RESEARCH ARTICLE / *Araştırma Makalesi*

Comparison of Closed Reduction with Percutaneous Kirschner Wire Fixation Versus Open Reduction with Internal Fixation In Adult Patients with Distal Phalangeal Fractures

Distal Falanks Kırığı Olan Erişkin Hastalarda Kapalı Redüksiyon ve Perkutan Kirschner Teli Uygulaması İle Açık Redüksiyon İnternal Fiksasyon Uygulaması Sonuçları Karşılaştırılması

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Abstract

Objective	We aimed to compare functional and radiological results of closed reduction with percutaneous Kirschner wire (K-wire) fixation versus open reduction with internal fixation in adult patients with distal phalangeal fractures.
Materials and Methods	A total of 13 patients (8 males, 5 females) who were operated for distal phalangeal fractures in our center between February 2019 and December 2020 were retrospectively reviewed.The patients were divided into two groups according to the type of surgery:Group 1 (n=6) undergoing closed reduction with percutaneous K-wire fixation and Group 2 (n=7) undergoing open reduction with internal fixation.Functional results were evaluated using the total active range of motion (TAROM) scale.Demographic and clinical characteristics and operative data were recorded.The time to return to work was assessed between the groups.
Results	The median age was 37 (range, 24 to 51) years and the median follow-up was 13 (range, 10 to 18) months.According to the TAROM scale, excellent and good results were achieved in 11 and two patients, respectively.The median time to complete union was 4 (range, 3 to 6) weeks.There was no significant difference in the functional and radiological results between the groups.However, the median time to return to work was significantly shorter in Group 2 (p=0.03).None of the patients had postoperative complications such as infection, reduction loss, nonunion or complex regional pain syndrome.
Conclusion	Although both treatment methods yield satisfactory and comparable functional and radiological results in patients with distal phalangeal fractures, open reduction with internal fixation is significantly associated with a shorter time to return to work.
Keywords	Distal phalangeal fracture; adult; Kirschner wire; open reduction; internal fixation

Öz

Amaç	*Çalışmada; kapalı redüksiyon ve perkutan Kirschner teli (K teli) ile açık redüksiyon internal fiksasyon uyguladığımız distal falanks kırığı olan erişkin hastaların fonksiyonel ve radyolojik sonuçlarının değerlendirilmesi amaçlandı.*
Gereç ve Yöntemle	*Şubat 2019 ile Aralık 2020 tarihleri arasında 13 hasta (8 erkek, 5 kadın), iki ayrı gruba ayrılarak retrospektif olarak değerlendirildi. 1. gruba kapalı redüksiyon ve perkutan K teli (6 hasta) ve 2. gruba açık redüksiyon internal fiksasyon (7 hasta) uygulandı. Fonksiyonel sonuçlar total aktif eklem hareket açıklığı (TAEHA) skalasına göre değerlendirildi. Analiz Statistical Package for the Social Sciences (SPSS) ve Student t-testine göre yapıldı. p<0.05 olması anlamlı kabul edildi.Gruplarda işe dönüş zamanı karşılaştırıldı.*
Bulgular	*Hastaların ortalama yaşı 37 (24-51) ve ortalama takip süresi 13 (10-18) aydı. TAEHA skalasına göre 11 hasta mükemmel ve 2 hastada iyi sonuç elde edildi. Ortalama 4 (3-6) hafta içinde tüm hastalarda tam kaynama görüldü. Radyolojik ve fonksiyonel açıdan anlamlı fark saptanmadı. İşe dönüş zamanı açısından 2. grup anlamlı bulundu (p=0.03). Enfeksiyon, redüksiyon kaybı, kaynamama ve kompleks bölgesel ağrı sendromu gibi komplikasyonlar görülmedi.*
Sonuç	*Distal falanks kırığı olan erişkin hastalarda uygulanan 2 ayrı tedavi yöntemi ile tatmin edici fonksiyonel ve radyolojik sonuçlar elde edilmesine rağmen, açık redüksiyon internal fiksasyon uygulanan hastalarda işe dönüş açısından daha anlamlı olduğu görülmektedir.*
Anahtar Kelimeler	*distal falanks kırığı; erişkin hasta; Kirschner teli; açık redüksiyon; internal fiksasyon*

INTRODUCTION

Distal phalangeal fractures are the most common fractures of the hand and usually affect the thumb and middle finger.[1-4] Although falls from a height and occupational accidents are the main causes, sports injuries may also lead to such fractures.[5,6] These fractures are more commonly seen in adult males than females and affect both hands equally.[7] Physical examination and radiographic findings are the mainstay of the diagnosis.[8] Classification of distal phalangeal fractures is made according to the Schneider's classification which divides these fractures into three groups as tuft fractures, shaft fractures, and articular fractures.[9]

Conservative treatment and surgery are indicated in the management of distal phalangeal fractures. Non-displaced fractures are usually treated conservatively.[10] Surgical treatment is indicated forunstable and displaced fractures. During surgery, fixation can be performed using a variety of instruments including the Kirschner wire (K-wire), compression screws, mini-late screw system, and cerclage wires.[11-14]

In the present study, we aimed to compare functional and radiological results of closed reduction with percutaneous K-wire fixation versus open reduction with internal fixation in adult patients with distal phalangeal fractures.

MATERIALS and METHODS

Study design and study population

This is a descriptive and cross sectional study was conducted at Ankara City Hospital between February 2019 and December 2020. Prior to surgery, all patients were informed about the possible risks and benefits of surgery and a written informed consent was obtained. The study protocol was approved by Ankara City Hospital, Ethics Committee (Approval No: E1-21-1582) (03/03/2021). The study was conducted in accordance with the principles of the Declaration of Helsinki.

A total of 13 patients who were operated for distal phalangeal fractures in our center between February 2019 and December 2020 were retrospectively reviewed. Those having nail bed injuries, open fractures, and pediatric cases were excluded from the study. The patients were divided into two groups according to the type of surgery: Group 1 (n=6) undergoing closed reduction with percutaneous K-wire fixation and Group 2 (n=7) undergoing open reduction with internal fixation. Demographic and clinical characteristics and operative data were retrieved from the hospital database. All patients were evaluated based on physical examination and radiographic findings.Classification of distal phalangeal fractures was made according to the Schneider's classification (Table 1)[9]. Functional results were evaluated using the total active range of motion (TAROM) scale. The time to return to work was assessed between the groups.

Table 1. Schneider's classification of distal phalangeal fractures

Tuft fractures	Simple
	Communited
Shaft fractures	Stable
	Unstable
Proximal (articular) fractures	Volar (flexor digitorum profundus avulsion)
	Dorsal (extensor avulsion)
	Epiphyseal separation
	Comminuted/pilon

Surgical technique

Surgery was performed using standard surgical technique under regional anesthesia (axillary block). All surgeries and follow-up were carried out by the hand surgeons. Group 1 underwent closed reduction under fluoroscopy and a K-wire was placed longitudinally, after anatomic reduction was achieved (Figure 1). The volar approach was applied to six patients and dorsal approach in one patient in Group 2. In six patients in this group, internal fixation was performed using a 1.1 mm mini-plate screw system(-Figure 2), while a 1.1 mm mini-screw was used in another patient (Figure 3). As all operations were made under regional anesthesia, a short arm cast to the fingertip was

used to avoid any damage to the K-wire and to preserve the soft tissue. In the early postoperative period (Day 1), wound dressing was made smaller to allow movement of the non-affected fingers. All patients and caregivers were educated on active or passive motion for fingers.

Figure 1. A postoperative lateral X-ray image showing fixation with K-wire

Figure 2. Postoperative lateral and anteroposterior X-rays showing internal fixation using mini-plate screw system

Figure 3. Postoperative lateral and anteroposterior X-rays showing internal fixation using mini-screw system

In the postoperative period, non-steroidal anti-inflammatory drugs were prescribed for one week with wound dressing every three days. In Group 2, the sutures were removed on Day 14 after surgery and the patients were scheduled for a physical rehabilitation program. In Group 1, the K-wires were removed at four weeks as confirmed by X-ray images showing complete union, and the patients were scheduled for a physical rehabilitation program. All patients were followed at 12 weeks in the outpatient setting as the final control.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) Statistics for Windows version 17.0 software (SPSS Inc., Chicago, IL, USA). Descriptive data were expressed in median (min-max) and number, where applicable. The Student t-test was used to analyze data. All normally distributed data were analyzed using Student's t-test. A p value of <0.05 was considered statistically significant.

RESULTS

Of the patients, 8 were males and 5 were females with a median age of 37 (range, 24 to 51) years. The etiology of distal phalangeal fractures was fall from a height in eight patients and occupational accidents in five patients. The fracture was located in the third digit in nine patients and fourth digit in four patients. In one of the patients, a distal phalangeal fracture and a proximal phalangeal fracture co-existed.According to the Schneider's classification, 11 patients had an unstable shaft fracture (Figure 4), one patient had a volar proximal articular fracture (flexor digitorum profundus avulsion) (Figure 5), and one patient had a dorsal proximal articular fracture (extensor avulsion) (Figure 6). One patient with a dorsal proximal articular fracture had also proximal phalangeal fracture in the fourth digit and open reduction with internal fixation was performed at the same session using a 1.5-mm mini-plate screw system.

Figure 4. A preoperative lateral X-ray image showing unstable distal phalangeal shaft fracture

Figure 5. Preoperative lateral and anteroposterior X-rays showing volar proximal articular fracture

Figure 6. A preoperative lateral X-ray image showing dorsal proximal articular fracture

The median follow-up was 13 (range, 10 to 18) months. According to the TAROM scale, excellent and good results were achieved in 11 and two patients, respectively. The median time to complete union was 4 (range, 3 to 6) weeks. There was no significant difference in the functional and radiological results between the groups. However, the median time to return to work was significantly shorter in Group 2 (p=0.03). None of the patients had postoperative complications such as infection, reduction loss, nonunion or complex regional pain syndrome (Sudeck atrophy). In one patient with a dorsal proximal articular fracture, the 1.1-mm mini-plate screw was removed under local anesthesia at six months after surgery. In Group 2, one patient had a loss of 5° extension.

DISCUSSION

Closed distal phalangeal fractures are more common in men than women and mostly occur between the third and fifth decades of life.[15] The main causes of closed fractures are traumatic injuries such as fall from a height and occupational accidents. In our study, the etiology of the fractures is consistent with the previous studies.

Closed distal phalangeal fractures are treated with either conservative or surgical techniques.[16] In general, non-displaced fractures are managed by conservative modalities.[17] In our study, surgical treatment was applied to all patients. Surgery can be performed using both open and closed reduction techniques. The most common procedures are closed reduction with a percutaneous K-wire and open reduction with internal fixation using mini-plate screw systems.[11,18] In a retrospective study including 60 patients, Senesi et al.[19] showed that a 23-gauge needle was a favorable alternative to K-wire in the treatment of distal phalangeal fractures. The authors placed a 23-gauge needle in 32 patients and a K-wire in 28 of patients. They found a significantly shorter time tounion in the needle group. In a case series, including 12 patients with an extra-articular or intra-articular distal phalangeal fracture, Pruniereset al.[18] showed complete union with K-wire and the wires were removed at four weeks. In our study, six patients underwent closed reduction with percutaneous K-wire fixation and complete union was achieved in all patients during follow-up. According to the TAROM scale, five patients had excellent results and one patient had good results.In a study, Liao et al.[20] recommended fixation using a 1.0-mm screw in the treatment of volar proximal articular fractures. Similarly, in our study, we performed internal fixation with a 1-1-mm mini-plate screw in one patient in Group 2.

Extension limitation of the finger is the most critical functional problem in patients with dorsal proximal articular fractures. In a prospective, randomized-controlled study, Auchinclosset al.[21] compared internal fixation versus external splintage of the distal interphalangeal joint and showed a 6° extension loss in the internal fixation group. In another study comparing the results of displaced mallet fractures treated with an extension block pin and transarticular fixation of the distal interphalangeal joint, Hofmeister et al.[22] reported a 4° extension loss at ≥1-year follow-up. In our study, one patient treated with open reduction had a loss of 5° extension.

Although favorable results can be achieved with surgical treatment of closed distal phalangeal fractures, complications such as infection, reduction loss, nonunion, or complex regional pain syndrome can occur in selected patients.[23-25] However, none of these complications were observed in any of the patients in this study.

The retrospective design and relatively small sample size are the main limitations of the present study. Further large-scale, prospective studies are needed to draw a firm conclusion on this subject.

In conclusion, although both treatment methods yield satisfactory and comparable functional and radiological results in patients with distal phalangeal fractures, open reduction with internal fixation is significantly associated with a shorter time to return to work.

Conflict of interest statement

The authors have no conflicts of interest to declare.

Ethical Approval

This study was approved by the Ankara City Hospital, Ethics Committee with the Approval No: E1-21-1582 (03/03/2021)

Kaynaklar

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