

## Splinting and Percutaneous Pinning Treatments of Non-Bony Mallet Finger:

### A Retrospective Clinical Trial

#### Kemiksiz Çekiç Parmağın Splintleme ve Perkütan Pinleme Tedavileri:

#### Retrospektif Klinik Çalışma

Selami KARADENİZ<sup>1</sup>  Alparslan YURTBAY<sup>2</sup> 

#### ÖZ

**Amaç:** Çekiç parmak ortopedi pratiğinde sıkça karşılaşılan tendon yaralanmasıdır. Bu çalışmada kemiksiz çekiç parmak tanısı alan hastalarda uyguladığımız Kirschner teli (K-teli) ile perkütan pinleme ve splint uygulamasının klinik sonuçları retrospektif olarak karşılaştırıldı.

**Araçlar ve Yöntem:** Çalışmaya 2011-2020 tarihleri arasında yaralanmanın ilk 7 gün içerisinde distal interfalangeal eklem bozukluğu olan 81 hasta dahil edildi. Ekstansiyon splinti 42 hastaya K-teli ile perkütan pinleme ise 39 hastaya uygulandı. Klinik değerlendirme Crawford değerlendirme kriterlerine göre yapıldı.

**Bulgular:** Ortaçağ takip süresi splint grubunda 17 ay iken, K-teli grubunda 16 ay idi ( $p=0.632$ ). Her iki grupta gözlenen komplikasyonlar ( $p=0.107$ ) arasında anlamlı bir fark yoktu. Her bir gruptaki ekstansiyon kaybı derecesindeki azalma ise istatistiksel olarak anlamlıydı ( $p<0.001$  ve  $p<0.001$ ). Tedavi öncesi ve sonrası ekstansiyon kayıpları arasında splint ve K-teli grubunda (sırasıyla;  $p=0.522$  ve  $p=0.085$ ) anlamlı bir fark bulunmadı. Tedavi bitiminde fleksiyon derecesi splint grubunda daha fazlaydı ve aralarındaki fark anlamlıydı ( $p<0.001$ ). Gruplar arasında Crawford değerlendirme kriteri dağılımına göre anlamlı bir fark tespit edilmedi ( $p=0.859$ ).

**Sonuç:** Sonuç olarak çekiç parmak tedavisinde konservatif ve cerrahi yaklaşım sonuçları başarılı ve benzerdir. Hastalara her iki tedavi seçeneği de sunulabilir.

**Anahtar Kelimeler:** crawford kriterleri; eğimli tokmak; kirschner telleri; uzatma splintleme

#### ABSTRACT

**Purpose:** Mallet finger is a common tendon injury in orthopedic practice. In this study, the clinical results of Kirschner wire (K-wire) and percutaneous pinning and splint application in patients diagnosed with non-bony mallet finger were retrospectively compared.

**Materials and Methods:** The study included 81 patients with distal interphalangeal joint disorder within the first seven days of injury between 2011 and 2020. An extension splint was applied to 42 patients, and percutaneous pinning with K-wire was applied to 39 patients. Clinical evaluation was performed according to Crawford's mallet finger criteria.

**Results:** The median duration of follow-up was 17 months in the splint group and 16 months in the K-wire group ( $p=0.632$ ). There was no significant difference between these groups regarding the complications observed ( $p=0.107$ ). The decrease in extension was significant in both groups ( $p<0.001$  and  $p<0.001$ ). There was no significant difference between the groups regarding the pre- and post-treatment extension losses ( $p=0.522$  and  $p=0.085$ , respectively). At the end of the treatment, the degree of flexion was higher in the splint group, and the difference between the groups was significant ( $p<0.001$ ). There was no significant difference between the groups regarding the assessment based on Crawford criteria ( $p=0.859$ ).

**Conclusion:** In conclusion, both conservative and surgical approaches for the treatment of mallet finger are successful, and the results are similar. Both treatment options may be offered to the patients.

**Keywords:** crawford's criteria; extension splinting; kirschner wires; tendinous mallet

Received: 06.11.2021; Accepted: 19.04.2022

<sup>1</sup> Amasya University, School of Medicine, Department of Orthopaedics and Traumatology, Amasya, Türkiye.

<sup>2</sup> Ondokuzmayıs University, School of Medicine, Department of Orthopaedics and Traumatology, Samsun, Türkiye.

Corresponding Author: Selami Karadeniz, Amasya University, School of Medicine, Department of Orthopaedics and Traumatology, Amasya, Türkiye.  
e-mail: drskaradeniz@hotmail.com

**How to cite:** Karadeniz S, Yurtbay A. Splinting and percutaneous pinning treatments of non-bony mallet finger: a retrospective clinical trial. Ahi Evran Med J. 2023;7(1):1-5. DOI: 10.46332/aemj.1019915

## INTRODUCTION

Mallet finger is one of the most encountered extensor tendon injuries. It occurs with the rupture or avulsion of the extensor tendon at the level of insertion on the distal phalanx. Although it is often observed due to sports injuries, it can also occur during daily routines.<sup>1</sup> If a mallet finger is not treated, it can cause swan neck deformity. Patients can be treated with conservative or surgical approaches, but the current effective treatment option is contentious.<sup>2</sup> The basic principle of treatment is to fix the distal interphalangeal joint (DIPJ) in extension.<sup>3</sup>

In the conservative treatment, a full-time extension splint is applied. Treatment results are successful in patients who adhere to the treatment with the splint. However, complications such as maceration of the skin or deterioration of skin integrity may be observed in some patients due to improper use of the extension splint.<sup>4</sup> In the surgical treatment, the current approach is the percutaneous pinning of the DIPJ in extension with an intramedullary K-wire. Post-surgical complications such as pin site infection, loosening of the pin, and pin migration from the finger may occur after surgery.

We hypothesized that the clinical results would be better in the patient group who underwent percutaneous pinning. Our study aimed to retrospectively compare the clinical results of percutaneous pinning with K-wire and splinting in patients diagnosed with non-bony mallet finger.

## MATERIALS and METHODS

Ondokuz Mayıs University Clinical Research Ethics Committee approved this retrospective study (07.02.2019-2019/115). All patients in this study gave informed consent. Patients with a distal interphalangeal joint disorder were evaluated within the first seven days of injury between 2011 and 2020. Patients who had a rupture and fracture, started treatment late, had deformity or nail disorder in the relevant finger before the injury, or had open injuries were excluded from the study. The study included 81 patients diagnosed with mallet finger and found to have isolated tendon injury (Doyle type I) with direct X-ray detection. All patients were informed about treatment options. The decision to treat was made together with the patient.

Gender, age, affected finger, dominant hand, time of injury, injury mechanism, and occupation were under record.

Microperforated stack splint (Figure 1) was applied as an extension splint to 42 patients (20 women and 19 men; mean [range] age 50.6 [23-78] years). The injuries were in the second finger in 10 cases, the third in 13 cases, the fourth in 13 cases, and the fifth in 6 cases. The patients were told to use the splint full-time for six weeks. In splinting, the DIPJ was fixed in complete extension. Free movement was allowed at the proximal interphalangeal joint. The patients were informed about possible skin problems. Provided the finger was in full extension, they were asked to remove the splint for 30-60 minutes daily and check their skin. The patients were called for a follow-up control every week, and the course of the treatment was assessed. Full-time splint treatment was terminated at the end of the six weeks, and the patients were told to continue using the splint at night for two weeks. A radiographic examination was requested for diagnosis only at the beginning of the treatment. Imaging was not required at the follow-up controls and at the end of the treatment.



Figure 1. Microperforated stack splint applied to the 4th digit.

Percutaneous pinning with K-wire (Figure 2) was applied to 39 patients (19 women and 20 men; mean [range] age was 44.1 [22-70] years). The injuries were in the second finger in 7 cases, the third in 13 cases, the fourth in 12 cases, and the fifth in 7 cases. The DIPJ was taken to a full extension during the surgical treatment and fixed with an intramedullary K-wire under digital block after proper cleaning was done in the operating room conditions. The K-wire was advanced up to the proximal metaphysis of the middle phalanx, and care was taken not to cross the proximal interphalangeal joint. The position of the wire was confirmed with a scope, and the operation was terminated. The patient was given an appropriate medical treatment,

discharged on the same day, and called for follow-up controls every two weeks. At the end of the sixth week, the wire was removed in the outpatient clinic, and patients used a night splint for the following two weeks. X-rays were not requested in the follow-up controls of the patients. A skin examination was conducted. Complications during the treatment period were recorded. The evaluation of the patients was done according to Crawford's criteria.<sup>5</sup>



**Figure 2.** Percutaneous pinning of the distal interphalangeal joint in the third finger with K-wire in extension.

### Statistical Analysis

Descriptive statistics were reported as mean±standard deviation for variables with normal distribution, and median, minimum, and maximum for variables without normal distribution. Categorical variables were presented as numbers and percentages. The normal distribution of numerical data was checked with Shapiro-Wilk and Kolmogorov-Smirnov tests. In comparing two independent groups for numerical data, the independent samples *t*-test was used for those with normal distribution, and the Mann-Whitney U test was used for those without normal distribution. In comparing categorical variables, Pearson Chi-square was used in 2x2 tables with expected values of 5 and above in cells. Otherwise, Fisher's exact test was used. Fisher Freeman Halton test was used in RxC tables with expected values of less than 5 in cells to compare groups for categorical variables. Statistical analyzes were performed with Jamovi software (Version 2.0.0, Jamovi project 2020, downloaded from <https://www.jamovi.org>) and JASP (Version 0.14.1.0, retrieved from <https://jasp-stats.org>). P-values under 0.05 were accepted as statistically significant.

### RESULTS

A total of 81 patients, 42 in the splint group and 39 in the K-wire group, were included in the study. The splint and K-wire groups were similar in terms of age, gender, dominant side, affected hand, and the finger with the deformity (Table 1).

**Table 1.** Demographic and clinical characteristics of the patients.

Variables	Splint group (n=42)	K-wire group (n=39)	p
Age (year) †	50.6 ± 16.3	44.1 ± 13.3	0.051**
Gender ‡			
Male	22 (52.4)	20 (51.3)	0.999*
Female	20 (47.6)	19 (48.7)	
Dominant side ‡			
Right	38 (90.5)	36 (92.3)	0.999*
Left	4 (9.5)	3 (7.7)	
Affected hand ‡			
Right	28 (66.7)	22 (56.4)	0.471*
Left	14 (33.3)	17 (43.6)	
Affected digit §			
2	10 (23.8)	7 (17.9)	
3	13 (31.0)	13 (33.3)	0.911*
4	13 (31.0)	12 (30.8)	
5	6 (14.3)	7 (17.9)	

† mean±standard deviation

‡ n (%)

\*Pearson chi-square or Fisher's exact test was used.

\*\*Independent samples t-test was used.

The median follow-up period was 17 months in the splint group and 16 months in the K-wire group (p=0.632). Although complications were seen at a higher rate in the splint group, their difference was not significant (33.3% vs. 15.4%, p=0.107) (Table 2).

**Table 2.** Comparison of the groups in terms of duration of treatment and complications.

Variables	Splint group (n=42)	K-wire group (n=39)	p
Follow-up duration (ay) §	17.0 [13.2–19.8]	16.0 [13.0–18.0]	0.632**
Complication ‡			
No	28 (66.7)	33 (84.6)	0.107*
Yes	14 (33.3)	6 (15.4)	

‡ n (%)

§ median [min-max]

\*Pearson chi-square or Fisher's exact test was used.

\*\*Mann-Whitney U test was used.

Before treatment, the median loss of extension was 20 degrees in the splint group and 18 degrees in the K-wire group. The median post-treatment extension loss was 4 degrees in the splint group and 2 degrees in the K-wire group. The groups were similar regarding extension loss before and after treatment (p=0.522 and p=0.0085) (Table 3). The decrease in extension loss was significant in both groups (p<0.001 and p<0.001).

**Table 3.** Comparison of the groups in terms of extension loss before and after the treatment.

Variables	Splint group (n=42)	K-wire group (n=39)	p <sup>*</sup>
Pre-treatment extension loss (°) §	20.0 [17.0–25.8]	18.0 [17.0–22.0]	0.522
Post-treatment extension loss (°) §	4.0 [0.0–8.0]	2.0 [0.0–4.0]	0.085
p <sup>**</sup>	<0.001	<0.001	

§ median [min-max]

\*Mann-Whitney U test was used.

\*\*Wilcoxon test was used.

Based on Crawford's mallet finger criteria, 16(38.1%) patients in the splint group were graded as perfect and 20(47.6%) as good. In the K-wire group, 18 patients (46.2%) were graded as perfect and 17 (43.6%) as good. Although the rate of patients graded as perfect was higher in the K-wire group, the difference between the groups was not significant regarding the results based on Crawford's criteria (p=0.859). After the treatment, the median degree of flexion was 47° in the K-wire group and 55° in the splint group; the difference between the groups was significant (p<0.001) (Table 4).

**Table 4.** Comparison of treatment outcomes based on Crawford's mallet finger criteria.

Variables	Splint group (n=42)	K-wire group (n=39)	P
Crawford grade ‡			
Perfect	16 (38.1)	18 (46.2)	0.859*
Good	20 (47.6)	17 (43.6)	
Fair	5 (11.9)	4 (10.3)	
Poor	1 (2.4)	0 (0.0)	
Post-treatment flexion (°) §	55.0 [50.0–60.0]	47.0 [40.0–52.0]	<0.001**

‡ n (%)

§ median [min-max]

\*Fisher Freeman Halton test was used.

\*\*Mann-Whitney U test was used.

## DISCUSSION

Our study has shown that the success rate of extension splint application was as high as that of the surgical approach in treating mallet finger. Although previous studies have investigated the subject matter, the results were contentious.<sup>2-4,6</sup>

The volar, dorsal, and stack-type extension splints are among the conservative treatment options; these splints can be mass-produced or custom-made thermoplastics. Micro-perforated models have also been produced to reduce the maceration on the skin due to these splints. However, the effect of the splint type used on clinical outcomes is contentious.<sup>4,6,7</sup> In 2018, Vernet et al.<sup>4</sup> evaluated the clinical results of 50 patients who had dorsal splints and 50

patients who had stack splints, and could not show a significant difference in terms of skin complications. Warren et al.<sup>6</sup> reported the clinical results of 116 patients who used Abouna splint or stack splint and found that the results were similar. Kinninmonth et al.<sup>7</sup> reported that microperforated splints reduce skin maceration and therefore are better than conventional splints in terms of the complication rate. In our study, a mass-produced microperforated stack splint was applied to all patients, and skin maceration was observed in approximately one-third of the patients.

There are different opinions in the literature regarding the prescribed duration of extension-splint use.<sup>8,9</sup> In general, 6-8 weeks of all-day splint use followed by 2-4 weeks of intermittent night splint use is recommended.<sup>8</sup> Hong et al.<sup>9</sup> advocated using splints for more prolonged periods: they obtained an excellent Crawford grade in 57% of the patients and a good grade in 26% in a study with 100 patients and recommended 12 weeks of full-time splint use followed by four weeks of part-time night use. In our study, we applied full-time extension splints for six weeks, and then night-time splint use for two weeks to all patients. According to Crawford's criteria, we obtained an excellent grade in 38% of patients and a good grade in 47%.

Several surgical techniques were described for the treatment of mallet finger.<sup>10,11</sup> Fixation of the DIPJ in extension with an intramedullary K-wire is one of the standard surgical techniques applied in acute cases. Surgery is a technically easy and minimal-invasive procedure. Surgical treatment is usually recommended in cases that involve an avulsion fracture of more than one-third of the joint, with joint subluxation, in patients who were not expected to comply with splint use, with a high risk of developing skin necrosis, in actively working patients, and in cases where conservative treatment have failed. In other groups, the choice of treatment approach may be left to the patient.<sup>12</sup> We explained the advantages and disadvantages of each treatment method and left the choice of treatment approach to the patient. Based on Crawford's criteria, we achieved a perfect grade of 46% and a good grade of 43% in the surgical treatment patients. Comparisons indicated no statistically significant difference, although the surgical approach was superior to splinting. The most commonly observed complications in treating mallet finger with splints

are maceration, laceration, and necrosis on the skin. In addition, complications such as infection, joint disorders, nail disorders, and the migration or breakage of the wire are observed in the surgical treatment. In a study of 123 patients receiving surgical or conservative (splint) treatment, Stern et al.<sup>13</sup> reported a 53% complication rate in the former group and 45% in the latter. Although we reported a complication rate of 33.3% in patients who underwent a stack splint operation in our study, maceration had improved in all patients without stopping the treatment. The complication rate was 15.4% in patients who underwent percutaneous fixation with intramedullary K-wire, all of whom had a pin-tract infection and were treated with oral administration of antibiotics without the need for retraction of the wire.

There was no significant difference between the groups regarding the loss of extension at the last follow-up visit after the treatment. After the treatment, DIPJ flexion was 47 degrees in the group treated with the K-wire and 55 degrees in the group treated with a splint, and the difference was statistically significant.

In conclusion, both conservative and surgical approaches for treating mallet finger are successful, and the results are similar. Therefore, both treatment options may be offered to the patients.

#### Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

#### Ethics Committee Permission

Ondokuz Mayıs University Clinical Research Ethics Committee approved this retrospective study (07.02.2019-2019/115).

#### Authors' Contributions

Concept/Design: SK, AY. Data Collection and/or Processing: SK, AY. Data analysis and interpretation: SK, AY. Literature Search: SK, AY. Drafting manuscript: SK. Critical revision of manuscript: SK.

#### REFERENCES

1. McCue FC, Meister K. Common sports hand injuries. *Sports Med.* 1993;15(4):281-289.
2. Bloom JM, Khouri JS, Hammert WC. Current concepts in the evaluation and treatment of mallet finger injury. *Plast Reconstr Surg.* 2013;132(4):560e-566e.
3. Jm A. Splint For Mallet-Finger. *Br Med J.* 1965;1(5432):444-444.
4. Vernet P, Igeta Y, Facca S, Toader H, Diaz JJH, Liverneaux P. Treatment of tendinous mallet fingers using a Stack splint versus a dorsal glued splint. *Eur J Orthop Surg Traumatol.* 2019;29(3):591-596.
5. Crawford GP. The molded polythene splint for mallet finger deformities. *J Hand Surg Am.* 1984;9(2):231-237.
6. Warren R, Norris S, Ferguson D. Mallet finger: a trial of two splints. *J Hand Surg Am.* 1988;13(2):151-153.
7. Kinninmonth A, Holburn F. A comparative controlled trial of a new perforated splint and a traditional splint in the treatment of mallet finger. *J Hand Surg Am.* 1986;11(2):261-262.
8. Altan E, Alp NB, Baser R, Yalçın L. Soft-tissue mallet injuries: a comparison of early and delayed treatment. *J Hand Surg Am.* 2014;39(10):1982-1985.
9. Hong IT, Baek E, Ha C, Han S-H. Long-term Stack splint immobilization for closed tendinous Mallet Finger. *Handchirurgie· Mikrochirurgie· Plastische Chirurgie.* 2020;52(3):170-175.
10. Fritz D, Lutz M, Arora R, Gabl M, Wambacher M, Pechlaner S. Delayed single Kirschner wire compression technique for mallet fracture. *J Hand Surg Am.* 2005;30(2):180-184.
11. Han HH, Cho HJ, Kim SY, Oh DY. Extension block and direct pinning methods for mallet fracture: A comparative study. *Arch. Plast. Surg.* 2018;45(4):351.
12. Geyman JP, Fink K, Sullivan SD. Conservative versus surgical treatment of mallet finger: a pooled quantitative literature evaluation. *J Am Board Fam Pract.* 1998;11(5):382-390.
13. Stern PJ, Kastrup JJ. Complications and prognosis of treatment of mallet finger. *J Hand Surg Am.* 1988;13(3):329-334.