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RETROSPECTIVE EVALUATION OF PATIENTS WITH TRAUMATIC HAND INJURIES

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Abstract

Objective: This study aimed to retrospectively examine the demographic, etiologic, and clinical characteristics of patients with traumatic hand-wrist injuries and to profile patients with the goal of contributing to preventive measures and protective programs.

Methods: The records of 225 patients who came to the Hand Rehabilitation Unit of our clinic with a traumatic hand injury in the last 5 years were reviewed retrospectively. Many parameters were recorded, including demographic characteristics such as age, sex, and occupation, as well as information about the injured hand, dominant hand, type of injury, injured tendon and zone, number of affected fingers, and associated structures.

Results: The study included 225 patients. Tendon injuries occurred most frequently in the 3rd decade. Of the injuries, 31.1% were caused by occupational accidents and 55.1% occurred in the dominant hand. Of the tendon injuries, 64% were flexor tendon injuries and 32.4% were extensor tendon injuries. Extensor Digitorum Communis (EDC)-3 tendons were involved in 11.6% of extensor tendon injuries, and Flexor Digitorum Superficialis (FDS)-4/Flexor Digitorum Profundus (FDP)-5 tendons were involved in 18.2% of flexor tendon injuries. In nerve injuries, median and ulnar nerves were equally affected (14.2%).

Conclusion: Tendon injuries primarily affect young male workers, resulting in significant disability and an inability to work. Epidemiologic data can expand our knowledge about injury patterns. Occupational training and the prevention of occupational accidents can help patients improve their functional capacity and minimize their economic burden.

Keywords: *Hand, trauma, tendon, injury, retrospective.*

Introduction

As the hand is crucial for most activities of daily living and working, hand injuries can lead to significant functional losses. Loss of hand function resulting from injury to the upper extremities/hands (occupational accidents, injuries caused by sharp instruments, etc.) requires long-term treatment in rehabilitation units. Previous research has reported that 57% of patients with hand injuries are young adults aged 16-35 years. A significant part of hand injuries in these patients are traumatic tendon injuries or peripheral nerve lacerations.[1,2] Traumatic tendon injuries account for 6.6%-8.6% of all musculoskeletal injuries. The most frequently affected group is male workers who are economically active and under 40 years of age.

Patients with hand injuries are usually treated as outpatients, except in severe cases involving multiple lesions in different types of tissues. Hand injuries range from simple soft tissue trauma to amputations, resulting in functional loss and disability in activities of daily living. The treatment of these patients often requires a prolonged period of time and, when performed by unqualified personnel, can have a significant clinical, social, and economic impact on the patient and community, with varying degrees of severity.[3-9] Most of the adverse economic impact can be attributed to productivity loss rather than health expenditure.[10] Therefore, the main goal is to allow the patient to return to work and social life as early as possible and with minimal functional loss.[11-14] Few studies have investigated the epidemiology, determinants, and distribution of hand and wrist injuries. These studies have revealed significant geographical differences. For instance, occupational injuries are most common in Turkey, in contrast with leisure time injuries being common in Denmark.[10,15,16]

Given that traumatic injuries of the hand and wrist are frequent in Turkey and lead to major loss of productivity and function, determining the epidemiologic, demographic, and clinical characteristics associated with these injuries may expand our knowledge of injury patterns and shed light on the prevention and rehabilitation process of future injuries. This, in turn, can play an important role in reducing the loss of productivity and economic burden associated with hand-wrist injuries. In the light of this information, we aimed to retrospectively determine the demographic and clinical characteristics of patients with traumatic hand injuries followed up in our clinic.

Methods

This retrospective study received approval from local ethics committee. The demographic, etiologic, and clinical characteristics of 225 patients with traumatic hand and wrist injuries who presented to the Physical Therapy and Rehabilitation Traumatic Hand Injury Outpatient Clinic over the last 5 years were analyzed. Traumatic hand injuries investigated in the study included injuries to tendons, nerves, and arteries, as well as fractures and combined injuries. Injuries involving three or more of the tendons, nerves, bones, arteries, and vascular structures were considered combined injuries. The study excluded isolated fractures, complete amputations, burn injuries, and congenital and acquired deformities. Demographic characteristics of the patients (age, sex, occupation), dominant hand, injured hand, mechanism of injury, affected anatomical structures, and injured tendons and zones were determined. Flexor tendon injuries were classified using Verdan's classification, while extensor tendon injuries were classified using the International Federation of Societies for Surgery of the Hand criteria.[32,33] When analyzing incidence rates, the age at diagnosis was divided into eight groups: 0-9 years, 10-19 years, 20-29 years, 30-39 years, 40-49 years, 50-59 years, 60-69 years, and ≥70 years.

All statistical analyses were performed using SPSS 20.0 (IBM Corp., Armonk, NY, USA). Kolmogorov-Smirnov's test was used to assess the assumption of normality. Since the normality assumption did not hold, continuous variables were presented with median and interquartile range (IQR). Categorical variables were summarized as counts and percentages.

Results

The median age of 225 patients with traumatic hand injuries was 36 (24- 48.5) years. Tendon injuries occurred most frequently in the 3rd decade (25.3%). 164 (72.9%) of the patients were male and 61 (27.1%) were female. In the distribution of patients according to occupation, industrial workers were in the first place with 91 patients (40.4%). 56 patients (24.9%) were unemployed, 44 patients (19.6%) were students, 25 patients were self-employed (11.1%) and 9 patients (4%) were civil servants. The dominant hand was right-sided in 220 patients (97.8%) and the injured hand was right-sided in 124 patients (55.1%) (Table 1).

Table 1. Demographic characteristics of the patients

Parameters	
Age, median (IQR)	36 (24-48.5)
Age range, n (%)	
0-9	6 (2.7)
10-19	24 (10.7)
20-29	57 (25.3)
30-39	48 (21.3)
40-49	39 (17.3)
50-59	29 (12.9)
60-69	18 (8)
70+	4 (1.8)
Sex, n (%)	
Female	61 (27.1)
Male	164 (72.9)
Dominant hand, n (%)	
Right	220 (97.8)
Left	5(2,2)
Injured hand, n (%)	
Right	124 (55.1)
Left	101 (44.9)
Occupation, n (%)	
Worker	91 (40.4)
Civil servant	9 (4)
Student	44 (19.6)
Unemployed	56 (24.9)
Other	25 (11.1)

n: Number, IQR: Interquartile range (25^{th}-75^{th} percentile)

Trauma was mainly caused by sharp metals, work tools, ceramics, and traffic accidents. Tendon injuries were caused by machine accidents in 70 patients (31.1%), laceration from glass in 69 patients (30.7%), trauma in 58 patients (25.8%), and stab wounds in 21 patients (9.3%). In terms of the injured anatomical structures, 53 (23.6%) had combined injuries, 53 (23.6%) had tendon and nerve injuries, 92 (40.9%) had isolated tendon injuries, and 27 (12%) had fractures associated with tendon injuries (Table 2).

Table 2. Causes of injuries and injured structures.

Parameters	n	%
Etiology		
Laceration from glass	69	30.7
Stab wound	21	9.3
Trauma	58	25.8
Work machine	70	31.1
Other	7	3.1
Injured Structure		
Tendon laceration	92	40.9
Tendon and nerve	53	23.6
Tendon fracture	27	12
Combined	53	23.6
Involves a fracture	47	20.9
No fracture	178	79.1

n: Number

Of the patients, 144 (64%) had flexor tendon injuries, 73 (32.4%) had extensor tendon injuries, and 8 (3.6%) had both flexor and extensor tendon injuries. Flexor tendon injuries occurred most frequently in zone V (51.5%), while extensor tendon injuries occurred most frequently in zones III (20%) and V (16.9%). Flexor tendon injuries occurred most frequently in zone II (50%), while extensor tendon injuries occurred most frequently in zone IV (63.2%) of the first finger (Table 3).
The extensor tendon injured was mostly extensor digitorum communis (EDC)-3 (11.6%), and the flexor tendon injured was mostly flexor digitorum superficialis (FDS)-4/flexor digitorum profundus (FDP)-5 (18.2%). Nerve injuries were equally distributed between median and ulnar injuries (14.2%) (Table 4).

Discussion

In our study, we aimed to retrospectively analyze the patients admitted to our clinic in order to shed light on the epidemiology of traumatic wrist injuries, which are frequently encountered and cause functional losses and limitations in activities of daily living. Epidemiologic data may increase our knowledge about injury patterns and help in the prevention of future injuries and the rehabilitation process. As a result, it may play a role in reducing the lost working time and economic burden in hand and wrist injuries. Traumatic hand injuries can include soft tissue injuries and fractures to complex injuries requiring nerve, tendon or artery repair. Among these patients, traumatic tendon injuries or peripheral nerve lacerations constitute a large group.[1,2] Studies have reported that most hand injuries occur at work or during home occupation.[17,18]

Table 3. Distribution of flexor and extensor tendon injuries by zone

Parameters	n	%
Zone type		
Flexor	144	64
Extensor	73	32.4
Both	8	3.6
Flexor zone level		
Zone 1	3	2.2
Zone 2	42	31.1
Zone 3	4	3
Zone 5	69	51.5
Zones 1 and 2	9	6.7
Zones 2 and 3	1	0.7
Zones 3 and 4	1	0.7
Zones 4 and 5	3	2.2
Zones 3, 4, and 5	1	0.7
Zones 2 and 4	1	0.7
Thumb flexor zone level		
Zone 2	9	50
Zone 3	5	27.8
Zones 1 and 2	2	11.1
Zones 2 and 3	2	11.1
Extensor zone level		
Zone 1	2	3.1
Zone 2	3	4.6
Zone 3	13	20
Zone 4	6	9.2
Zone 5	11	16.9
Zone 6	7	10.8
Zone 7	4	6.2
Zone 8	3	4.6
Zones 1 and 2	3	4.6
Zones 2 and 3	3	4.6
Zones 3 and 4	4	6.2
Zones 4 and 5	1	1.5
Zones 3 and 5	1	1.5
Zones 5 and 6	3	4.6
Zones 4, 5, and 6	1	1.5
Thumb extensor zone level		
Zone 2	1	5.3
Zone 3	2	10.5
Zone 4	12	63.2
Zones 1 and 2	2	10.5
Zones 3 and 4	2	10.5

Because some patients had injuries at multiple sites, the sum of the percentages is >100.

Table 4. Incidence of specific extensor and flexor tendon injuries.

Parameters	n	%
APL	15	6.7
EPB	17	7.6
EPL	24	10.7
EIP	2	0.9
EDM	4	1.8
ECRL	6	2.7
ECRB	6	2.7
ECU	2	0.9
EDC 2	19	8.4
EDC 3	26	11.6
EDC 4	13	5.8
EDC 5	6	2.7
FPL	31	13.8
FPB	1	0.4
FDS 2	29	12.9
FDS 3	36	16
FDS 4	41	18.2
FDS 5	38	16.9
FDP 2	31	13.8
FDP 3	29	12.9
FDP 4	37	16.4
FDP 5	41	18.2
FCR	33	14.7
FCU	36	16
PL	19	8.4
Median nerve	32	14.2
Ulnar nerve	32	14.2
Radial nerve	15	6.7
Digital nerve	43	19.1

n: Number
APL: Abductor pollicis longus, EPB: Extensor pollicis brevis, EPL: Extensor pollicis longus, EIP: Extensor indicis proprius, EDM: Extensor digiti minimi, ECRL: Extensor carpi radialis longus, ECRB: Extensor carpi radialis brevis, ECU: Extensor carpi ulnaris, EDC 2: Extensor digitorum communis 2, EDC 3: Extensor digitorum communis 3, EDC 4: Extensor digitorum communis 4, EDC 5: Extensor digitorum communis 5, FPL: Flexor pollicis longus, FPB: Flexor pollicis brevis, FDS 2: Flexor digitorum superficialis 2, FDS 3: Flexor digitorum superficialis 3, FDS 4: Flexor digitorum superficialis 4, FDS 5: Flexor digitorum superficialis 5, FDP 2: Flexor digitorum profundus 2, FDP 3: Flexor digitorum profundus 3, FDP 4: Flexor digitorum profundus 4, FDP 5: Flexor digitorum profundus 5, FCR: Flexor carpi radialis, FCU: Flexor carpi ulnaris, PL: Palmaris longus.

Ergüner et al.[2] and Campbell et al.[17] reported that traumatic hand injuries were most common in the third decade of life. Sorock et al. reported that 75% of hand injuries were seen below the age of 44 years.[18] Nieminen et al. reported that 14% of the applicants were below the age of 15 years and 8% were above the age of 65 years.[19] In our study, similar to the literature, we found that traumatic hand injuries occurred most frequently in the young active working population in the 3rd decade with a rate of 25.3%.

Ergüner et al.[2] reported a male patient ratio of 70%, Karakurt et al.[20] reported 90%, and Altan et al.[21] reported 84.8%. In our study, the rate of male patients was 72.9% with 164 patients. The reason for the high rate of male patients may be that the male worker population is higher than the female worker population in the industrial sector in our province.

When we examine the distribution of hand injuries according to occupations and causes in the literature, it is seen that traumatic hand injuries are most commonly seen in construction, mining, cookery, service personnel and manufacturing workers and the rate of occupational accidents is between 40% and 85%.[2,20-23] Keskin et al. reported that 85% of patients with hand injuries were industrial workers.[11] Altan et al. reported that this was due to the fact that the machines in the workplaces were not at the desired standard in terms of maintenance and occupational safety and that the rate of inexperienced young workers was high.[21] In our study, traumatic hand injuries were most commonly seen in workers with 91 patients (40.4%) and 70 patients (31.1%) were injured due to work machines. The high rate of occupational accidents in our study may be due to the fact that the general population of our region mostly works in the industrial sector. Since occupational accidents affect the active working group, they cause both loss of labor force and increased economic costs. In the industrial sector, we think that this rate can be reduced by ensuring the adequacy of workplace physical conditions, protective measures to be taken specific to each line of work and ensuring the necessary standards in terms of occupational safety.

There are studies indicating that the dominant hand is more commonly injured.[21,24,25] and there are also studies indicating that the non-dominant hand is more commonly injured.[26] In our study, similar to the literature, we found that the dominant hand had a higher risk of injury with 124 patients (55.1%).

In the present study, 144 patients (64%) had flexor tendon injuries and 73 (32.4%) had extensor tendon injuries. De Jong et al. reported extensor tendon injuries in 395 patients (85.8%) and flexor tendon injuries in 297 patients (64.4%).[23] Previous studies have reported that flexor tendon injuries most frequently occur in zones II–V.[2,27] The results of the present study are consistent with previous reports; tendon injuries were found to occur frequently and in zone V (n: 69, 51.5%). Extensor tendon injuries, on the contrary, have been reported to involve most frequently zones III and V.[2,28] In the present study, extensor tendon injuries were found to occur mostly in zones III (20%) and V (16.9%). In terms of the thumb, flexor tendon injuries were most common in zone II and observed in 9 patients (50%), while extensor tendon injuries occurred in 12 patients (63.2%).

In terms of the incidence of specific extensor and flexor tendon injuries, the FDS-4 and FDP-5 tendons were the most frequently injured flexor tendons in 41 patients (18.2%). This result is consistent with a study conducted by Rosberg et al.[27] who reviewed 135 flexor tendon injuries in the Swedish population. The specific extensor tendon that was injured was EDC-3 in 26 patients (11.6%). In the thumb, the specific flexor tendon that was injured was FPL in 31 patients (13.8%), while the specific extensor tendon that was injured was EPL in 24 patients (10.7%).

Ergüner et al. reported that 41% of patients with tendon injury had accompanying nerve injury.[2] In the study by Keskin et al. 29 patients (19%) had accompanying tendon injury, 59% of whom had nerve injury.[19] In our study, 53 patients (23.6%) had injuries accompanying tendon damage, 35.1% of which were nerve injuries. The median and ulnar nerves were involved in 32 patients (14.2%), while the

radial nerve was involved in 15 patients (6.7%). 12% of tendon injuries were accompanied by fractures.

The spectrum of traumatic hand injuries ranges from minor soft tissue injuries and fractures to complex injuries requiring repair of the nerves, tendons, or arteries. With the progress of technology, large-scale and heavy machineries have become an indispensable part of heavy industry. Although this reduces the workload for the industry, it increases the magnitude and severity of potential traumatic hand injuries.

The combination of these work-related injuries leads to an overall economic burden as a result of lost working time. A 10-year retrospective study by de Jong et al. reported that the incidence of tendon injuries was decreasing, and the available data would contribute to ongoing rehabilitation efforts as a means of reducing morbidity.[23] This decrease may be attributed to a change in occupation as well as increased awareness of potential risks.

This study sought to retrospectively analyze the patients who presented to our clinic with traumatic hand and wrist injuries in order to clarify the epidemiology of these injuries, which occur frequently and cause functional losses and limitations in daily living activities. Epidemiologic data can expand our knowledge of injury patterns, help prevent future injuries, and contribute to improving the rehabilitation process, which in turn can play a role in reducing the loss of working time and economic burden associated with hand-wrist injuries.

This study has some limitations. This was a retrospective study that was conducted in a region with a specific industrial pattern. It could not examine socioeconomic factors and working environments that might affect injury patterns and injured structures. The data from our study may not be applicable to smaller urban areas. There is a need for further studies in mixed cities with industrial and agricultural areas. It is likely that the study data has been affected by the decrease in the number of patients admitted to our clinic over the last 2 years due to the COVID-19 pandemic. Although studies in this field have increased significantly in recent years, there is still a need for larger-scale, multicenter, long-term studies due to the complexity of the mechanisms as well as personal and environmental factors that facilitate the occurrence of hand injuries.

Conflict of Interest

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Compliance with Ethical Statement

The study was performed after obtaining the necessary permission from the Kocaeli University Non-Invasive Research Ethics Committee (Date: 10/11/2022, Decision No: GOKAEK-2022/18.26).

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Author Contributions

All authors contributed equally to the article.

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