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External Fixator Applications in Phalanx and Metacarpal Bone Fractures

Falanks ve Metakarpal Kemik Kırıklarında Eksternal Fiksatör Uygulamaları

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ABSTRACT

Objective: Hand injuries can be a great source of stress and a cause of disconnection from life by negatively impacting the work that patients do in their daily lives. This study aimed to evaluate the presence of fracture union and deformity in patients operated on with a mini external fixator for metacarpal and phalanx fractures in our institution.
Method: A total of 148 patients who underwent external fixation due to phalanx and metacarpal bone fractures were retrospectively evaluated. The patients' radiographic examinations were performed, and fracture union and deformity were evaluated. The results were clinically assessed by applying joint movements and scoring the Total Active Joint Range of Motion (Strickland-Glogovac finger function scale).
Results: The patients were operated on within the first three days after their trauma; 17 (15.3%) of the patients had metacarpal fractures, 94 (84.7%) had phalanx fractures, 8 (47%) of the metacarpal fractures were 2nd metacarpal fractures, and 26 (27.6%) of the 94 patients with phalanx fractures had 5th finger fractures. According to the Strickland–Glogovac finger function scale, the number of patients with active joint range of motion >150 (excellent) was 45, the number of patients with 125–149 (good) was 36, the number of patients with 90–124 (moderate) was 20, and the number of patients with <90 (poor) was 10. In total, excellent and good results were found in 81 patients.
Conclusion: Mini external fixators should be preferred more frequently among surgical options for tubular bone fractures of the hand because they are easy to apply, have satisfactory stability, are safe, allow for painless early mobilization, and provide versatility in treatment options.

Keywords: external fixation, mini external fixator, phalanx fracture, metacarpal fractures, K–wire

ÖZ

Amaç: El yaralanmaları, hastaların günlük yaşamlarında yaptıkları işleri olumsuz etkileyerek büyük bir stres kaynağı ve yaşamdan kopma nedeni olabilir. Bu çalışma, kurumumuzda metakarpal ve falanks kırıkları için mini harici fiksatörle ameliyat edilen hastalarda kırık kaynaması ve deformitenin varlığını değerlendirmeyi amaçlamıştır.
Yöntem: Falanks ve metakarpal kemik kırıkları nedeniyle harici fiksasyon uygulanan toplam 148 hasta retrospektif olarak değerlendirildi. Hastaların radyografik muayeneleri yapıldı ve kırık kaynaması ve deformite değerlendirildi. Sonuçlar, eklem hareketleri uygulanarak ve Toplam Aktif Eklem Hareket Aralığı (Strickland-Glogovac parmak fonksiyon ölçeği) puanlanarak klinik olarak değerlendirildi.
Bulgular: Hastalar travmalarından sonraki ilk üç gün içinde ameliyat edildi; Hastaların 17'sinde (%15.3) metakarpal kırık, 94'ünde (%84.7) falanks kırığı, metakarpal kırıkların 8'inde (%47) ikinci metakarpal kırık ve falanks kırığı olan 94 hastanın 26'sında (%27.6) beşinci parmak kırığı vardı. Strickland-Glogovac parmak fonksiyon skalasına göre aktif eklem hareket açıklığı >150 (mükemmel) olan hasta sayısı 45, 125–149 (iyi) olan hasta sayısı 36, 90–124 (orta) olan hasta sayısı 20 ve <90 (kötü) olan hasta sayısı 10 idi. Toplamda 81 hastada mükemmel ve iyi sonuçlar bulundu.
Sonuç: Mini eksternal fiksatörler, elin tübüler kemik kırıkları için cerrahi seçenekler arasında daha sık tercih edilmelidir çünkü uygulanması kolaydır, tatmin edici stabiliteye sahiptir, güvenlidir, ağrısız erken mobilizasyona izin verir ve tedavi seçeneklerinde çok yönlülük sağlar.

Anahtar kelimeler: eksternal fiksasyon, mini eksternal fiksatör, falanks kırığı, metakarpal kırıklar, K-teli

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Introduction

Hand injuries are frequently encountered orthopedic issues, particularly in industrialized environments. They can occur due to accidents, disasters, floods, wars, and fights. 14% of all emergencies are hand fractures and dislocations [1]. Accordingly, hand fractures constitute 12% of all fractures and 23% of upper extremity fractures. Although hand injuries are not life-threatening, they cause functional losses and disability in daily life activities. Since most hand injuries occur in workplaces, dirty environments, with heavy machinery and cutting tools, the wounds are infected and dirty. Therefore, the evaluation and treatment of hand injuries are critical. Careless intervention or inappropriate rehabilitation programs can cause permanent damage to patients in terms of sensation, movement, and skills [2, 3].

Upper extremity injuries cause various personal, psychological, and social consequences. These consequences are accompanied by psychological problems that occur with patients returning to their daily activities later, delayed return to work, the appearance of the extremity, and restrictions in social and occupational activities [4]. It has been reported that factors such as the severity of the injury, its type, and the characteristics of the injured structures are different elements that affect the long-term results of rehabilitation and return to work. Hand injuries can be a great source of stress and a cause of disconnection from life by negatively impacting the work that patients do in their daily lives. Since the human hand is the main instrument in maintaining a sense of independence and participation in activities in life, hand injuries can change a person's goals in life, economic level, and role in the family [5]. Using valid and reliable methods to reveal the injury's functional, social, and occupational consequences is also important from a clinical perspective. With the definition of the International Classification of Functioning, Disability and Health (ICF), the concepts of body structure and functions, activity, and participation were used to determine the effect of the disease on health. In recent years, outcome measures used in evaluating upper extremity injuries have also been implemented within the framework of these concepts [6].

Swanson's statements, "If hand fractures are not treated at all, they result in deformity, if over-treated, they result in stiffness, and if treated poorly, they result in both deformity and stiffness," emphasized how sensitive and experienced the treatment of hand fractures should be [7].

Within the scope of this research, the presence of fracture union and deformity were evaluated in patients who were operated on with a mini external fixator for metacarpal and phalanx fractures in our institution.

Method

A total of 148 patients who underwent external fixation due to phalanx and metacarpal bone fractures were retrospectively evaluated. Thirty-seven patients were excluded from the analysis as they did not come for postoperative check-ups. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Ethics committee approval has been granted from our institution with protocol number 2017-17/37, and informed consent has been obtained from all participants.

Posterior-anterior (PA), oblique, and lateral radiographs were taken, and surgical treatment was applied after acute conservative treatment of metacarpal and phalanx fractures. Mini external fixator technique was preferred among surgical treatment techniques as it is easy, fast to use, cost-effective, has a short operation and hospitalization time, is easy to follow up the high number of patients in industrial zones, and allows early mobilization. The study group consisted of open metacarpal and phalanx fractures, unstable metacarpal and phalanx fractures, intra-articular or extra-articular metacarpal and phalanx fractures, patients who could not undergo general anesthesia due to medical problems, metacarpal and phalanx fractures with segmental bone loss, and multiple metacarpal and phalanx fractures due to external fixation.

The patients' radiographic examinations were performed, and fracture union and deformity were evaluated. The results were clinically assessed by applying joint movements and scoring the Total

Active Joint Range of Motion (Strickland-Glogovac finger function scale).

The inclusion criteria could be elaborated as open metacarpal and phalanx fractures, unstable metacarpal and phalanx fractures, intra-articular or extra-articular metacarpal and phalanx fractures, patients who cannot undergo general anesthesia due to medical problems, metacarpal and phalanx fractures with segmental bone loss, and all patients were between the ages of 9 and 79. Additionally, I suggest expanding on the surgical techniques and postoperative care instructions, including any specific safety measures taken.

Surgical Procedure

First-generation cephalosporin treatment (1 g) was administered before the surgery for prophylactic purposes. A hand table was set up on the side of the extremity to be operated on in the patient lying in the supine position. After the patients were cleaned with chlorhexidine gluconate solution, they were disinfected using povidone-iodine. No tourniquet was used. Monolateral mini external fixators (a simple system established between half-chanz pins with the help of bars and clamps) were applied to the patients under local anesthesia (Figure 1).

Considering the safe areas, the application was performed from the hand dorsomedial or dorsolateral. While applying the chanz under scopy, the muscle was kept at the maximum possible length/stretched. It was anticipated that muscle functions would be allowed in the postoperative period thanks to this maneuver. The chanz pins were first advanced in the soft tissue and reached on the bone. The safe corridor was caught after gently ensuring the bone was in contact (up-down/forward-back). After the appropriate angle was given, the pins were applied.

During this application, the pins must be sent at the appropriate depth and should not protrude from the opposite cortex. After clamps were placed on the transmission pins, the fractures were reduced with the help of 1 carbon rod, which had the effect of ligamantotaxis and was fixed. In applying the preoperative external fixator, attention was paid to the cortex's continuity and the pins' parallel placement to avoid rotation. A resting splint was applied to the patient for the first three days to support postoperative stabilization and patient compliance. The patients were informed about what to do in postoperative care during discharge. Postoperative care includes recommendations such as keeping the operated hand of the patient elevated, pin site dressing for wound care, antibiotic therapy, and analgesia. The splint applied to the patients was removed on the 3rd postoperative day. The patients were called for outpatient clinic control 3 weeks later.

After the scopic control (Figure 1), a resting splint was applied to the patient, and the patient's operation was terminated and discharged on the same postoperative day.

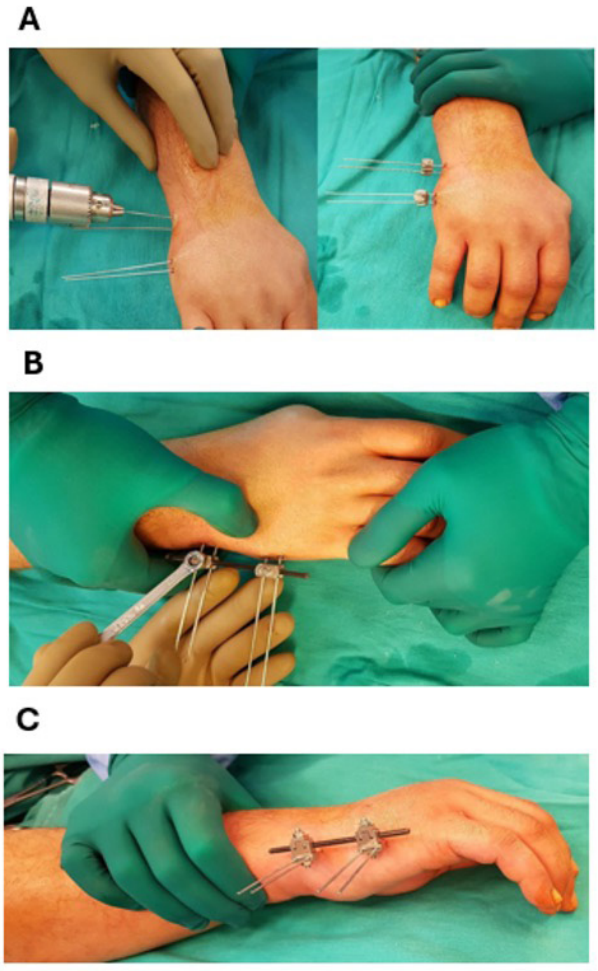

Figure 1: External fixator application procedure

The patients were informed about what to do in postoperative care during discharge. Postoperative care includes suggestions such as keeping the patient's operated hand elevated, pin site dressing for wound care, and providing analgesia. In the

postoperative period, the patients were called for a 3rd-day outpatient clinic check, and the resting splint applied to the patients was terminated at this check. The patients were told to continue with pin-site dressing for wound care. From the moment the resting splint was terminated (postoperative day 3), joint movements were started in the patients. The patients were called for an outpatient clinic check-up three weeks later; a joint range of motion and imaging were examined.

Radiological imaging of the patients was performed on the 3rd week. After radiological healing/union (formation of a trabecular bridge on the fracture line in the obtained X-ray images, absence of radiolucent image on the fracture line, and absence of tenderness on the fracture line clinically) was observed, local anesthesia was applied under outpatient clinic conditions and mini external fixators were removed. It was observed that the number of patients whose mini external fixators were removed in the third week was 55 (Figure 2).

Figure 2: (A): Fifth metacarpal boxer's fracture postoperative 4th week control radiographs showed union.(B): Fourth finger proximal phalanx fracture postoperative 1st day radiographs

Patients with incomplete union were called for weekly check-ups for imaging. Of the remaining 56 patients, 33 had their mini external fixators removed on the 4th week, 11 on the 5th week, and 12 on the 6th week. Hand ROM exercises were started on the patients whose fixators were removed. After removing the mini external fixator, patients were called for check-ups at regular intervals, and their joint movements at their last check-up and Total Active Joint Range of Motion (Strickland-Glogovac finger function scale) scoring were evaluated at their follow-up.

Statistical Analysis

Patient data collected within the scope of the study were analyzed with the IBM Statistical Package for the Social Sciences (SPSS) for Windows 26.0 (IBM Corp., Armonk, NY) package program. Frequency and percentage for categorical data and mean and standard deviation for continuous data were given as descriptive values. For comparisons between groups, the “Independent Sample T-test” was used for two groups, and the “Pearson Chi-Square Test” was used to compare categorical variables. The results were considered statistically significant when the p-value was less than 0.05.

Results

This retrospective analysis evaluated 111 patients who underwent external fixation for phalanx and metacarpal bone fractures. Regarding gender distribution, 95 were male, and 16 were female. The mean age was 34.3 years (range 8–78 years). Fractures occurred in 78 patients due to work accidents, 19 patients due to home accidents, 5 patients due to traffic accidents, and nine due to falls (Table - 6). The average follow-up period of the patients was 23.1 months (range 8–40 months) (Table 1). The patients were operated on in the first three days after their trauma. Fifty-one patients had right-hand injuries, and 60 had left-hand injuries. Seventeen (15.3%) of the patients had metacarpal fractures, and 94 (84.7%) had phalanx fractures. Of the 47%, metacarpal fractures were 2nd metacarpal fractures. Twenty-six (27.6%) of the 94 patients with phalanx fractures had 5th finger fractures. When the patients were evaluated according to their ages, one patient was between 0-9 years old, 24 patients were between 10-19

years old, 23 patients were between 20-29 years old, 25 patients were between 30-39 years old, 20 patients were between 40-49 years old, eight patients were between 50-59 years old, eight patients were between 60-69 years old, and two patients were between 70-79 years old (Table 2).

Table 1: Demographic characteristics of the patients participating in the study

Mean Age	34.3 (8 – 78)
Gender	95 M / 16 F
Involvement (Right/Left)	51 / 60
Injury Mechanism	Work Accident 78
	Domestic Accident 19
	Traffic Injury 5
	Fall 9
Fracture localization	Phalanx Fracture 94
	Metacarpal Fracture 17
Median Follow-up	23.1 months (8–40)

Table 2: Distribution of the patients according to age according to the 15.3-Glogovac finger function scale

Age	Very Good	Good	Moderate	Low
0-9			1	
10-19	20	3	1	
20-29	13	4	4	2
30-39	9	10	4	2
40-49	3	9	6	2
50-59		6	2	
60-69		3	2	3
70-79		1		1

In 54 patients (57.4%) with phalanx fractures, there were proximal phalanx fractures in 21 (22.3%) and distal phalanx fractures in 19 (20.2%). In 9 of 111 patients (8.1%), there was a Gustilo Anderson type 1 open fracture. The fracture was at the middle phalanx level in 5 patients with open fractures (55.5%). The patients were followed up radiologically for a mean of 3.8 weeks (range 3–6 weeks). In cases where the union was assessed, the patients were called for a control visit one month after removing the mini external fixator, and the patients were evaluated radiologically and clinically. Nonunion was detected in 11 patients. Of the patients with nonunion, 2 had open fractures, and 1 had a comminuted fracture. Patients with nonunion were subsequently treated with graft and plate-screw osteosynthesis. The joint range of motion was assessed using the Strickland-Glogovac finger function scale, which evaluates the total active joint range of motion (Table 3).

Table 3: Distribution of the number of patients participating in the study according to the Strickland-Glogovac finger function scale

Strickland-Glogovac finger function scale	n
Excellent	45
Good	36
Moderate	20
Poor	10

According to the Strickland–Glogovac finger function scale, the number of patients with active joint range of motion >150 (excellent) was 45, the number of patients with 125–149 (good) was 36, the number of patients with 90–124 (moderate) was 20, and the number of patients with <90 (poor) was 10. Overall, excellent and good results were found in 81 patients (Table 3 & Table 4).

Table 4: Distribution of the Strickland-Glogovac finger function scale according to the fracture location and the number of patients participating in the study

	Excellent	Good	Moderate	Poor	Total
Intraarticular	19	7	2	3	31
Extraarticular	26	29	18	7	80

When the patients were classified according to their ages and the Strickland-Glogovac finger function scales were compared, it was found that one patient between the ages of 0–9 had good results, 20 of 24 patients between the ages of 10–19 had excellent results, 3 had good results, and 1 had fair results, 1 of 23 patients between the ages of 20–29 had excellent results, 4 had good results, 4 had fair results, and 2 had poor results, 9 of 25 patients between the ages of 30–39 had excellent results, 10 had good results, 4 had fair results, and 2 had poor results, 2 of 20 patients between the ages of 40–49 had excellent results, 9 had good results, 6 had fair results, and 2 had poor results, eight patients between the ages of 50–59 had good results, 2 had fair results, 3 of 8 patients between the ages of 60–69 had good results, It was determined that two patients had moderate results, 3 had poor results, two patients between the ages of 70–79 had one good result, and 1 had poor results.

Thirty-one patients (27.9%) had intraarticular fractures, and 80 patients (72.1%) had extraarticular fractures. In 19 patients (61.2%)

with intraarticular fractures, excellent results were found; 7 patients (22.5%) had good results, two patients (6.4%) had fair results, and three patients (9.6%) had poor results. In 26 patients (32.5%) with extraarticular fractures, excellent results were found; 29 patients (36.2%) had good results, 18 patients (22.5%) had fair results, and seven patients (8.7%) had poor results. Post-traumatic arthritis was observed in 5 patients (16.1%) with intraarticular fractures.

The Strickland-Glogovac finger function scale was evaluated using external fixator removal times. It was determined that 38 of 55 patients whose external fixator removal time was 3 weeks had excellent results, 6 had good results, 11 had fair results; 7 of 33 patients whose external fixator removal time was 4 weeks had excellent results, 18 had good results, 5 had fair results, and 3 had poor results; 6 of 11 patients whose 5-week follow-up time was 5 weeks had good results, 5 had fair results; 1 of 12 patients whose 6-week follow-up time was 6 weeks had good results, 4 had fair results, and 7 had poor results.

The number of patients working in the preoperative period was 86, the mean age was 29.1, the mean follow-up time was 26.4 months, the number of patients who returned to work was 71, and the mean return to work time was 2.2 months (range 1–10 months). No union was found in 11 patients; 2 patients with nonunion had open fractures, and one had comminuted fractures. Apart from these three patients, five patients with nonunion were found to be over 60 years of age. No factor affecting nonunion was found in the other three patients.

Three of the patients had comminuted fractures, and despite being under 50 years of age, two had union, and one had no union. According to the Strickland—Glogovac finger function scale, the patients with no union had poor range of motion, while those with union had good results. During the follow-up period, three patients were reoperated due to implant insufficiency. It was determined that the implant insufficiency of these patients was patient-related (implants could not be removed at their request). Therefore, the patients were reoperated. There were no problems in union and range of motion in the three reoperated patients. Apart from implant failure and union, no complications such as pin tract infection, osteomyelitis, or neurological and vascular damage were observed in the patients.

Discussion

The most common fractures in our body are fractures of the metacarpals and phalanges. This frequency is 10% of all fractures or 1/3 of all hand injuries. 14% of all emergencies are hand fractures and dislocations [1–3]. Most metacarpal and phalangeal fractures can be treated conservatively. However, surgical treatment is the preferred option for some unstable fractures. Two types of fixation options exist for hand region fractures: internal fixation according to AO standards and external fixation in fractures with open, unstable fractures and severe soft tissue injuries [8].

Although plate-screw fixation used for open reduction internal fixation provides good stability, it can cause soft tissue damage and progressive devascularization of bone fragments [9, 10]. The least invasive intervention in the surgical treatment of hand region fractures is fixation with k-wires. After closed reduction, fixation with K wires minimizes soft tissue damage and does not disrupt bone blood flow. In the early 1900s, Parkhill in the USA and Lambotte in Belgium performed the first external fixator applications in the hand region without knowing each other. The external fixator applied in the hand region has undergone many changes and developments until today. Today, sophisticated miniature devices have replaced hand-made external fixators [11]. Mini external fixators do not require open reduction and can be applied from safe areas, so they do not cause soft tissue damage, are easy to use, and allow sufficient reduction to provide standard bone length in multi-part fractures. Despite all these advantages, some studies have not achieved satisfactory results. The inadequacy in these studies is thought to be due to the inadequacy of the mini external fixator system. The small diameter of the fixator pins is also effective in insufficient rigidity [11, 12].

A comparative biomechanical study conducted by Tun et al. [13] using mini external fixators found no loosening in the pins compared to similar devices. They stated that mini external fixators

were found to be less rigid than comparable devices. However, the pins were not loosened. The same study noted that using mini external fixators in hand fractures provides versatility in surgical treatment. Our analysis indicated that the mini external fixator technique should be preferred more among surgical treatment techniques because it is easy, fast to apply, cheap, and allows early mobilization. In our study, it was seen that there were 72.9% successful results. When the literature was reviewed, it was determined that our study was compatible with the literature.

In many studies, mini external fixators have been used in open complicated fractures, fractures with serious soft tissue damage, severely contaminated fractures, intra-articular fractures, and fractures with significant bone loss. Some authors have advocated that mini external fixators should also be used in closed simple fractures. Schuind and colleagues applied standard mini external fixators to uncomplicated hand region fractures, especially closed metacarpal fractures [14]. Our study used external fixators to close simple fractures, leaving fracture characteristics in the background. Of 111 patients, 45 (40.5%) had excellent functional results, and 36 (32.4%) had good functional results.

Clinically satisfactory results are obtained with the use of mini external fixators in all types of hand region fractures, including those with severe soft tissue injuries and open, complicated, contaminated, intra-articular multi-fragmented fractures. The biggest problem in external fixator applications is that they cause soft tissue contractures. For this reason, it is a surgical method preferred as a secondary option by surgeons. It has been demonstrated that mini external fixator applications have good results by rendering acute fractures painless quickly and allowing early mobilization. In one study, mini external fixator results were successful in fracture-dislocations of the neglected PIP joint [15].

A study by Yaseen et al. determined that 66.07% of 56 patients had excellent functional results, 16.07% had good functional results, 10.71% had moderate functional results, and 7.14% had poor functional results. In this study, union was observed in 51 (91.07%) patients, and nonunion was detected in 5 (8.93%) patients [16]. Our analysis detected nonunion in 11 (9.99%) of 111 patients. In a study conducted by Thakur et al., it was determined that 98% of patients had a union, 68% had excellent functional results, 22% had good functional results, 8% had moderate functional results, and 2% had poor functional results [17]. Li et al. [18] reported that (n=26) with intra-articular fractures, eight patients (30.9%) had excellent functional results, 13 patients (50%) had good functional results, and three patients (11.5%) had moderate functional results. Two patients (7.6%) had poor functional results.

A study by Dailiana et al. [19] with 33 patients found that the results were sufficiently good. It was determined that none of the patients in the study group had any changes in their activities or occupations at the end of treatment. Dailiana et al. [20] found high efficacy and good functional results in patients who underwent mini external fixation for intra-articular and complicated fractures. Margic [21] found 25% nonunion and 62.5% moderate and poor functional results. It was thought that the poor results in this study may be due to the small number of patients, the selection of patients with open fractures and segmental bone tissue loss with severe soft tissue injuries, and the properties of the materials used being inadequate compared to the mini external fixators used today. A study by Ahmad et al. [22] determined that 66.07% of 56 patients had excellent functional results, 16.07% had good functional results, 10.71% had moderate functional results, and 7.14% had poor functional results. In this study, union was observed in 51 (91.07%) patients, and nonunion was detected in 5 (8.93%) patients. Our analysis detected nonunion in 11 (9.99%) of 111 patients. In a study by Gupta et al. [23], 6 out of 20 patients had excellent, and 4 had good results. Although satisfactory results were obtained in 50% of the patients, the results were found to be unsatisfactory in the rest. In this study, it is thought that the results were not good enough because ten patients had open fractures, and seven patients had intra-articular fractures. In a study by Gupta et al., 45.1% of the patients had excellent results, 41.9% had good results, 9.6% had moderate results, and 3.2% had poor results. In this study, 6.4% of the patients had nonunion [23]. In a study conducted by El-Shaer et al. [24], excellent results were determined in 6 out of 20

patients and good results in 4. Although satisfactory results were obtained in 50% of the patients, the results were found to be unsatisfactory in the rest. In this study, it is thought that the results were not good enough because ten patients had open fractures, and seven patients had intra-articular fractures. Tank and Patel [25] had done a similar study with a spinal needle cap as a uniplanar unilateral fixator for phalangeal fractures; they had stated that “at 3 months follow-up of range of motion and TAM score ion 27 patients 19 had an excellent result, five cases had good range, and three had a fair result.

Our study included a higher number of patients compared to the existing literature. It was observed that most of the patients participating in our research had injuries due to work accidents. The reason for the high number of patients and the fact that the mechanism of injury in most of these patients was work accidents was thought to be related to the fact that our province is one of the few industrial provinces in our country. The number of male workers in our study was high due to the high number of male workers in industrial zones. Treatment of hand injuries occurring in industrial zones should be fast, easy to apply, cheap, and allow early mobilization to shorten the time needed to return to work. Therefore, the mini external fixator technique is suitable for patients undergoing surgery. Distal phalanx fractures are the most common fractures among hand region fractures. However, the majority of these fractures heal with conservative treatment. Fractures requiring surgical treatment are usually fractures at the proximal phalanx level. As in our study, the number of proximal phalanx fractures was high, consistent with the literature.

The extended follow-up period between patients due to patient density made it difficult to follow up on patient recovery. Although it is thought that external fixator applications in simple fractures, not only complicated fractures, may positively affect the study results, we think that external fixator applications frequently cause soft tissue contractures, and this positivity is balanced. Monolateral external fixator use may cause implant failure due to insufficiency instability. In our study, reoperation was required due to implant failure in 3 patients during the follow-up period. The large number of patients and the good results will be a good data quality for comparing other treatment options in future studies.

Conclusion

The mini external fixator technique can be easily applied under local anesthesia and is fast and safer than internal fixation techniques. It can help shorten the treatment of hand injuries and the time to return to work, especially in industrial areas where patient circulation is fast. II. To apply a mini external fixator, the operator must have sufficient knowledge. Given all this information, we believe that the mini external fixator technique, applied with the right indication, the right patient selection, and the right technique, should be used more frequently in tubular bone fractures of the hand region.

Conflict of Interest: No conflict of interest was declared by the authors.

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Ethics Committee Approval: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Ethics committee approval has been granted from Uludag University Faculty of Medicine Clinical Research Ethics Committee with protocol number 2017-17/37, and informed consent has been obtained from all participants.

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REFERENCES

1. Weir TB, Abzug JM, Gaston RG, Osterman MN, Osterman AL. Hand Fractures-Management and the Complications That Inevitably Occur: Metacarpal Fractures. Instr Course Lect. 2024;73:285-304. PMID: 38090905.

2. Christodoulou N, Asimakopoulos D, Kapetanos K, Seah M, Khan W. Principles of management of hand fractures. J Perioper Pract. 2023;33(11):342-9. doi: 10.1177/17504589221119739.

3. Poggetti A, Fagetti A, Lauri G, Cherubino M, Borelli PP, Pfanner S. Outcomes of 173 metacarpal and phalangeal fractures treated by intramedullary headless screw fixation with a 4-year follow-up. J Hand Surg Eur Vol. 2021;46(5):466-70. doi: 10.1177/1753193420980324.

4. Ahmad S, Gupta T, Ansari S, Jain A, Barik S, Singh V. Intramedullary Crossed K-wire Fixation for the Hand Fractures is a Useful Treatment Modality: A Prospective Observational Study. Strategies Trauma Limb Reconstr. 2022;17(2):74-80. doi: 10.5005/jp-journals-10080-1556.

5. Korkmaz O, Abourdan J, Birinci M, Bostanci B, Kara A. The Use of External Fixator and Iliac Crest Bone Graft in Traumatic Metacarpal Bone Defect. J Orthop Case Rep. 2022;12(12):43-49. doi: 10.13107/jocr.2022.v12.i12.3458.

6. Hadeed A, Werntz RL, Varacallo MA. External Fixation Principles and Overview. 2023 Aug 4. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan- PMID: 31613474.

7. Malik S, Herron T, Taqi M, Rosenberg N. Fifth Metacarpal Fracture. 2024 Feb 24. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan–. PMID: 29261999.

8. McDaniel DJ, Rehman UH. Phalanx Fractures of the Hand. 2023 Aug 8. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan–. PMID: 32491557.

9. Akdemir M, Kiliç AĪ, Kurt C, Çapkin S. Open Reduction and Plate Fixation, External Fixator, and Conservative Treatment for Intra-articular Distal Radius Fractures. Cureus. 2024;16(1):e52014. doi: 10.7759/cureus.52014.

10. Kamil R, McKenna E, Romeo P, Burke O, Zakusylo A, Andemichael A, et al. The Role of External Fixation in the Treatment of Distal Radius Fractures. Cureus. 2024;16(7):e64346. doi: 10.7759/cureus.64346.

11. Lee BJ, Lee CH, Lee YH, Woo S. Intramedullary fixation of metacarpal and phalangeal bone fractures with bioabsorbable Mg K-wire in 20 cases. Eur J Orthop Surg Traumatol. 2023;33(7):2911-20. doi: 10.1007/s00590-023-03503-3.

12. Widanage KND, De Silva MJ, Dulantha Lalitharatne T, Bull AMJ, Gopura RARC. Developments in circular external fixators: A review. Injury. 2023 Dec;54(12):111157. doi: 10.1016/j.injury.2023.111157.

13. Tun S, Sekiya JK, Goldstein SA, Jebson PJ. A comparative study of mini-external fixation systems used to treat unstable metacarpal fractures. Am J Orthop (Belle Mead NJ). 2004 Sep;33(9):433-8. PMID: 15509107.

14. Li Y, Zhang H. Effect of Joint Use of External Minifixator and Titanium Lockplate on Total Active Motion Range and Hand Function Recovery in Comminuted Metacarpal and Phalanx Fracture Patients. J Healthc Eng. 2022;2022:3566364. doi: 10.1155/2022/3566364.

15. Houshian S, Ghani A, Chikkamuniyappa C, Sakka SA. Single-stage distraction correction for neglected dorsal fracture dislocations of the proximal interphalangeal joint: a report of eight cases. J Hand Surg Eur Vol. 2008;33(3):345-9. doi: 10.1177/1753193408091351.

16. Yaseen G, Qureshi KK, Hussain A. Results of mini external fixator in metacarpal and phalangeal fractures: Mini External Fixator in Metacarpal And Phalangeal Fractures. Pak Armed Forces Med J. 2016;66(5):715-19.

17. Thakur A. Operative management of metacarpal and phalangeal fractures. J Med Educ Res. 2008; 10(1):1-9.

18. Li WJ, Tian W, Tian GL, Chen SL, Zhang CQ, Xue YH, et al. Management of intra-articular fracture of the fingers via mini external fixator combined with limited internal fixation. Chin Med J (Engl). 2009;122(21):2616-9. PMID: 19951580.

19. Drenth DJ, Klasen HJ. External fixation for phalangeal and metacarpal fractures. J Bone Joint Surg Br. 1998;80(2):227-30. doi: 10.1302/0301-620x.80b2.8131

20. Dailiana Z, Agorastakis D, Varitimidis S, et al. Use of a mini-external fixator for the treatment of hand fractures. J Hand Surg Am. 2009;34(4):630-636. doi:10.1016/j.jhsa.2008.12.017.

21. Margić K. External fixation of closed metacarpal and phalangeal fractures of digits. A prospective study of one hundred consecutive patients. J Hand Surg Br. 2006;31(1):30-40. doi: 10.1016/j.jhsb.2005.09.013.

22. Ahmad S, Gupta T, Ansari S, Jain A, Barik S, Singh V. Intramedullary Crossed K-wire Fixation for the Hand Fractures is a Useful Treatment Modality: A Prospective Observational Study. Strategies Trauma Limb Reconstr. 2022;17(2):74-80. doi: 10.5005/jp-journals-10080-1556.

23. Gupta R, Singh R, Siwach R, Sangwan S, Magu NK, Diwan R. Evaluation of surgical stabilization of metacarpal and phalangeal fractures of hand. Indian J Orthop. 2007;41(3):224-9. doi: 10.4103/0019-5413.33687.

24. El-Shaera AF, Shams El-Deenb AF, El-Deen Abu Husseinb AS , et al. Results of management of recent fractures of phalanges of the hand by a mini external fixator. Menoufi a Medical Journal 2015, 28:965–70. doi: 10.4103/1110-2098.173689

25. Tank PM and Patel NB. Simple low cost static external fixators for phalangeal fractures of hand. Int J Orthop Sci. 2018;4(1):714-20. doi: 10.22271/ortho.2018.v4.i1k.103