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The relationship between injury severity, grip strength and functionality in traumatic hand injuries

Relación entre la gravedad de la lesión, la fuerza de agarre y la funcionalidad en las lesiones traumáticas de la mano

Relação entre a gravidade da lesão, força de preensão e funcionalidade em lesões traumáticas da mão

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ABSTRACT

Purpose: This study aimed to investigate the relationship between injury severity and functionality in traumatic hand injuries.
Methods: Forty-four patients with traumatic injuries to the hand were included. Patients who were grouped as minor, moderate, and severe-major by Modified Hand Injury Severity Score (mHISS) score, were evaluated with grip strength, lateral grip strength, and Sollerman Hand Function Test (SHFT) at the 4th and 12th weeks. Among the functional scales, The Disabilities of the Arm, Shoulder and Hand questionnaire (DASH) and the Patient-Rated Hand and Wrist Evaluation (PRWHE), Health Assessment Questionnaire (HAQ) were used.
Results: According to the patients' total mHISS score, 27.2% were classified as having minor injuries, 43.1% as having moderate injuries, and 29.4% as having serious-major injuries. The first 4 weeks of the rehabilitation period showed a statistically significant increase in both grip strength and SHFT scores. Furthermore, grip strength and SHFT scores were significantly lower across all mHISS groups, with greater reductions observed in the group with more severe injuries. A significant positive correlation was observed between the total mHISS score and PRWHE, DASH, and HAQ scores in all follow-ups. As the severity score increased, functionality worsened.
Conclusion: Assessing the severity of injury and functionality in these patients allows for effective management of treatment and rehabilitation, ultimately improving their functional status and general health.
Key words: Functional Status, Modified Hand Injury Severity Score, Traumatic hand injury

RESUMEN

Objetivo: El objetivo de este estudio fue investigar la relación entre la gravedad de la lesión y la funcionalidad en las lesiones traumáticas de la mano.
Métodos: Se incluyeron cuarenta y cuatro pacientes con lesiones traumáticas en la mano. Los pacientes se agruparon según la puntuación de la Escala de Gravedad de Lesiones de Mano Modificada (mHISS) en leves, moderados y graves-mayores, y fueron evaluados con la prueba de fuerza de agarre, la prueba de fuerza de agarre lateral y la Prueba de Función de la Mano Sollerman (SHFT) en las semanas 4 y 12. Entre las escalas funcionales utilizadas, se emplearon el cuestionario de Discapacidades del Brazo, Hombro y Mano (DASH), la Evaluación de Mano y Muñeca Calificada por el Paciente (PRWHE), y el Cuestionario de Evaluación de la Salud (HAQ).
Resultados: Según la puntuación total de mHISS, el 27,2 % de los pacientes tenían lesiones leves, el 43,1 %, lesiones moderadas y el 29,4 %, lesiones graves-mayores. Las cuatro primeras semanas del período de rehabilitación mostraron un aumento estadísticamente significativo tanto en la fuerza de agarre como en las puntuaciones de la SHFT. Además, la fuerza de agarre y las puntuaciones SHFT fueron significativamente más bajas en todos los grupos de mHISS, y se observaron mayores reducciones en el grupo con lesiones más graves. Se observó una correlación positiva significativa entre la puntuación total de mHISS y las puntuaciones de PRWHE, DASH y HAQ en todos los seguimientos. A medida que aumentaba la puntuación de gravedad, empeoraba la funcionalidad.
Conclusión: La evaluación de la gravedad de la lesión y la funcionalidad de estos pacientes permite gestionar eficazmente su tratamiento y rehabilitación, mejorando en última instancia su estado funcional y su salud general.
Palabras clave: Escala de gravedad de la lesión de la mano modificada, Estado funcional, Lesión traumática de la mano

RESUMO

Objetivo: Investigar a relação entre a gravidade da lesão e a funcionalidade em lesões traumáticas da mão.
Métodos: Quarenta e quatro pacientes com lesões traumáticas na mão foram incluídos. Os pacientes foram agrupados de acordo com o escore de gravidade da lesão da mão (mHISS) em três grupos: menor, moderado e grave. Foram avaliadas a força de preensão, a força de preensão lateral e o teste de função da mão de Sollerman (SHFT) na 4ª e 12ª semanas. Entre as escalas funcionais, foram utilizados o questionário The Disabilities of the Arm, Shoulder and Hand (DASH) e o Patient-Rated Hand and Wrist Evaluation (PRWHE), além do Health Assessment Questionnaire (HAQ).
Resultados: De acordo com o escore total do mHISS, 27,2% dos pacientes foram classificados como tendo lesões menores, 43,1% como tendo lesões moderadas e 29,4% como tendo lesões graves-maiores. As primeiras quatro semanas do período de reabilitação mostraram um aumento estatisticamente significativo tanto na força de preensão quanto nos escores do SHFT. Além disso, a força de preensão e as pontuações SHFT foram significativamente menores em todos os grupos mHISS, com maiores reduções observadas no grupo com lesões mais graves. Foi observada uma correlação positiva significativa entre a pontuação total mHISS e as pontuações PRWHE, DASH e HAQ em todos os acompanhamentos. À medida que a pontuação de gravidade aumentava, a funcionalidade dos pacientes piorava.
Conclusão: Avaliar a gravidade da lesão e a funcionalidade nesses pacientes permite o gerenciamento eficaz do tratamento e da reabilitação, melhorando, em última análise, seu estado funcional e sua saúde geral.
Palavras-chave: Lesão traumática de mão, Pontuação de gravidade de lesão de mão modificada, Status funcional

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INTRODUCTION

The hand is the last link in the upper extremity chain that allows a person to interact directly with their environment and is responsible for performing functional activities. Injuries to this region, which plays a key role in upper extremity function, have a significant negative impact on the patient's level of functional independence, overall well-being, and quality of life[1, 2]. These outcomes are accompanied by psychological problems that occur with delayed return to activities of daily living, delayed return to work, and limitations in social and occupational activities[3, 4]. With industrialization, the incidence of upper extremity injuries has gradually increased, causing not only a great economic burden, but also serious social, functional and workforce losses. It has been reported that hand injuries account for between 6.6 and 28.6% of all emergency department admissions and approximately 28% of all musculoskeletal trauma[5]. Objective assessment of hand injuries is a complex issue. Therefore, it is clinically important to use valid and reliable assessments that provide objective scores to determine the functional, occupational, and social prognosis of the injury[6, 7, 8]. These scales, along with objective assessments, can help us understand the patient's prognosis and psychosocial experience of the disease. This approach enables the estimation of the prognosis of patients prior to the commencement of rehabilitation. The hypothesis of this study is that as the severity score increases, there is a corresponding deterioration in the patient's functionality, which in turn leads to an extension of the treatment period. The objective of this study was to ascertain the relationship between the injury severity score and upper extremity functionality in patients with traumatic hand injuries. Additionally, the objective was to assess the various factors influencing the rehabilitation of patients with hand injuries and to quantify the impact of these factors.

MATERIAL AND METHODS

Patients with forearm or hand injuries between November 2018 and April 2019 were included in the study. Participants were patients between the ages of 18 and 65 who had a forearm or hand injury, received conservative or surgical treatment, and had not previously participated in a hand rehabilitation program. The study excluded individuals with specific conditions, such as orthopedic and neurological diseases, entrapment neuropathy, polyneuropathy, radiculopathy causing neurological deficit in the affected extremity, local and systemic infection, trauma sequelae or a history of surgery in the affected extremity, reflex sympathetic dystrophy, malignancy, and pregnant women. Patients' age, sex, occupation, and dominant hand were recorded. Injury-related variables included diagnosis, injured hand, and time from date of injury to date of surgery, if any. Fractures were defined as forearm (ulna and radius), wrist (carpal bones), metacarpal, phalanx level, and flexor tendon cuts were defined by zone. According to the injured anatomical structures, patients were divided into 8 groups: flexor tendon injuries, extensor tendon injuries, isolated nerve injuries, fractures, nerve injury with any tendon injury, nerve injury with fracture, tendon injury with fracture, any tendon and nerve injury with fracture. Injury severity was determined using the Modified Hand Injury Severity Score (mHISS). Patients' injuries were categorized as mild (<20), moderate (21-50), severe (51-100), and major (>100) according to the mHISS. Grip strength was assessed using a Jamar® hydraulic hand dynamometer and lateral grip strength was assessed using a Baseline® hydraulic pinch dynamometer. Measurements were taken for both hands, and the average of 3 measurements was determined in kilograms (kg). Functionality was assessed using the Sollerman Hand Function Test (SHFT), the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH), and the Patient-Rated Hand and Wrist Evaluation (PRWHE), the Health Assessment Questionnaire (HAQ). All assessments were repeated before rehabilitation and after 4 and 12 weeks. The Sollerman Hand Function Test is a standardized, valid and reliable test that is used to evaluate hand functions. It comprises 20 activities based on eight fundamental hand grips (pulp grip, lateral pinch, triple pinch, five-finger pinch, diagonal volar grip, transverse volar grip, spherical volar grip, and extension type grip). These activities are designed to evaluate the hand's key functional capabilities, as well as the grip patterns employed. The completion time of each activity was recorded and subsequently scored according to a scale of 0-4. A score of zero is assigned in the event of failure to perform the activity. A score of one is given for completion within 60 seconds. A score of two is assigned for completion between 60 and 41 seconds or for instances where the desired grip pattern was not employed. A score of three is given for completion between 21 and 40 seconds and for instances where there was a minimum deviation in the grip pattern. Finally, a score of four is assigned for completion within 20 seconds with the specified grip pattern[9]. The DASH questionnaire is comprised of three sections. The initial section of the questionnaire comprises 30 questions. Of these, 21 assess the patient's ability to perform activities of daily living, 5 evaluate symptoms, and 4 assess social functioning, work, sleep, and the patient's self-confidence. This initial section is utilized to ascertain the patient's functional and symptomatic score. In addition to the 30 questions in the initial section, the Work Model, comprising four optional questions, determines the patient's disability in work-related activities. The Sports-Musicians Model, also comprising four optional questions, determines the disability level of patients who engage in sports or music. In all questions, the patient marks the answer that is most appropriate for them on the 5-point Likert scale[6]. PRWHE consists of two sub-scales: pain with five items,

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specific function with six items, and daily function with four items. Each item is scored between 0 and 10[10]. The HAQ is one of the first self-reports of functional status. The scale comprises 20 items distributed across eight sections, with the objective of evaluating the subject's capacity to perform daily living activities. Each item is scored on a scale of 0 to 3. The scale is comprised of seven sections, each of which assesses a specific domain of functioning. These domains include dressing, sitting up, eating, walking, hygiene, reaching out, grasping, and daily tasks. Each domain contains two or three items[11]. As a physical therapy and rehabilitation program, all patients received 14 sessions of conventional physical therapy, 3 days a week, 1 hour a day, consisting of therapeutic exercise program performed under the guidance of a physiotherapist, by selecting physical therapy modalities (transcutaneous electrical nerve stimulation, infrared, ultrasound/in-water ultrasound) according to the clinical condition and characteristics of the wound. This therapeutic exercise program was designed on the basis of the affected tendon and nerve. In addition to joint range of motion, stretching and strengthening exercises, it also included exercises to develop fine manual skills, including the ability to open a lock with a key, open and close a zipper, open a jar, and place wooden blocks. Mean, standard deviation, median, lowest, highest, frequency and ratio values were used in the descriptive statistics of the data. The distribution of variables was measured with the Kolmogorov Smirnov test. Wilcoxon test was used to analyze dependent quantitative data. McNemar's test was used to analyze dependent qualitative data. Spearman correlation analysis was used in correlation analysis. Kruskal-Wallis and Mann-Whitney U test were used in the analysis of quantitative independent data. The statistical package IBM SPSS 22.0 was used in the analyses. Significance was evaluated at $p<0.05$ levels.

This study was approved by the Ethics Committee of xxx Hospital (Date: 2018-11-6, No: 2166). Informed consent was obtained from all patients before inclusion in the study.

RESULTS

45 patients were included in the study and 1 patient who developed a wound infection during follow-up was excluded from the study. The mean age of the patients included in the study was 33.6±12.9 years. Of the study population, 81.8% (n=36) were male. Educational level analysis revealed that 15 (34.1%) patients were primary school graduates, 2 (4.5%) were middle school graduates, 23 (52.3%) were high school graduates, and 4 (9.1%) were university graduates. Out of the 44 patients evaluated, 21 (47.7%) were blue-collar workers, 8 (18.2%) were white-collar workers, 9 (20.5%) were students, 5 (11.4%) were retired, and 1 (2.3%) had another occupation. Moreover, 93.2% of the patients had a dominant right hand, with 54.5% of them having an injury on their dominant hand. Additionally, 47.7% of the patients had a right hand injury (**Table 1**).

Table 1. Demographic characteristics of the study population

		Min-Max			Median	Mean±SD/n-%		
Age		18.0	-	65.0	32.5	33.6	±	12.9
Sex	Female					8		18.2%
	Male					36		81.8%
Education	Primary School					15		34.1%
	Middle School					2		4.5%
	High School					23		52.3%
	University					4		9.1%
Occupation	Blue Collar					21		47.7%
	White Collar					8		18.2%
	Student					9		20.5%
	Retired					5		11.4%
	Other					1		2.3%
Dominant Hand	Right					41		93.2%
	Left					3		6.8%
Damaged Hand	Dominant					24		54.5%
	Non-dominant					20		45.5%
	Right					21		47.7%
	Left					23		52.3%

13 (29.5%) of the patients had nerve injury with flexor and/or extensor tendon injury, 12 (11.4%) had extensor tendon injury, and 7 (15.9%) had fracture. Flexor tendon injury in 5 patients (11.4%), isolated nerve injury in 2 patients (4.5%), tendon injury with fracture in 2 patients (4.5%), and fracture with tendon and nerve injury in 2 patients (4.5%). Nerve injury with fracture was also noted in one patient (2.3%). While flexor tendon injuries were most common in zone 5 (50%), extensor tendon injuries were most common in zone 2 (28%), followed by zone 3 (28%). Fractures were grouped at the forearm (ulna and radius), wrist (carpal bones), metacarpal, and phalanx levels. 90% of fractures were at the phalanx level. 27.2% of the patients' mHISS scores were in the minor (mean=14), 43.1% in the moderate (mean=30.6) and 29.4% in the serious-major (mean=83.1) injury category. All functional assessments of the patients were conducted at three time points: prior to rehabilitation, at week 4, and at week 12. This was done irrespective of mHISS. The results demonstrated a significant increase ($p<0.05$) in the damaged side's grip strength, lateral grip strength, and SHFT scores at the 4th and 12th weeks compared to the pre-rehabilitation period. Additionally, the 12th week exhibited a significant increase ($p<0.05$) in the damaged side's grip strength compared to the 4th week. The pain and function subscores and total scores of PRWHE demonstrated a statistically significant improvement ($p<0.05$) at the 12-week mark following rehabilitation when compared to the pre-rehabilitation scores. However, a more pronounced improvement was observed at the 12-week point when compared to the 4-week mark. However, at the 4th and 12th weeks following rehabilitation, the PRWHE-aesthetic question score did not demonstrate a statistically significant change ($p>0.05$) compared to the baseline assessment prior to rehabilitation. Similarly, the PRWHE-

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aesthetic question score at week 12 did not demonstrate a statistically significant change (p>0.05) compared to week 4. At 4 and 12 weeks' post-rehabilitation, the DASH Total and Work scores demonstrated a statistically significant ($p < 0.05$) improvement compared to the baseline assessment prior to rehabilitation. Furthermore, a significant improvement ($p < 0.05$) in DASH scores was observed at week 12 compared to week 4. At the 4th and 12th weeks after rehabilitation, the HAQ-eating, HAQ-hygiene, HAQ-gripping, HAQ-reaching, HAQ-other and HAQ-total scores showed a significant ($p<0.05$) improvement compared to before rehabilitation. There was a significant ($p<0.05$) improvement in the HAQ-hygiene, HAQ-reaching out, and HAQ-total scores at week 12 compared to week 4. However, there was no significant ($p>0.05$) change in the HAQ-Eating, HAQ-Sitting, HAQ-Gripping, and HAQ-Other scores. There was no significant ($p>0.05$) change in the HAQ-walking score at 4 and 12 weeks after rehabilitation compared with the pre-rehabilitation period. In the mHISS severe-major group, grip strength on the injured side was significantly lower than in the mHISS minor and moderate groups before rehabilitation, at week 4, and at week 12, and the mHISS moderate group was significantly ($p < 0.05$) lower than the mHISS minor group. In all groups, the grip strength of the injured side increased significantly ($p < 0.05$) at 4 and 12 weeks compared to the pre-rehabilitation period. The amount of increase in grip strength between follow-ups was not significantly different between the three groups ($p> 0.05$) (**Table 2**). A significant ($p < 0.05$) negative correlation was observed between the total mHISS score and the SHFT score before rehabilitation, at week 4, and at week 12, and as the severity score increased, the SHFT score worsened. In the mHISS severe-major group, the SHFT score before rehabilitation, at week 4, and at week 12 was significantly lower than in the mHISS minor and moderate groups, and in the mHISS moderate group was significantly lower than in the mHISS minor group ($p < 0.05$). In all groups, the SHFT scores at 4 and 12 weeks increased significantly ($p < 0.05$) compared to the pre-rehabilitation period (**Table 2**).

Table 2. Relationship between mHISS groups and damaged side grip strength and Sollerman Hand Function Test (SHFT)

	mHISS Minor			mHISS Moderate			mHISS Major			p
	Mean±SD		Med	Mean±SD		Med	Mean±SD		Med	
Grip Strength-Damaged Side										
Pre-Rehabilitation	7.8 ± 4.1		8.0	4.0 ± 3.7		3.0	1.9 ± 1.9		1.0	***0.002*** κ
4th week	17.3 ± 4.9		18.0	15.1 ± 5.9		13.0	10.2 ± 2.8		10.0	***0.002*** κ
12th week	23.3 ± 5.3		23.0	23.1 ± 5.8		23.0	16.5 ± 4.3		16.0	***0.004*** κ
4th week Change	9.4 ± 2.3		9.0	11.1 ± 3.6		10.0	8.5 ± 2.6		8.0	0.086 κ
Intra-Group Change p	***0.002*** w			***0.000*** w			***0.001*** w			
12th week Change	15.4 ± 4.3		15.0	19.2 ± 5.0		18.0	14.7 ± 4.4		15.0	0.056 κ
Intra-Group Change p	***0.002*** w			***0.000*** w			***0.001*** w			
SHFT										
Pre-Rehabilitation	49.8 ± 13.4		48.0	40.2 ± 11.5		38.0	25.9 ± 16.0		21.0	***0.003*** κ
4th week	69.8 ± 5.7		70.5	65.8 ± 4.9		68.0	60.9 ± 10.0		65.0	***0.025*** κ
12th week	74.5 ± 4.9		74.0	71.7 ± 4.2		71.0	67.8 ± 6.2		70.0	***0.029*** κ
4th week Change	20.0 ± 8.8		21.0	25.6 ± 8.0		23.0	35.0 ± 11.5		35.0	***0.007*** κ
Intra-Group Change p	***0.002*** w			***0.000*** w			***0.001*** w			
12th week Change	24.8 ± 9.4		24.0	31.5 ± 8.8		30.0	41.9 ± 11.8		45.0	***0.002*** κ
Intra-Group Change p	***0.002*** w			***0.000*** w			***0.001*** w			

κ Kruskal-wallis (Mann-whitney u test) / w Wilcoxon test.
Med: Median, SD: Standard deviation, Mhiss: Modified Hand Injury Severity Scale, SHFT: Sollerman Hand Function Test

A significant ($p < 0.05$) positive correlation was observed between the total mHISS score and the DASH, PRWHE, and HAQ scores before rehabilitation, at week 4, and at week 12. A significant ($p < 0.05$) negative correlation was observed between the skin, motor, neurovascular, and total scores of the mHISS and grip strength and SHFT on the injured side before rehabilitation, at week 4, and at week 12. These subscores have a significant impact on the deterioration of grip strength and SHFT. No significant ($p > 0.05$) correlation was observed between the mHISS-skeletal score and grip strength of the injured side before rehabilitation, at week 4, and at week 12, or between the mHISS-skeletal and mHISS-motor scores and SHFT. A significant ($p < 0.05$) negative correlation was observed between the total mHISS score and grip strength on the injured side, lateral pinch strength, and SHFT score before rehabilitation, and higher initial severity was associated with poorer functional outcomes (**Table 3**).

Table 3. Relationship between mHISS subgroups and grip strength and Sollerman Hand Function Test Score

			Skin-mHISS	Skeletal-mHISS	Motor-mHISS	Neurovascular-mHISS	Total-mHISS
Grip Strength (kg)-Healthy Side	Pre-Rehabilitation	r	0.005	-0.117	-0.113	-0.217	-0.183
		p	0.975	0.449	0.467	0.157	0.234
	4th week	r	0.030	-0.095	-0.131	-0.197	-0.169
		p	0.847	0.540	0.398	0.199	0.273
	12th week	r	0.005	-0.117	-0.113	-0.217	-0.183
		p	0.975	0.449	0.467	0.157	0.234
Grip Strength (kg)-Damaged Side	Pre-Rehabilitation	r	-0.353	0.150	-0.298	-0.487	-0.577
		p	***0.019***	0.330	***0.049***	***0.001***	***0.000***
	4th week	r	-0.359	0.154	-0.347	-0.547	-0.558
		p	***0.017***	0.318	***0.021***	***0.000***	***0.000***
	12th week	r	-0.388	0.112	-0.326	-0.519	-0.499
		p	***0.009***	0.471	***0.031***	***0.000***	***0.001***
Sollerman Hand Function Test	Pre-Rehabilitation	r	-0.436	0.213	-0.271	-0.515	-0.546
		p	***0.003***	0.164	0.075	***0.000***	***0.000***
	4th week	r	-0.533	0.245	-0.245	-0.453	-0.473
		p	***0.000***	0.109	0.109	***0.002***	***0.001***
	12th week	r	-0.501	0.248	-0.235	-0.440	-0.449
		p	***0.001***	0.104	0.125	***0.003***	***0.002***

Spearman Correlation.
mHISS: Modified Hand Injury Severity Scale

In **Table 4**, we conducted an analysis to determine whether certain parameters that were previously examined before treatment were indeed affected by the treatment itself. No significant ($p > 0.05$) correlation was observed between the mHISS total score and the PRWHE-pain and HAQ gait scores before rehabilitation. A significant ($p < 0.05$) positive correlation was observed between PRWHE-function, PRWHE-T, DASH-T, DASH-work score, HAQ general care, sit up, eating, hygiene, reaching, grasping, other and total score at baseline. Greater severity was associated with worsening. (**Table 4**). No significant ($p > 0.05$) correlation was observed between the mHISS total score and the 12-week change in damaged side grip and lateral pinch strength, PRWHE-pain score, HAQ walking, other, sit-to-stand score, and increasing severity did not affect recovery. A significant ($p < 0.05$) positive correlation was observed between the mHISS total score and the 12-week change in the SHFT score, and

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improvement was greater with increasing severity (**Table 4**). A significant ($p < 0.05$) negative correlation was observed between the mHISS total score and the 12-week change in PRWHE function, PRWHE-T, DASH-T, DASH-work, HAQ general care, eating, hygiene, reaching out, gripping and total scores. Recovery was found to be high with increasing severity (**Table 4**).

Table 4. Correlation of grip strength and functional scores according to mHISS total score and change at 12 weeks

	mHISS Total			
	Pre-Rehabilitation		12th week Change	
	r	p	r	p
Pre-Rehabilitation				
Grip Strength- Healthy Side	-0.183	0.234	-0.108	0.485
Grip Strength- Damaged Side	-0.577	***0.000***	-0.133	0.389
Lateral Pinch	-0.462	***0.002***	0.075	0.627
Sollerman Hand Function Test	-0.546	***0.000***	0.556	***0.000***
PRWHE-Pain	0.268	0.078	-0.066	0.671
PRWHE-Function	0.412	***0.005***	-0.362	***0.016***
PRWHE-Total	0.416	***0.005***	-0.323	***0.033***
PRWHE-Aesthetic	0.404	***0.007***	-0.287	***0.049***
DASH-Total	0.584	***0.000***	-0.448	***0.002***
DASH-Work	0.571	***0.001***	-0.472	***0.010***
HAQ-General Care	0.450	***0.002***	-0.331	***0.028***
HAQ-Sit up	0.314	***0.038***	-0.250	0.102
HAQ-Eating	0.417	***0.005***	-0.378	***0.011***
HAQ-Walking	-0.089	0.568	0.089	0.568
HAQ-Hygiene	0.417	***0.005***	-0.442	***0.003***
HAQ-Reaching Out	0.302	***0.046***	-0.305	***0.044***
HAQ-Grip	0.447	***0.002***	-0.361	***0.016***
HAQ-Other	0.405	***0.006***	-0.204	0.183
HAQ-Total	0.464	***0.002***	-0.359	***0.017***
Spearman Correlation				

mHISS: Modified Hand Injury Severity Scale, PRWHE: Patient-Rated Hand and Wrist Evaluation, HAQ: Health Assessment Questionnaire

DISCUSSION

Hand injuries affect the young and productive population particularly male gender. For peripheral nerve injuries, the age range is reported to be between 27 and 32 years[12, 13, 14, 15]. In our study, the mean age was found to be 33.6 years, which was close to the literature. 47.7% of our patients were injured in the right hand and 52.3% in the left hand, and 54.5% of these patients were injured in the dominant hand. Again, the literature reports a dominant hand injury rate of 49-54%[16]. A 10-year population-based study conducted by Jong et al. in 2014[17], found that, contrary to previous literature, extensor tendon injuries were more common than flexor tendon injuries. In the same study, extensor tendon injuries were most common in zone 3 and second in zone 5, while flexor tendon injuries were most common in zone 2 and second in zone 5. When tendon injuries were examined individually in our study, a total of 72% of flexor tendon injuries were in zone 2 (22%) and zone 5 (50%), which is consistent with the literature. In 2012, Lin et al.[18] investigated the relationship between severity scoring and hand strength in 80 patients with traumatic hand injuries and emphasized that HISS is useful in predicting hand strength after recovery. Our findings align with existing literature, indicating a negative correlation between injury severity and mean grip strength in patients with hand injuries. This relationship is analogous to the observed association between the mHISS system and grip strength. However, our study did not find that the severity of injury affected the change in grip strength during the follow-up period. This indicates that regardless of the injury severity score, comparable levels of improvement can be attained through rehabilitation. In 2018, Bemgard et al.[19] found the relationship between 11 out of 20 activities of SHFT and Q-DASH score sensitive in patients with distal radius fractures, emphasizing that the short form of SHFT can be used in clinical practice. In our study, a significant increase in SHFT score was observed in all mHISS groups, more rapidly in the first 4 weeks and by week 12. At the fourth and twelfth week, as the severity of injury increased in the mHISS groups, the SHFT score was found to be significantly lower. In our study, a positive correlation was found between mHISS total and DASH-total and PRWHE-total scores in all controls. This finding suggests that higher injury severity is associated with lower functional capacity. The PRWHE-pain section did not show a significant correlation between injury severity and pain score at all follow-ups. This may be due to injury to an anatomical structure with a low coefficient in the scoring or the emotional subjectivity of pain perception. Several studies in the current literature have shown a correlation between high mHISS and the DASH scale, which is consistent with our study[3, 20]. However, no study has investigated the relationship between the PRWHE scale and the injury severity score. This study is the first to investigate the relationship between injury severity score and PRWHE, and the data obtained make a significant contribution to the literature. This finding supports the existing literature which has demonstrated a link between certain subdivisions of HAQ and hand function in hand injuries[21, 22]. In our study, a positive correlation was found between total mHISS and total HAQ score at all follow-up visits. According to this result, increasing injury severity is associated with a decrease in self-report functional status. The limitations of our study are mainly the small number of patients in the group. In addition, the last evaluation of the patients was at week 12 and data for the later period are not available.

CONCLUSION

In traumatic hand injuries, a high injury severity score is associated with impaired upper extremity functionality. Therefore, it is possible to determine functionality and use it in prognosis with the severity score. By knowing the patient's prognosis from the first application, the treatment and rehabilitation process can be managed to increase the patients' functionality both functionally and psychosocially.

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REFERENCES:

1. Simmen BR, Angst F, Schwyzer HK, Herren DB, Pap G, Aeschlimann A, et al. A concept for comprehensively measuring health, function and quality of life following orthopaedic interventions of the upper extremity. Arch Orthop Trauma Surg. 2009;129(1):113-8.
2. Hoang-Kim A, Pegreffi F, Moroni A, Ladd A. Measuring wrist and hand function: common scales and checklists. Injury. 2011;42(3):253-8.
3. Rosberg HE, Carlsson KS, Dahlin LB. Prospective study of patients with injuries to the hand and forearm: costs, function, and general health. Scand J Plast Reconstr Surg Hand Surg. 2005;39(6):360-9.
4. Urso-Baiarda F, Lyons RA, Laing JH, Brophy S, Wareham K, Camp D. A prospective evaluation of the Modified Hand Injury Severity Score in predicting return to work. Int J Surg. 2008;6(1):45-50.
5. Trybus M, Lorkowski J, Brongel L, Hladki W. Causes and consequences of hand injuries. Am J Surg. 2006;192(1):52-7.
6. Beaton DE, Katz JN, Fossel AH, Wright JG, Tarasuk V, Bombardier C. Measuring the whole or the parts? Validity, reliability, and responsiveness of the Disabilities of the Arm, Shoulder and Hand outcome measure in different regions of the upper extremity. J Hand Ther. 2001;14(2):128-46.
7. Angst F, Schwyzer HK, Aeschlimann A, Simmen BR, Goldhahn J. Measures of adult shoulder function: Disabilities of the Arm, Shoulder, and Hand Questionnaire (DASH) and its short version (QuickDASH), Shoulder Pain and Disability Index (SPADI), American Shoulder and Elbow Surgeons (ASES) Society standardized shoulder assessment form, Constant (Murley) Score (CS), Simple Shoulder Test (SST), Oxford Shoulder Score (OSS), Shoulder Disability Questionnaire (SDQ), and Western Ontario Shoulder Instability Index (WOSI). Arthritis Care Res (Hoboken). 2011;63 Suppl 11:S174-88.
8. Wajngarten D, Campos JÁ DB, Garcia P. The Disabilities of the Arm, Shoulder and Hand scale in the evaluation of disability - A literature review. Med Lav. 2017;108(4):314-23.
9. Sollerman C, Ejeskär A. Sollerman hand function test. A standardised method and its use in tetraplegic patients. Scand J Plast Reconstr Surg Hand Surg. 1995;29(2):167-76.
10. Öke Topcu D, İkbali Afşar S. Reliability, validity, and cross-cultural adaptation study of the Turkish version of the Patient-Rated Wrist/Hand Evaluation questionnaire. Turk J Med Sci. 2019;49(2):574-82.
11. Küçükdeveci AA, Sahin H, Ataman S, Griffiths B, Tennant A. Issues in cross-cultural validity: example from the adaptation, reliability, and validity testing of a Turkish version of the Stanford Health Assessment Questionnaire. Arthritis Rheum. 2004;51(1):14-9.
12. Eser F, Aktekin LA, Bodur H, Atan C. Etiological factors of traumatic peripheral nerve injuries. Neurol India. 2009;57(4):434-7.
13. Ozdemir HM, Biber E, Oğün T. [The results of nerve repair in combined nerve-tendon injuries of the forearm]. Ulus Travma Acil Cerrahi Derg. 2004;10(1):51-6.
14. Kouyoumdjian JA. Peripheral nerve injuries: a retrospective survey of 456 cases. Muscle Nerve. 2006;34(6):785-8.
15. Ciaramitaro P, Mondelli M, Logullo F, Grimaldi S, Battiston B, Sard A, et al. Traumatic peripheral nerve injuries: epidemiological findings, neuropathic pain and quality of life in 158 patients. J Peripher Nerv Syst. 2010;15(2):120-7.
16. Keskin D SÜ, Bodur H, Sevil A, Erdoğan B, Akyüz M. Clinical Characteristics of Patients with Tendon Injuries. Turk J Phys Med Rehabil. 2005;51(3):94-7.
17. de Jong JP, Nguyen JT, Sonnema AJ, Nguyen EC, Amadio PC, Moran SL. The incidence of acute traumatic tendon injuries in the hand and wrist: a 10-year population-based study. Clin Orthop Surg. 2014;6(2):196-202.
18. Lin DC, Chang JH, Shieh SJ, Tsai FH, Lee YL. Prediction of hand strength by hand injury severity scoring system in hand injured patients. Disabil Rehabil. 2012;34(5):423-8.
19. Bemgård M, Archenholtz B. Developing an instrument for the measurement of grip ability after distal radius fracture. Scand J Occup Ther. 2018;25(6):466-74.
20. Saxena P, Cutler L, Feldberg L. Assessment of the severity of hand injuries using "hand injury severity score", and its correlation with the functional outcome. Injury. 2004;35(5):511-6.
21. Sahin F, Kotevoglu N, Taspinar S, Yilmaz F, Kuran B. Comparison of functional disability scales and their relevance to radiological progression in patients with rheumatoid arthritis in remission. Clin Exp Rheumatol. 2006;24(5):540-5.
22. Rannou F, Poiraudeau S, Berezné A, Baubet T, Le-Guern V, Cabane J, et al. Assessing disability and quality of life in systemic sclerosis: construct validities of the Cochin Hand Function Scale, Health Assessment Questionnaire (HAQ), Systemic Sclerosis HAQ, and Medical Outcomes Study 36-Item Short Form Health Survey. Arthritis Rheum. 2007;57(1):94-102.

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