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Demographic features and difficulties in rehabilitation in patients referred to hand rehabilitation unit for phalangeal fractures

El rehabilitasyonu için başvuran falanks kırıklı hastaların özellikleri ve rehabilitasyon sorunları

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Amaç: Elde falanks kırığı olan hastalarda demografik ve mesleki profiller, yaralanma nedenleri ve tipleri ve uygulanan rehabilitasyon sonuçları değerlendirildi.

Çalışma planı: Falanks kırığı nedeniyle el rehabilitasyon ünitesine başvuran 62 hasta (54 erkek, 8 kadın; ort. yaş 28±13; dağılım 4-59) çalışmaya alındı. Toplam 91 parmakta yaralanma vardı. Hastalar demografik özellikler, yaralanma nedeni ve yeri, ameliyat tipi, ameliyat ile rehabilitasyon arasındaki süre ve takip süresi açısından değerlendirildi. Rehabilitasyon sonunda ilgili eklem ve parmak için hareket açıklıkları Strickland-Glogovac sınıflandırmasına göre değerlendirildi.

Sonuçlar: Hastaların büyük çoğunluğunda yaralanma iş kazası sonucu meydana gelmişti. Diğer büyük grubu oluşturan öğrencilerde ise kırıklar sportif yaralanma veya düşme sonucu oluşmuştu. Altmış hasta (%96.8) sağ elini ağırlıklı olarak kullanmaktaydı. Kırıklar 29 hastada (%46.8) aktif olarak kullanılan elde idi. Hastaların büyük çoğunluğu (n=45) ilkokul mezunu idi. En sık yaralanma mekanizması ağır iş makinesinde yaralanma idi (n=18). En çok etkilenen parmak üçüncü parmak (n=25, %27.5), en çok etkilenen falanks da proksimal falankstı (n=59, %56.7). Hastaların sadece 27'sinin (%43.6) yeterli takibi vardı. Ortalama takip süresi 79.7±46.6 gün (dağılım 30-254 gün) idi. Rehabilitasyon sonunda hareket açıklığı, ilgili eklem için başparmakta 45.0±22.9°, diğer parmaklarda 31.3±22.5°; parmağın tümü için ise başparmakta 63.3±16.1°, diğer parmaklarda 122±60.3° bulundu.

Çıkarımlar: Çalışmamız falaks kırıklarının tedavi ve rehabilitasyonu ile ilgili, özellikle tedavi ve takipte yaşanan sorunlar üzerine yararlı bulgular ortaya koymuştur.

Anahtar sözcükler: Parmak yaralanmaları/cerrahi/rehabilitasyon; hareket açıklığı, eklem; başparmak/yaralanma.

Objectives: We evaluated demographic and occupational features of patients with phalangeal fractures of the hand, etiologies and types of injuries, and the results of rehabilitation.

Methods: The study included 91 fingers of 62 patients (54 males, 8 females; mean age 28±13 years; range 4 to 59 years) who were referred to our hand rehabilitation unit for phalangeal fractures. Demographic features, the cause and localization of injury, the type of surgery, time from surgery to rehabilitation, and the follow-up period were determined. At the end of rehabilitation, range of motion (ROM) of the phalangeal joint and total ROM of the injured fingers were assessed using the Strickland-Glogovac rating system.

Results: A great majority of injuries were caused by work accidents, followed by sport injuries and falls occurring in students. Sixty patients (96.8%) were right–handed. The fractures occurred in the dominant hand in 29 patients (46.8%). The majority of patients (n=45) were primary school graduates. The most common mechanism of injury was accidents related to heavy work machinery (n=18). The most commonly injured finger and the phalanx were the third finger (n=25, 27.5%) and the proximal phalanx (n=59, 56.7%), respectively. Only 27 patients (43.6%) had a sufficient follow-up with a mean of 79.7±46.6 days (range 30 to 254 days). Following rehabilitation, the mean ROM and the total ROM were 45.0±22.9° and 63.3±16.1° for the injured joint and the thumb, and 31.3±22.5° and 122±60.3° for the injured joint and the other fingers, respectively.

Conclusion: Our data provide important insight into appropriate treatment and rehabilitation of phalangeal fractures, in particular, shortcomings in the treatment and follow-up.

Key words: Finger injuries/surgery/rehabilitation; range of motion, articular; thumb/injuries.

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Various factors are defined to determine the importance of total active range of motion (AROM) and its complications in hand fractures. The factors depend on the patient, type of the fracture and type of the treatment.

Age over 50, systemic diseases which give way to infection that impair the recovery of the injury are among the factors that affect the ameloriation of the fracture. The features of the fracture (segmental, multiple, comminuted or with a bone loss), its location (in the joint or in the proximal phalanx), fixation type (plaque) and extended finger immobilization (more than four weeks) are also among the factors which negatively affect the clinical results of the hand fractures.[1-3] In addition, the severity and the size of the injury, injury of the tendon, contamination and a delay in the treatment are critical factors for the result.[4]

The cost of the treatment and absentism from work, occupational shift due to the change in hand abilities as a result of hand injury, demonstrate the financial severity of the injury.[5] In a study conducted with multi-trauma patients, the severity of the hand fractures are determined as the most critical factors in returning to work.[6]

This study aims to evaluate the rehabilitation results retrospectively, to determine the demographical and occupational features of the patients with phalangeal fractures, and to analyse the reasons and types of the injury.

Materials and method

Patients referred to hand rehabilitation unit during the years 1998-2004 were scanned and 62 patients (54 males, 8 females; mean age 28±13 years; range 4-59 years) with phalangeal fractures were included to the study. Age, sex, occupation, education, hand dominance, cause and location of the injury, type of the surgery, time between the surgery and rehabilitation, follow-up time, finger active range of movement (AROM) of the patients after the rehabilitation were recorded. Standard finger goniometer was used for the measurement of AROM. AROM was classified according to the Strickland-Glogovac [7] method (Table 1).

Results

Among the 1004 patients registered to our clinic, incidence of phalangeal fracture was 6.2%. In most of the patients, injury occurred as a job accident. The other major group was students and the fractures occurred as a result of fall or sports injury (Table 2).

Fractures occurred in the dominant hand of 29 patients (46.8%), in the nondominant hand of 33 patients (53.2%). Sixty patients were right-handed (96.8%) and two patients were left-handed.

Patients referred to the rehabilitation unit after an avarage of 7.6 weeks from surgery. A total of 91 fingers were analyzed in sixty two patients. According to the frequency, the most affected finger was the third finger; the most affected phalanx was the proximal phalanx (Table 2).

One finger was fractured in forty three patients (69.4%) and more than one finger was fractured in nineteen patients (30.7%). In twelve patients (19.4%) two phalanxes of the same finger were injured. Etiology of the injury and additional injuries are shown in Table 2.

Most of the additional injuries were tendon and amputation type injuries. Affected tendons were flexor pollisis longus (n=1), flexor digitorum superficialis (n=2), flexor digitorum profundus (n=3) and extensor digitorum communis (n=8). Amputations were from the distal (n=3), proximal (n=2) and middle phalanx (n=1) of all the finger except thumb. It is seen that digital nerve and artery were injured in all of the nerve and artery injuries. Skin lacerations

Table 1. Strickland-Glogovac finger function rating scale[7]

	Total active range of motion		
Result	%	Fingers (°)	Thumb (°)
Excellent	85-100	220-260	119-140
Good	70-84	180-219	98-118
Fair	50-69	130-179	70-97
Poor	<50	<130	<70

Table 2. Education and Occupation of the Patients

Occupation	Worker	11	
	Student	10	
	Self-employed	7	
	Carpenter	7	
	House wife	4	
	Repairman	4	
	Unemployed	4	
	Tailer	3	
	Farmer	2	
	Civil servant	2	
	Technician	2	
	Child	3	
	Driver		1
	Cook	1	
	Designer	1	
Education	Elementary School	45	
	Secondary School	3	
	High School	6	
	Undergraduate	1	
	Illiterate	4	
	Elementary School student	3	

in two patients were treated by wound care. One patient had distal forearm fracture and in one patient was also injured joint capsule of the third. Sixty patients (96.8%) had surgical treatment. Open reduction+internal fixation (n=1), interosseous wiring (n=1), fixation with K-wire (n=58) were the procedurs applied to the patients. Fixation with K-wire was applied with closed method in 26 patients and with open method in 32 patients. Patients who had K-wire with open method had also additional injury. Four of the patients had surgery one day after the trauma, one had after 11 days, one had after 25 days and 56 of the patients had surgery on the same day of the trauma. Two patients who were treated conservatively had open fracture.

Only 27 (43.6%) of the patients who had fractures could have been followed-up for more than four weeks. Other 35 patients (56.5%) generally could not be followed-up within one or two days or after the second visit. Two of the patients were living out of the city and went back to their hometown, and one patient was sent to plastic surgery due to an open wound and did not apply yet. Other than these data, the reasons of lost follow-up could not be

Table 3. Most affected fingers and phalanxes, causes of injuries and additional injuries

	Number	Percentage
Affected finger (n=91)		
1. finger	11	12.1
2. finger	14	15.4
3. finger	25	27.5
4. finger	22	24.2
5. finger	19	20.9
Affected phalanx (n=104)		
Proximal	59	56.7
Middle	32	30.8
Distal	13	12.5
Causes of Injury		
Machinery	18	29.0
Crush of a heavy object	13	21.0
Jam in the door	9	14.5
Fall	7	11.3
Traffic accident	7	11.3
Cutting objects	2	3.2
Ball crush	2	3.2
Other	4	6.5
Additional Injuries		
Tendon	14	
Amputation	6	
Crush	4	
Tendon+nerve+artery	4	
Tendon+nerve+ampute	2	
Lateral bandage laceration	3	
Laceration	2	
Other	2	

determined. When compared to monitored group, the mean age was lower (26±13 vs 31±13) in the lost follow-up group; the number of primary school graduates (30 and 15), self-employed and workers were higher in the lost follow-up group than the monitored group (15 and 3). It was also determined that the rehabilitation began later (8.2±5.4 weeks vs 6.6±2.2 weeks) in these patients.

The mean follow-up duration of the 27 patients was 79.7±46.6 days (range between 30-254 days). According to the control x-rays taken before the exercise program and physical treatment, healing of the fractures were insufficient in eight patients (29.6%), sufficient in 19 patients (70.4%). In five of the eight patients with insufficient healing of the fractures, surgery was not considered, and rehabilitation was administered. One patient due to the

increased angulation, and two patients due to unhealing of the fractures were reoperated. Three of the five patients who were not considered for surgery had basis fracture of the D1 proximal phalanx. In the patient with increased angulation there were D3, and in the patients with insufficient healing of the fractures there were D4 middle phalangeal fractures.

In five of the patients there were intraarticular joint fractures. Two of them were in the distal interphalangeal (DIP) joint, three of them were in the proximal interphalangeal (PIP) joint.

Except three patients 15 sessions of physical therapy and exercise was applied to all of the patients and also home exercise was given. Three patients in good condition were followed with only home exercise program. Fourteen patients (51.9) were applied splints. These were traction splint (n=5) to increase AROM, night splint (n=6) and antiedema splint (n=3).

In the active range of movement measurements done after the rehabilitation, AROM was 45.0±22.9 degrees in the first finger and 31.3±22.5 degrees in the other fingers. AROM for the whole finger was 63.3±16.1 degrees in the first finger and 122±60.3 degrees in the other fingers. When the results compared according to Strickland-Glogovac classification (7), both the thumb and the other fingers' functional conditions were poor. Two of the patients in the follow-up group were in the childhood.

In the fractured fingers (D2 and D4) of these patients (age 8 and 9) ARM was respectively 220° (perfect) and 175° (median). Three patients had ulnar deviation over 10 degrees.

After the follow-up period, seven patients (25.9%) were referred to plastic or orthopedic surgery for another surgery. Reason for another surgery was tenolysis in three patients, insufficient healing of the fractures in two patients and increased in angulation after the rehabilitation in one patient. One of the patients was already referred patient to increase AROM before the tenoraphy and neurorapy.

Discussion

Phalangeal and metacarpal fractures are the most frequent fractures in the body.[8] The frequency of hand among other fractures ranges between 12.3% and 30%. The frequency of phalangeal fractures among all hand fractures are 6%-18%.[9] We determined that among the patients referred to our hand policlinic, 6.2% of them had phalangeal fracture. Although our study indicated that the most frequent fracture was in the third finger (27.5%), it is widely known that because of the high trauma risk due to their location, fifth and first finger fractures are more common.[9] High percentage of the proximal phalangeal fracture does not confirm with the literature either it is reported that most of the fractures occurred in the distal phalanxes of the first and the third fingers due to the trauma risk.[9,10] Total AROM obtained as a result of the treatment and the rehabilitation is accepted as the crucial indicator of the functional improvement.[5] Study results show that improvement of proximal phalangeal fractures are less when compared to distal phalangeal and metacarpal fractures. Similarly, fractures including distal interphalangeal and metacarbophalangeal joint improve better than the intrafractures of the proximal interphalangeal joint.[5]

In a study which analyzed the metacarpal and phalangeal fractures (n=105) active range of movement which reached up to 220 degrees after follow-up is obtained in 67% of the metacarpal fractures and in only 11% of the phalangeal fractures.[11] In addition, the incidence of rigidity, angulation and rotation are higher in proximal phalangeal fractures.[12] The cause of the poor total active range of movement gains based on the Stricland-Glogovac rating scale may be due to the high percentage (56.7%) of the proximal phalangeal fractures.

Another factor that influence the results is patient's age. Decrease in function after the immobilization is seen more frequently in adults than in children.[13] Although the effect of the age cannot be evaluated because our study group was composed mostly of adults, total AROM was respectively excellent and fair in two of our child patients.

Additional injuries also affect the result. In 27 patients in the follow-up group, 10 of them had tendon lacerations.

50% patients had tendon injury and this may be the cause of the poor results. Especially flexor and extensor tendon injuries accompanying middle and proximal phalangeal fractures cause poor results.

This situation is more distinctive in the existence of open injuries as the fibroelastic response is dense in these injuries[3,5] Fundamental problems of volar and dorsal combined injuries are in general the formation of adhesions and the joint rigidity. Pulley damage on the volar surface also affects the functional result negatively. When the three groups of patients namely the isolated extensor tendon injury, isolated fracture and the combined extensor tendon injury and the fracture group are compared; perfect result is obtained above 90% of the isolated injury group, whereas it is only 58% in patients in the combined injury group. Isolated and combined artery and nerve injuries and the quality of skin also affect the functional results. Crush injuries cause more problems when compared to dorsal or volar combined injuries because contusion, contraction, lacetation and displacement of the soft and bony tissues in the injury location.[14] Additional injuries were distinctively higher in the follow-up group when compared to the lost follow-up group. Most probably these patients attended the follow-up group because they had more extensive injuries and unfortunately results were unsatisfactory. More than half of our patients did not attend the follow-up process and this limited our study to make further comments.

In phalangeal fractures, the time interval between the fracture and the fixation may also adversely affect the results. We found out that fixation occurred generally within the first 24 hours in the follow-up group. Although some of the critics indicate that time to fixation does not affect the result[5,8] some of them report that fixation done after 24 hours affects the result negatively.[15] Non-union of the fractures is another problem in patients with phalangeal fractures. In a study where 666 phalangeal fractures were analyzed, non-union was reported as 6%.[16] In another study, only one non-union was reported among 24 patients (35 phalange fractures).[17] In our study, 29% insufficient callus formation was reported radiologically of the first evaluation. After the first evaluation, three of these patients were considered for another surgery, five of the patients were not considered for surgery and referred to rehabilitation. It was worth considering that three of the five patients had D1 proximal phalanx basis fracture. It is reported that the frequency of the non-union in this location is 60%.[18,19]

When we sum up our results, 6.2% of the patients referring to hand rehabilitation unit had phalangeal fractures. Injuries occurred slightly more in the non-dominant hand. In most of the patients injury occurred while working and the other major group was students. Most of the injured patients were elementary school graduates. Additional injuries were reported in 60% of the patients and most of them had surgical treatment. Fracture healing was not satisfactory in 30% of the patients having rehabilitation. A significant number of the patients failed to come to the follow-up and only 43.6% continued the rehabilitation. 60% of the follow-up patients needed splint. At the end of the rehabilitation period, AROM obtained in the affected finger joint was found to be lower than the optimum range.

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