

Evaluation of treatment processes in childhood fifth metacarpal bone (Boxer) fractures with QuickDASH scoring system

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Abstract. – OBJECTIVE: Metacarpal fractures are one of the most common orthopedic injuries seen in emergency departments. Despite this, only a few data have been published about the epidemiology of metacarpal fractures. Simple radiographs are the standard imaging modality used to diagnose boxer fractures and determine the degree of angulation. Fractures and angulations should be identified by anteroposterior and lateral radiographs. The aim of this study was to follow the healing after closed reduction of fifth metacarpal neck fractures in a pediatric population using the QuickDASH score to determine whether it results in clinically significant improvement.

SUBJECTS AND METHODS: Between 2020 and 2022, our clinical record database for all metacarpal fractures treated at our institution was searched retrospectively every month. Children aged 18 years and younger with fifth metacarpal neck fractures treated with closed reduction and immobilization in our tertiary care emergency clinic were retrospectively reviewed.

RESULTS: 52 pediatric patients were included in the study. The mean age at the time of injury was 14.04 years (SD=2.10, range=10-18 years). 92.30% (n=48) of the patients were male, and 7.70% (n=4) were female.

CONCLUSIONS: Accurate diagnosis and appropriate treatment are crucial in the management of childhood fifth metacarpal fractures to ensure proper healing, prevent long-term complications, and facilitate optimal functional recovery.

Key Words:

Emergency department, Boxer fracture, Metacarpal fracture, Trauma.

Introduction

Metacarpal fractures are one of the most common orthopedic injuries seen in emergency de-

partments. Despite this, only a few data have been published about the epidemiology of metacarpal fractures. The two most common mechanisms of injury are accidental falls and direct impacts¹. The majority of metacarpal fractures are fractures of the fifth metacarpal bone. The lower head or neck of the fifth metacarpal fracture is commonly known as a boxer fracture. It is more common in males than females, and its incidence has been observed^{2,3} to peak in the 10-29 age group. An etiologic study of metacarpal fractures found that the most likely mechanism of injury for patients aged 9-50 years was accidental falls. In the same study, accidental falls were found to be an important risk factor for all ages³.

Simple radiographs are the standard imaging used to diagnose boxer fractures and determine the degree of angulation. Fractures and angulations should be identified by anteroposterior and lateral radiographs. Lateral radiographs should be used to determine and measure the degree of angulation of the metacarpal shaft compared to the midpoint of the fracture fragment⁴.

Computed tomography (CT) is generally not used in the diagnosis of metacarpal fractures; however, occult fractures can be detected with CT in patients with high clinical suspicion of fracture and negative plain radiographs⁵. Recent studies⁶ suggest that bedside ultrasound can also be used to make the initial diagnosis of boxer fractures.

A significant amount of deformity in the sagittal plane can be tolerated without functional deficit, especially in fifth metacarpal neck fractures. Typically, acceptable angulation limits are 40° for fifth metacarpal neck fractures⁷. Biomechanical studies⁸ have shown that angulation greater than 30° leads to impaired grip strength and range of motion. However, case reports and randomized controlled trials⁹ have also shown that

with early closed reduction and immobilization, patients with angulations up to 70° can be treated with acceptable functional outcomes. In addition, there is a high potential for remodeling in young children given the proximity of the fracture to the distal metacarpal physis; higher angulation limits can potentially occur and are well tolerated^{9,10}.

Most fifth metacarpal fractures are treated conservatively with ulnar gutter splinting (UGS). Closed treatment of these fractures with immobilization can lead to complications such as malunion, delayed extension, stiffness, and decreased grip strength¹¹. Although satisfactory clinical results have been reported with the application of the traditional UGS splint, it can lead to patient discomfort due to restriction of wrist and finger movements¹². Different functional splinting and soft wrapping/bandaging treatment methods have been described to overcome the patient's discomfort, and the majority of studies have reported satisfactory results¹¹. However, open 5th metacarpal fractures and intra-articular fractures resulting from closed injuries almost always require operative treatment. Operative techniques include closed reduction and percutaneous fixation with Kirschner wires (K-wires) or open reduction and internal fixation using K-wires, plates, and screws¹³.

In this study, we aimed to determine whether closed reduction of the fifth metacarpal neck fracture in pediatric patients who underwent closed reduction in the emergency department resulted in a significant functional improvement using the QuickDASH score.

Subjects and Methods

Study Design and Data Collection

Children aged 18 years and younger with fifth metacarpal neck fractures who were treated conservatively and discharged from our tertiary care emergency clinic were retrospectively analyzed. Data were obtained from the hospital data processing system regularly every month during a one-year period. The data of the patients eligible for the study were evaluated. Their parents were called from the phones registered in the hospital data processing system. The parents were informed about the study and asked whether patients could participate in it.

All patients included in the study were assigned numbers to ensure confidentiality and privacy of participant data. Since the patients

were under 18 years of age, consent was obtained from the parents of the patients who participated in the survey. The patients included in the study were invited to participate in the survey at 1, 3, and 6 months after the end of conservative treatment in our room in the emergency department, which was accepted as the doctor's restroom in the emergency department. Accompanied by their parents, the patients were asked the survey questions one by one in an understandable way. The data of the patients were then recorded.

Functional outcomes were measured with a shorter version of the Disabilities of the Arm, Shoulder, and Hand (QuickDASH) Questionnaire^{14,15}. The valid Turkish version of the QuickDASH questionnaire was used in the study¹⁶.

Patients treated in the emergency department, multi-trauma, multiple metacarpal fractures, open fractures, patients undergoing surgical intervention, patients who did not want to participate in the survey, and patients whose data could not be accessed were excluded from the study. The manuscript was prepared in accordance with STROBE guidelines.

The research protocol was reviewed and approved by the Clinical Research Ethics Committee of the Health Sciences University Gazi Yaşargil Training and Research Hospital. The study was conducted according to the Declaration of Helsinki.

Statistical Analysis

The data were analyzed using the IBM SPSS Statistics 24 package program (IBM Corp., Armonk, NY, USA). Descriptive statistical methods such as frequency, percentage, arithmetic mean and standard deviation, and minimum and maximum values were used in the evaluation of age, gender, and trauma mechanism data obtained within the scope of the study. Categorical data were analyzed using percentage and frequency values. An Independent sample *t*-test was used to evaluate the QuickDASH scores of the patients according to gender at 1, 3, and 6 months. The Pearson χ^2 test was used for intergroup comparisons. *p*-values below 0.05 were considered significant in statistical analyses.

Results

A total of 52 pediatric patients were included in the study (Table I). The mean age at the time of injury was 14.04 years (SD=2.10, range=10-18

Table I. Demographic data.

Age	14.04 ± 2.10 (Min=10, Max=18)		
Gender			
Male	48 (92.30%)		
Female	4 (7.70%)		
Trauma Mechanism	Punching	Falling	p-value**
Female	3 (7.3%)	1 (9.1%)	0.626
Male	38 (92.7%)	10 (90.9%)	

**Chi-Square test.

years). 92.30% (n=48) of the patients were male, and 7.70% (n=4) were female. Regarding the mechanism of injury, 78.84% of patients (n=41) had fractures as a result of punching, and 21.16% of patients (n=11) had fractures as a result of falling. While 9.09% (n=1) of the patients who came after a fall were female, 90.91% (n=10) were male. While 7.31% (n=3) of the patients admitted after punching were female, 92.69% (n=38) were male.

When we evaluated QuickDASH scores according to the cause of trauma and gender (Table II), the mean QuickDASH scores of the patients at 1, 3, and 6 months were 84.40±1.65, 38.11±1.83, and 1.88±0.67, respectively. Sixth-month QuickDASH scores showed that 82.69% (n=43) patients had completely normalized, and 17.31% (n=9) patients had incomplete recovery. When QuickDASH scores were analyzed according to gender, no statistical difference was found (*p*-values were 0.102, 0.326, and 0.424, respectively). According to the independent sample *t*-test in which we compared the QuickDASH scoring with the mechanism of injury, the 1st- and 3rd-month scores

were statistically significant, while the 6th-month score was statistically insignificant (*p*≤0.000, *p*≤0.000, *p*=0.261).

Discussion

In this study, we evaluated the feasibility of using the QuickDASH scoring system to evaluate the post-treatment follow-up of pediatric patients with fifth metacarpal neck fractures. QuickDASH is a short form of the 30-item DASH questionnaire, reduced to 11 items. It is a valid and reliable scale that measures the degree of difficulty in using the shoulder, arm, wrist, and hand in daily life and evaluates upper extremity problems through physical function and symptoms. It is a patient-reported scale that evaluates symptoms and problems by considering activity and participation. The raw score obtained from the scoring according to the questions given in a five-point Likert scale is converted with the formula [(raw score/number of questions ticked-1)*25]. The total score rang-

Table II. Analysis of QuickDASH scores by cause of trauma and gender.

	Punching	Falling	p-value*
QuickDASH score			
Month 1	88.83 ± 8.94	67.88 ± 5.43	<i>p</i> ≤ 0.000
Month 3	41.46 ± 12.18	25.62 ± 8.98	<i>p</i> ≤ 0.000
Month 6	2.27 ± 5.36	0.41 ± 1.37	<i>p</i> = 0.261
	Female	Male	
QuickDASH score			
Month 1	74.99 ± 6.69	85.18 ± 12.01	0.102
Month 3	31.81 ± 12.44	38.63 ± 13.27	0.326
Month 6	0	2.04 ± 5.01	0.424

*Independent Samples *t*-test.

es from 0 to 100, with a higher score indicating greater functional limitation. Healing and rehabilitation of fifth metacarpal fractures in childhood play a crucial role in restoring functionality and preventing long-term complications.

Uncomplicated fifth metacarpal fractures are usually treated with immobilization, splinting, or adjacent banding with similar functional outcomes. Fractures with significant angulation require closed reduction and splinting. The acceptable degree of angulation is controversial among authors; many studies¹⁷ have shown that 5th metacarpal bone fractures with angulation up to 75° can heal without any functional problems.

All of the cases examined in our study were patients who were followed up using the immobilization and splinting method. While conducting this study, we were not involved in the treatment processes of the patients after the initial treatment in the emergency department. The treatment of the patients was continued by the orthopedic clinic. Therefore, we could not follow the fracture angulations of the patients, which was one of the limitations for us. In the study, we aimed to see how QuickDASH scores at 1, 3, and 6 months can show functional improvement in patients. As a result, we found that there was a decrease in QuickDASH scores of our patients at 1, 3, and 6 months, and the functional limitation of the hand gradually decreased over time.

We found that the QuickDASH score had a higher mean in injuries caused by punching and that recovery was delayed compared to patients followed up for falls. We think that this situation may probably occur as a result of higher energy coming in the mechanism of fracture formation.

In a 54-patient study by Lee et al⁹, the mean age at the time of injury was 14.8 years (SD=2.3, range=9-18 years). 50 (93%) patients were male, and 4 (7%) were female. The mechanism of injury was a punch in 37 patients (70%), sports in 10 patients (19%), and fall in 5 patients (9%). In another study by Kaynak et al¹¹, 30 patients (75%) were evaluated as a punch, and 10 patients (25%) as a fall as a mechanism of injury. In our study, there were 48 (92.30%) male and 4 (7.70%) female patients. The mechanism of injury was a punch in 41 patients (78.85%) and a fall in 11 patients (21.15%). Similarly, when we looked at the literature, it was observed that 5th metacarpal fractures occurred more frequently as a result of punching and were more common in the male gender.

Limitations

Since the study was organized retrospectively and we were not involved in the ongoing treatment and follow-up processes of the patients after their initial treatment at an emergency medicine clinic, we could not evaluate the bone fracture angulation processes of the patients. These were the main limiting factors for our study.

Conclusions

Accurate diagnosis and appropriate treatment are very important in the treatment of pediatric fifth metacarpal fractures to ensure proper healing, prevent long-term complications, and facilitate optimal functional recovery. The psychological impact of metacarpal fractures on children should not be ignored. Children with fifth metacarpal fractures may face emotional and psychological difficulties during their recovery. Supportive measures such as counseling and age-appropriate explanations about the healing process will help children cope with the psychological effects of metacarpal fractures and gain the strength to cope with the challenges they will face during their rehabilitation.

Informed Consent

As this was a retrospective study consisting of a review of hospital records and radiographs, specific informed consent was not required. Questionnaires were administered after consent was obtained to calculate the QuickDASH score, with which we assessed the duration of treatment with patients.

Conflict of Interest

The authors declare no potential conflicts of interest related to the research, authorship, and publication of this article.

Funding

None.

Ethics Approval

Our study was approved by the Health Sciences University Gazi Yaşargil Training and Research Hospital Clinical Research Ethics Committee on 24/05/2019 with the number 278. All procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national) and the 1975 Declaration of Helsinki, revised in 2008.

Authors' Contributions

ÖA: Conceptualization, methodology, investigation, software, resources, data curation, writing -original draft MT: Software, resources, writing -review and editing, supervision.

Data Availability

The data supporting the conclusion of this article will be available to the authors without undue reservation.

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