). Average age of the cases was 27.4 (between the ages of 21 and 37). The cases were grouped according to Doyle's classification. Doyle classification was made according to osseous mallet finger injury's being closed or open injury and the magnitude of fracture. According to Doyle classification, all cases were type IVb^[1] (Table 1). 28 cases had injury in right hand, six cases had in left hand. In 19 cases second finger had been injured, in seven cases third finger had been injured and in eight cases fifth finger had been injured. The injury mechanism was work accident in 28 cases, home accident in three cases and sportive injury in three cases. Closed reduction was tried on osseous mallet fingers after assessing the cases in terms of supplementary injury when they applied to orthopedy emergency ward (Figure 1b) and the cases on which reduction was unable to be obtained were applied open surgical treatment for the purpose of reduction and stabilization of fracture. Surgical treatments were applied in 1.3 days in average (between one-four days) after trauma. Postoperative radiological imaging of all cases was done (Figure 1c,d). The patients were reassessed after 12 weeks from surgical application. The cases were assessed in terms of mis-knitting, osteophytic extension in fracture, subluxation of the distal interphalangeal joint, reduction in joint aperture, degenerative changes, instability, swan-neck deformity and nail bed injury. Clinical results were assessed using the criteria published by Crawford.^[2] Such assessment criteria allow grading the patients from perfect to bad according to flexion-extension movement loss of DIP joint and possible ongoing ache (Table 2). Distal interphalangeal joint flexion and extensi-

on values were measured using goniometer and taken into assessment.

Surgical technique

Applying finger tourniquet to all patients under digital block anesthesia, they were applied Y or H incision over distal interphalangeal joint according to the experience of surgical team (H in 14 patients, Y in 10 patients and reverse Y in 10 patients). Fracture was removed by protecting its adherence to extensor tendon. Intra-articular tissue and fracture ends were cleaned up in terms of hematoma and soft tissues (Figure 2a). Reducing the fracture, fixation was made sending one mm K-wire from fracture to distal phalanx, from dorsal to volar and from proximal to distal by means of 550 speed motor (Bosch GSR 12-2). Thereafter, taking distal interphalangeal joint to full extension, one unit of one mm K-wire was sent toward intermediate phalanx in manner that it shall traverse the distal interphalangeal joint from distal phalanx end point. Closing the layers, aluminum distal interphalangeal joint extension splint was applied (Figure 2b). Two weeks later, the sutures were removed and at the end of the fourth week finger splint usage was finalized. During the period of these four weeks, patients whose proximal interphalangeal and metacarpophalangeal joints (MCP) were released were encouraged to use such joints of them actively. At the end of sixth week, solid knit-

Table 1. Doyle classification of mallet finger injuries

Type	Definition
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
IVc	Involving >50% of joint surface

Table 2. Crawford evaluation criteria

Result	Definition
Perfect	Normal DIP joint extension, normal flexion, no pain
Good	0-10 degrees of extension loss, normal flexion, no pain
Moderate	10-25 degrees of extension loss, any degree of flexion loss, no pain
Bad	>25 degree of extension loss or persistent pain

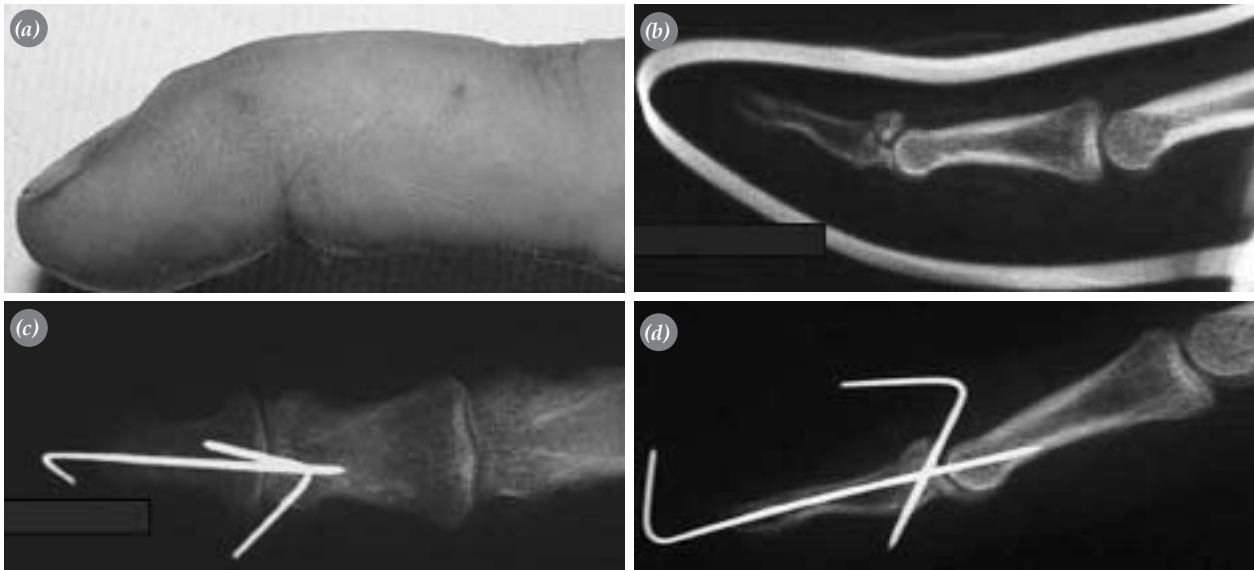


Figure 1. (a) The clinical figure of the patient. Mallet finger of the distal phalanx and extension insufficiency. (b) Insufficient reduction after closed reduction in the splint radiographically. After surgery, (c) anterior and (d) lateral radiographs. Reducing the fracture, the fragment was fixed with a K-wire and another K wire was used for stabilization intraarticularly.

ting was seen in patients assessed by means of graphy and their K-wires were removed. Patients whose wires were removed were applied physical treatment and rehabilitation for a period of two weeks. Patients who were provided to make passive extension exercises for their distal interphalangeal joint in the first week were provided to make active exercises to increase joint movement aperture. Average monitoring period was 18 months (11-34 months).

Results

In radiographic assessment, knitting was obtained in all of the patients. Not any malunion other than osteophyte has been determined in dorsal lip of three patients. There was a step of one mm in joints of such patients in their postoperative graphies. In other 31 patients, anatomical reductions were determined. Not any subluxation of joint, reduction in

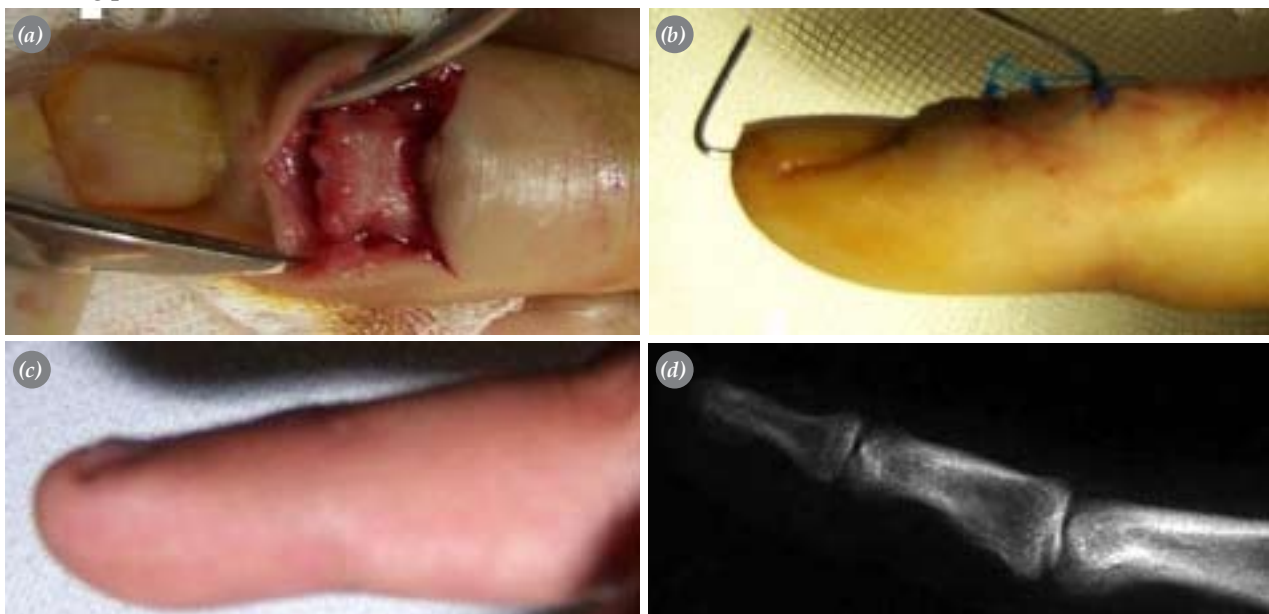


Figure 2. (a) Surgery of the patient. Intra-articular tissue and fracture ends were cleaned and prepared for fixation. (b) The figure of the finger and fixation material after surgery. (c) The clinical vision of the finger at the last control. The mallet pathology and extension insufficiency were improved. (d) The radiographical results of the finger at the last control. The fracture line was disappeared and healed.

joint aperture and degenerative change were determined in any patient. Not any wound mark or wire bottom infection developed in follows-up. In clinical assessment, not any ache, instability, swan-neck deformity and nail bed injury were observed in patients. Not any joint movement aperture loss did exist in metacarpophalangeal and proximal interphalangeal joints of any of the patients. While a flexion loss of 10 degrees was determined in three patients whose dorsal lip of distal phalanx is with osteophyte, not any flexion loss was observed in other patients. While extension loss of five degrees was determined in four patients, other patients had full extension. While joint movement aperture of 80 degrees in average was obtained in patients in whom flexion loss developed and joint movement aperture of 85 degrees in average was obtained in patients in whom extension loss developed, other patients had full joint movement aperture. The patients were assessed according to the rating scale used by Crawford: the results obtained were perfect in 27 patients, good in four patients and fair in three patients (Figure 2c,d).

Discussion

In spite of developing technology and the possibility of using various hand protective covers, osseous mallet finger deformity is frequently seen as a result of work accidents in those using their hands, sportive injuries depending on increasing sportive activities and home accidents.^[3] Although it is mostly seen as a result of distal interphalangeal joint's becoming hyperextended as a result of vertical pushing down to distal phalanx end, it may also be seen as fracture with sudden contraction of extensor tendon. The ruptured part includes the distal phalanx joint surface. In cases where anatomical reduction is not obtained, subluxation and instability together with degenerative changes may

happen depending on intra-articular fracture.^[4] In case of chronic osseous mallet finger deformity depending on insufficiency of extensor tendon, the balance among intrinsic and extrinsic extensor tendons is destroyed and swan-neck deformity occurs when proximal interphalangeal joint becomes hyperextended.^[5] In order not to experience such kinds of complications, osseous mallet finger deformity should be treated preserving the anatomic position. Among the alternatives of treatment are applications of splint with closed reduction, extension block method with closed reduction, open reduction and tension band technique with K-wire, internal suture method, techniques of fixation with hooked plaque and screw. In cases where there is subluxation in distal interphalangeal joint together with fracture not becoming reduced and the dimension of the part is above 30%, the treatment is of surgical character.^[6] One of the popular methods among surgical methods is the method of extension block wire application together with closed reduction defined by Ishiguro.^[7] and ark in 1988 (Figure 3a). By means of this method, osseous mallet finger deformity has been tried to be corrected with indirect closed reduction of fracture. Although surgical treatment complications are tried to be minimized using this technique, it has been reported that extension loss occurred in patients in various degrees. At the same time, protuberance deformity occurred in DIP joint dorsal as well in patients in whom extension loss developed. Conducting this technique under fluoroscopic control is another disadvantage. Tetik and Güdemez^[8] have made a change in extension block method with K-wire. Differently from the technique of Ishiguro, this technique includes sending the wire to intermediate phalanx following indirect reduction application before K-wire is entered into intermediate phalanx. In addition to its low complication rate, experiencing extension loss in

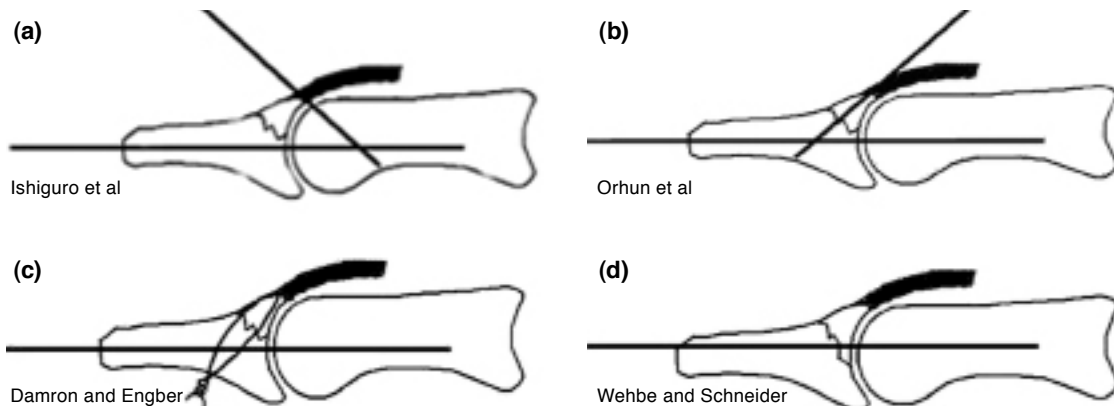


Figure 3. (a) The surgical technique of the Ishiguro at al⁷. (b) Our technique; The fixation of the fragment and intraarticularly. (c) The technique of the Damron and Engber⁹. After suturing of the fragment, K wire was used for stabilization. (d) The technique of the wehbe and Schneider¹¹. Reduction and stabilization were made for just one K wire.

approx. 20% of cases and the necessity of being conducted under fluoroscopic control are the disadvantage of the technique. Since, in our technique, the fracture is directly revealed and the joint is in sight, fluoroscopic control is not a must. By provision of the continuity of dorsal cortex completely anatomical reduction is obtained. The second important point in addition to the continuity of dorsal cortex is that the joint is not subluxated during reduction. And this is obtained by not making the joint over-hyperextended while making reduction (Figure 3b). Although the possibility that the fragment is fractured during passage of K-wire through direct part seems a probable complication, this portability is decreased to minimum in passages sent under control and in which multiple trials are not made. Besides, this complication may be seen as well in uncontrolled and multiple trials in extension block method. T.A.Damron and Engber have defined the application of open reduction and external splintage technique^[9] (Figure 3c). Ache complaint was reported in various degrees in 44% of the cases and extension loss was reported in 28% of the cases. In our cases, not any ache complaint was received. In only four cases of ours, an extension loss of five degrees developed. Fritz and ark have obtained successful results in their 22 cases and acceptable results in their two cases in their compression techniques with K-wire in their studies.^[10] Having assessed the results of wire fixation passing through the joint, Wehbe and Schneider have reported that this technique is found together with high complication rate^[11] (Figure 3d). Failure was observed in K-wire fixation in 25% of the cases. Having assessed the trans-articular fixation technique, Stern and ark have reported a surgical complication rate of 52-67%.^[12] Such complications are implant insufficiency, subluxation with distortion of joint alignment, extension loss, infection and nail bed deformities. We are of the opinion that the reasons for failure in trans-articular wire technique are related with the placement area of the wire together with trying to control the fracture in indirect way. While sending the K-wire from distal phalanx end, choosing the location should be suitable. Although K-wires passing close to dorsal grip the fracture better, this may cause nail bed problems. The K-wires passing through more palmar are not able to grip the fracture and thus implant insufficiency may develop. Not any fixation material failure, infection, skin necrosis and nail bed deformity have been observed in our cases. Takami and ark have published an article regarding direct fixation of fracture.^[13] In such article, they have reported the results of direct reduction of 33 osseous mallet finger deformity cases. They have assessed the results of the part put forward with a transverse incision over distal

interphalangeal joint by applying direct K-wire fixation as in our cases. The results obtained were perfect in 24 patients, good in nine patients. At the end of the study, minor ache was determined in three patients. Distal interphalangeal joint extension loss is in average four degrees (between 0-20 degrees) and active flexion is in average 67 degrees (between 45-90 degrees). In monitoring films, contraction was determined at joint apertures in six patients. Takami and ark have also mentioned about the importance of non-disruption while passing through the fracture during placement of K-wire. The conclusions of this study bear resemblance to our study. Surgical reduction has a low complication rate in treatment of osseous mallet finger deformity when applied with a suitable technique. Together with the surgical reduction which we use in our cases, the technique of fixation of the part with K-wire is an efficient technique which is easily applicable, without trouble, cheap, does not require fluoroscopic control and has a low complication rate. The post-operative contentment of cases and the non-occurrence of functional loss in cases are encouraging in terms of application of this technique.

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