 Acta Chir Orthop Traumatol Cech., 91, 2024, No. 4, p. 222–228
DOI: 10.55095/ACHOT2024/029

ORIGINAL PAPER
PŮVODNÍ PRÁCE

Analysis of Punch Injuries: Clinical Characteristics, Management and Outcomes

Analýza poranění způsobených údery pěstí: klinická charakteristika, léčba a výsledky

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ABSTRACT

PURPOSE OF THE STUDY

The aim of this study is to describe injury patterns, characteristics, treatment modalities and functional outcomes after punching related injuries.

MATERIAL AND METHODS

Retrospective data of cases admitted to emergency department following punch injury between January 1, 2012, and December 31, 2022. was collected.

Patient's demographic data, the dominant and injured upper extremity side, punched object, a time of patient admission were recorded. Smoking habit and blood ethanol level were documented. Trauma mechanism, diagnosis (1: dermabrasions: skin, 2: lacerations: neurovascular structures or tendons and 3: osseous pathologies), treatment modalities were analyzed. Outcomes were assessed using the DASH questionnaire (Disabilities of the Arm, Shoulder, and Hand) at the last follow-up.

RESULTS

A total of 1052 patients (male=968 (92%), female=84 (8%)) with mean age 24.6 ± 7.2 included this study. Six hundred and twenty-one (59%) patients punched a solid object and 675 (64%) had osseous pathology. The most commonly fractured bone, injured tendon, injured nerve, and injured artery were 5th metacarpal, extensor digitorum communis (EDC), ulnar nerve, and ulnar artery, respectively. The majority of the patients, (73%) were smokers while 15% of the patients had high level of blood ethanol concentration on admission (82±12.3 mg/100 ml). A comparison between smokers and non-smokers did not reveal any significant differences (p=0.425) in terms of diagnosis whereas 74% of alcoholic patients admitted with lacerations which was statistically significant (p=0.023). Injuries of 321 (30.5%) patients required surgery in the operating room, while 711(67.5 %) patients received interventions in the emergency room setting. The average DASH score differed between subgroups, with significantly higher scores in patients with laceration type injuries (7.2 SD), indicating more disability (p=0.001)

DISCUSSION

The study reveales a high prevalence of hand injuries among individuals aged 18 to 40, with the dominant hand being most affected, primarily due to physical violence and self-harming behaviors. Primary contributing factors to this pattern are the escalated incidents of physical violence and self-harming behaviors arising from an inability to manage anger impulses. Punching solid objects, especially during late afternoon and evening periods often associated with alcohol use, was a common cause, resulting in metacarpal fractures being the most reported injury. Multiple tendon and nerve injuries were frequent, highlighting the severity and complexity of these traumas, often necessitating surgical intervention.

CONCLUSIONS

These findings highlight the several key aspects, including demographic characteristics of the patient population, common causes and types of injuries observed, and the association between alcohol use as well as the specific injury profiles. Satisfactory results can be achieved with both conservative and surgical treatment for punch injuries.

Key words: punching, fisting, boxing injuries, laceration, blood ethanol level.

INTRODUCTION

Hand injuries represent a clinically common reason for admission to the emergency department (2, 9). The cause of injury could be multifactorial. Among those punch / closed fist account for a high proportion of injury mechanism. Intentionally fist striking might have multifactorial reasons including deliberate self-harm, fight, angry outburst or professional sport (6, 7). Consequently it may cause a large spectrum of injuries varying from fractures and dislocations of lacerations requiring neurovascular repair (23).

Different studies have investigated hand and upper extremity injuries regardless of the mechanism. Recent research highlight either only bony injuries of hand in boxing or injury patterns in a specific population such

as athletes or occupational injuries (10, 25, 26). There are only limited number of studies which focuses on the mechanism of injury including entire injury patterns of upper extremity (3, 5, 18). Given the variety of injuries, effective clinical assessment is essential for management of patients presenting with a punch injury. Understanding the nature and the severity of these injuries can help healthcare professionals in accurately diagnosing and effectively managing such cases.

We aimed to describe the characteristics of admissions presenting with injury via punch mechanism to an emergency department in a tertiary center. We also aimed further to identify demographics, and management strategies, and clinical results particularly in this injury pattern.

MATERIAL AND METHODS

Ethic committee approval for the study was granted the institution to which the authors were affiliated (09.2022.1393). The study was conducted in our tertiary-level trauma center of a university hospital. This study included patients who were evaluated in the emergency department due to upper extremity injuries following punching between January 1, 2012, and December 31, 2022. Patients with trauma history related to alternative mechanisms (crush, traffic accidents, etc.) were not included in this study. Patients who discontinued hospital follow-up from 1207 applications, a follow-up period of less than 6 months, those with missing data, or deceased patients were excluded from the study. 1052 patients were enrolled in this study.

The findings were systematically categorised and evaluated into three distinct groups based on the specific injury mechanisms: punching a hard object, punching glass surfaces, and punching during a physical altercation. Incidents of punching a hard object typically involved striking a wall, table, or floor. Admission due to punching during physical altercations included intentional self-injurious behaviour, sports-related altercations, or self-defense situations. The results were categorized into three subgroups based on type of injury (diagnosis): dermabrasions, lacerations and osseous pathologies including joint dislocations. Dermabrasion refers to superficial injury that involves grazing or scraping of the outer layers of skin, while lacerations are deeper and more severe injuries characterized by tears or cuts in the skin. Lacerations often result in significant tissue damage and can involve deeper structures such as vessels, nerves, and tendons. This categorisation helps to understand the injury patterns and their clinical implications within each mechanism of injury.

At the time of first presentation, patient's demographic data (age, gender), the dominant and injured upper extremity side, and time of patient admission were documented. Patient's serum ethanol level (mg/ml) and smoking habit (cigarette pack/year) were evaluated.

The initial evaluation and follow up examinations of the patients were made by two different orthopedics and traumatology specialists experienced in hand surgery. The management of fractures involved either surgical approaches, which include closed or open reduction with fixation or conservative methods utilizing plaster or splints. Treatment for non-osseous injuries included repair of vessels, nerves, muscles, tendons, and/or skin closure.

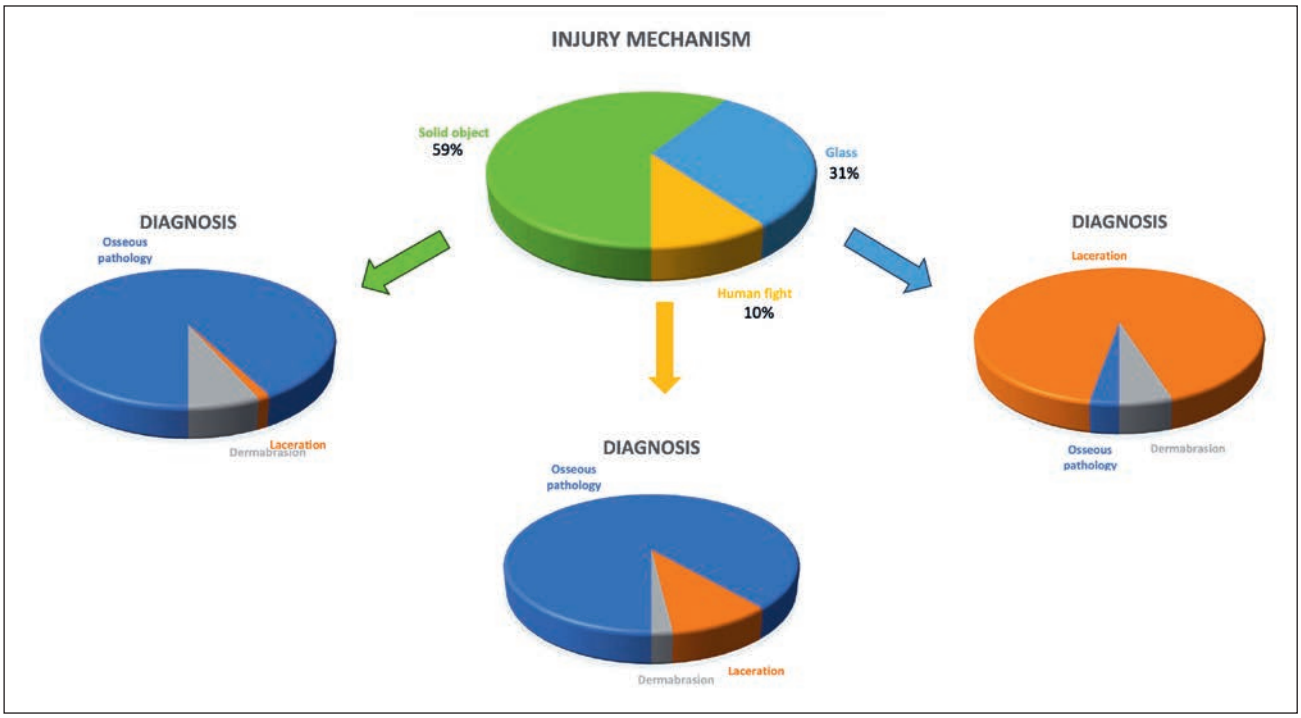

Fig. 1. Injury mechanism and related injuries.

Table 1. Patient demographics

		Patient number (N)	Percentage (%)
Age	<18	221	21%
	18-40	705	67%
	>40	126	12%
Gender	male	968	92%
	female	84	8%
Injury Laterality	dominant	870	83%
	non-dominat	179	17%
	bilateral	3	0.2%
Admission time	00:00-08:00	263	25%
	08:00-16:00	274	26%
	16:00-24:00	515	49%
Injury mechanism	solid object	621	59%
	glass	326	31%
	human fight	105	10%
Alcohol use	yes *	158	15%
	no	894	85%
Cigarette status	yes **	772	73.4%
	no	280	26.6%
Diagnosis	osseous pathology	675	64%
	laceration	318	30%
	dermabrasion	59	6%
Total		1052	100%

* 82±12.3 mg ethanol/100 ml blood mean
** 1 pack per day or more

Our clinical treatment principle for distal fractures of the 5th metacarpal, commonly referred to as Boxer's fracture, is prevention of finger rotation and achieving the neck shaft angle of less than 40 degrees (21). For patients who fail to meet the criteria for adequate reduction using closed reduction techniques we have open reduction and fixation protocol utilizing implants (compression plates, lag screw) or K-wire depending on patient's functional demand and compliance.

Open wound management included tetanus prophylaxis by means of intravenous administration and intramuscular protection was implemented for all patients with open fractures and lacerations. Antibiotics were expeditiously administered within the initial 30 minutes of admission to individuals presenting with open wound injuries (2 g iv cefazolin every 8 hours (total 3 doses) (8). In accordance with the institutional policy, the use of antibiotics was discontinued 24 hours subsequent to definitive wound closure, unless an explicit infection was documented. To ensure immobilization, the affected extremities were carefully secured with either short or long arm splints.

During the concluding follow-up, patients who were still under active monitoring were assessed. Patients whose follow-up had ceased were summoned for an additional examination and assessed. The treatment details provided to the patients were validated rigorously. Experienced orthopaedic-trained hand surgeons performed all assessments using a protocol that evaluated medical complications and applied the DASH questionnaire (Disabilities of the Arm, Shoulder, and Hand). Under standard conditions, patients were asked to complete questions based on daily activities and symptoms, including pain, as well as an optional module for work and sports/performing arts. The score ranges from 0 to 100 points, with 0 representing complete and unrestricted function of the upper extremities, while 100 represents the greatest possible functional impairment**.**

Data entry and data analysis were performed using Statistical Package for the Social Sciences software (SPSS version 18.0, Chicago, IL, USA). Descriptive statistics were stated in the tables as number and percentage for discrete random variables and as mean±standard deviation, or median and range values as appropriate for continuous random variables. The Chi-square test was used in the comparisons between categorical variables, and the unpaired t-test and One-Way ANOVA test were applied to continuous variables. The level of statistical significance was set at 0.05.

RESULTS

The study included a total of 1052 patients with mean age 24.6±7.2 who presented with upper extremity injuries. Among the participants, 92% were male (n=968). Dominant extremity was affected in 83% of cases. Regarding the timing of admissions, it was found that 49% of the patients sought medical attention between 16:00-24:00 **(Table 1)**. None of the patients had partially or total extremity amputation on admission. Analysis of the injury mechanisms and diagnosis based on nature of injuries are presented in Figure 1.

The majority of the patients, (73%) were smokers while 15% of the patients had high level of blood ethanol concentration on admission (82±12.3 mg/100 ml). 74% of patients with increased level of ethanol concentration admitted with laceration type injuries which was statistically significant (p=0.023).

The most common fracture region was the metacarpal bones (55.8%) (Table 2, Fig. 2). None of the patients were found to have open fractures. 12.3% of the laceration injuries involved multi regions, affecting both the volar and dorsal sides (Figure 3). Additionally, artery (most common ulnar) injuries were identified in 49 patients (4.6%), while nerve injuries (most common ulnar) were observed in 66 patients (6.2%). The extensor digitorum communis (EDC) and palmaris longus (PL) tendons were found to be the most commonly injured tendons (Table 3). Three patients were diagnosed with joint dislocations (two shoulder, one 4.5. metacarpophalangeal joint). A total of 321 patients (30.5%) un-

Table 2. Fracture locations of patients

Pathology		Patient number (N)	Percentage (%)
Finger fractures	1st finger phalange	13	1.2%
	2nd finger phalange	10	0.9%
	3rd finger phalange	17	1.6%
	4th finger phalange	16	1.5%
	5th finger phalange	21	1.9%
	total	77	7.3%
Metacarpal fractures	proximal	44	4.1%
	shaft	53	5%
	distal (neck)	491	46.6%
	total	588	55.8%
Wrist fractures		3	0.3%
Forearm fractures		4	0.4%
Dislocation		3	0.3%
Total		1052	100%

derwent surgery in the operating room while 711 patients (67.6%) received interventions in the Emergency Room setting. Twenty patients (1.9%) refused treatment, due to personal reasons or preferences. Regarding the management of laceration, it was found that 19.9% (n=209) of such cases were managed surgically (Table 4).

The mean follow-up period was 73.1±16.5 months (Table 5). During the follow up period 4 patients experienced flexor tendon re-ruptures following their initial injury (first 30 days after the operation). 2 of them were noncompliant patients not obeying the instructions and 2 of them was due to early aggressive mobilization by a low experienced physiotherapist. 13 patients presented with a sensory nerve defect. None of the patients required skin grafting due to tissue defects or infection. Three patients developed nonunion as a results of metacarpal neck fractures.

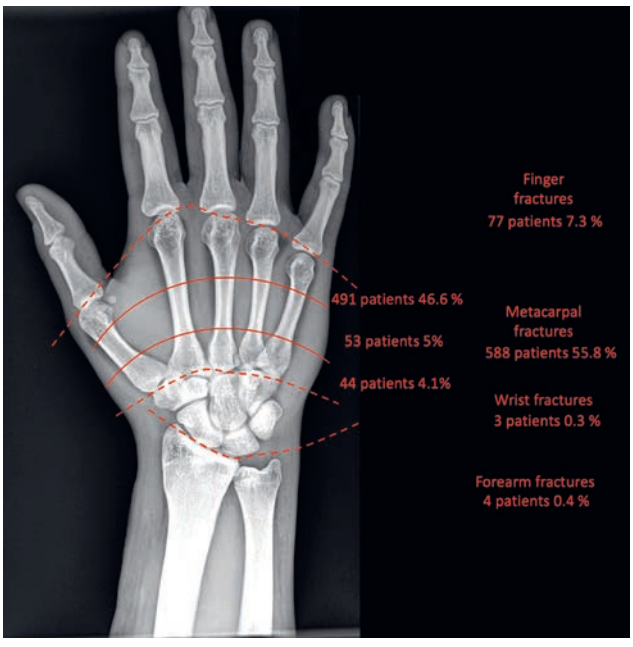

Fig. 2. Distribution of osseous pathologies.

Table 3. Lacerations; distribution of arterial, nerve, muscle and tendon injuries

Pathology		Patient number (N)	Percentage (%)
Region	volar	89	8.4 %
	dorsal	99	9.4 %
	multi region	130	12.3 %
	total	318	30.2 %
Arterial injuries	ulnar	25	2.3 %
	radial	17	1.6 %
	digital	7	0.6 %
	total	49	4.6 %
Nerve injuries	ulnar	31	2.9 %
	median	25	2.3 %
	radial	5	0.5 %
	digital	5	0.5 %
	total	66	6.2 %
Flexor tendon injuries	*palmaris longus*	63	5.9 %
	flexor digitorum superficialis	57	5.4 %
	flexor digitorum profundus	51	4.8 %
	flexor pollicis longus	42	3.9 %
	flexor carpi ulnaris	21	1.9 %
	flexor carpi radialis longus and brevis	15	1.4 %
	total	249	23.6 %
Extensor tendon injuries	*extensor digitorum communis*	79	7.5 %
	extensor pollicis longus and brevis	14	1.3 %
	extensor carpi radialis longus and brevis	4	0.4 %
	extensor carpi ulnaris	4	0.4 %
	extensor digiti minimi	3	0.3 %
	extensor indicis	2	0.2 %
	abductor pollicis longus	2	0.2 %
	total	108	10.2 %
Muscles	*flexor carpi ulnaris*	17	1.6 %
	flexor digitorum superficialis and longus	14	1.4 %
	flexor pollicis brevis and longus	4	0.4 %
	brachioradialis	4	0.4 %
	abductor pollicis brevis and longus	3	0.3 %
	total	42	3.9 %
Total		1052	

Fig. 3. a – Thumb dorsal penetrating injury after punching glass. Extensor hallucis longus injury; b – the photograph shows 21-year-old male patient with a multi-penetrating injury on the dorsal side of hand. There was a third EDC injury in the extensor zone 6 incision; c, d – first evaluation photograph of the patient with volar zone 5 penetrating injury after punching glass and median nerve injury image after exploration.

The DASH score varied significantly among different diagnosis groups. (p=0.001). Patients with osseous pathology had an average DASH score of 2.1±2.0, whereas patients in laceration group had an average DASH score of 7.2±3.4, indicating moderate disability (Table 5).

DISCUSSION

This retrospective epidemiological study aimed to identify punch injuries in a third level trauma center. The findings of our study reveal a significant prevalence of hand injuries among individuals aged 18 to 40,

Table 4. Treatment procedure of patients

Diagnosis	Surgery in OR		Outpatient clinic		Refusal of treatment		Total	
	Patient number (N)	Percentage (%)	Patient number (N)	Percentage (%)	Patient number (N)	Percentage (%)	Patient number (N)	Percentage (%)
Osseous pathology	112	10.6%	548	52.1%	15	14.2%	675	64.2%
Laceration	209	19.9%	104	9.9%	5	0.5%	318	30.2%
Dermabrasion	0	0	59	5.6%	0	0	59	5.6%
	321	30.5%	711	67.6%	20	1.9%	1052	100%

Outpatient clinic: primary repair and skin clousure under local anestesia. OR: operating room

Table 5. Clinical outcomes of patients according to their diagnosis

	Osseous pathology	Laceration	Dermabrasion	p value
	mean±SD	mean±SD	mean±SD	
Follow-up	72.1±15.4	73.4±12.6	73.1±17.2	0.432[a]
Complication (n)	3	17	0	0.0001[a]
Dash score	2.1±2.0	7.2±3.4	0.1±1.1	0.001[a]

a: one-way ANOVA, SD: standard deviation

with a rate of 67% among all admissions. This occurrence is twice as high as in other age groups. The primary contributing factors to this pattern are the escalated incidents of physical violence and self-harming behaviors arising from an inability to manage anger impulses (1, 11, 20). Moreover, the dominant hand is more frequently affected, resulting in challenges pertaining to work and social functioning during the recovery phase. Patients are more likely to suffer from a bone fracture following intentionally punching. This data is consistent with other reports (12, 15, 22). This is mostly related to cause and nature of injury as punching to solid object such as wall or furniture is the most common type of admission. Analysis of the fractures reveals that metacarpal fractures were the most frequently reported injury followed by phalanx fractures. While punching increase in longitudinal compression force at a flexed metacarpophalangeal joint that occurs suddenly causes fracture at metacarpals (16).

To our knowledge, our study is the first to describe the punching-object association of alcohol use in the literature. This situation and age frequency seem to confirm the Alcohol-related physical violence theory of alcohol use (ARPV) (4). Furthermore, our analysis indicates that admission rates were notably elevated during the late afternoon and evening periods. Environmental factors during the evening may contribute to increased rates of self-harm, aggression, and violence among young individuals. Alcohol consumption and substance use during this period can impair cognitive functioning and increase the likelihood of aggressive or violent behaviour (24). Social gatherings and events in the evening may lead to more social interactions, which can create opportunities for conflicts that escalate into physical altercations. Furthermore, fatigue during the evening may contribute to irritability and reduced impulse control, which can increase the risk of engaging in aggressive or violent behaviour. Overall, the increase in admissions resulting from physical altercations among young individuals in the evening can be attributed to a combination of factors, including alcohol and substance use, social interactions, stress, and fatigue.

Schafer at el. reported 15 cases of multiple tendon injuries in a series of 137 patients (23). Our study found a higher incidence of multiple tendon and nerve injuries, indicating a possible correlation between injury mechanism and severity. The forceful impact of a punch can cause significant damage to tendons and surrounding structures, resulting in lacerations, avulsions, or ruptures. Due to superficial location beneath the skin, palmaris longus and extensor digitorum communis were the structure that were affected most frequently.

Data about specific involvement of the *extensor digitorum communis* (EDC) and palmaris longus (PL) tendons as the most commonly injured tendons might aid healthcare professionals in prioritizing their evaluation and guiding appropriate treatment decisions. Early recognition and effective management of tendon injuries are vital to retain optimal hand and finger function, enabling patients to resume their daily activities with minimal impairment.

The high incidence of multiple areas being involved in penetrating injuries, affecting both the volar and dorsal regions, underscores the complexity and potential severity of these injuries. Through evaluation and comprehensive assessment is essential in detection of associated injuries. Injury to the nerve structures affects motor and sensory functions of hand therefore causes a decrease in the quality of life due to impairment in hand precision and prehension.

Previous researches suggest use of antibiotic for penetrating injuries to the musculoskeletal system (13, 17). Early administration of an antibiotic to the patient can prevent the inflammatory reaction and soft tissue infection. In our series besides the huge amounts of open wounds low infection rates was observed. Early administration of initial dose of treatment regimen and effective soft tissue irrigation play an important role in wound healing optimization.

Many authors suggest routine urgent exploration and surgical repair for penetrating upper extremity trauma (14, 19). In our series the majority of laceration injuries required surgical intervention in the operating room. Microsurgical techniques and orthoplastic approaches were applied in sterile operating rooms. Despite stable condition and normal findings surgical explorations may be required to identify potential significant injuries in penetrating type hand trauma. This data reveals that surgical consultation is essential for penetrating injuries after initial physician assessment. In contrast closed fracture management was performed in emergency room without a need of anesthesia and hospitalization. The significant proportion of patients receiving interventions in the Emergency Room setting highlights the critical role that timely and appropriate initial management plays in extremity injuries.

None of the patients required skin grafting due to tissue defects or infection. This suggests that appropriate initial wound care and management strategies employed in the Emergency Room and subsequent interventions were effective in promoting tissue healing and preventing complications.

This study has some limitations. Patients being followed by two different surgeons over a eleven-year period in a study may lead to several potential problems. The diverse approaches and practices of the individual surgeons may introduce bias and confounding factors into the study. Although the institution has implemented standardized protocols for patient management and data collection, the variability in clinical practice and decision-making among the different surgeons may result in inconsistencies in the management and documentation of patient care. Additionally, the retrospective design may limit the scope and depth of data available for analysis. Furthermore, since the study was conducted at a single institution, findings may not be generalizable to a broader population with diverse causes of hand trauma.

CONCLUSIONS

This is the largest patient series of injuries sustained after punching in a general population. Punching is identified as a significant etiological factor contributing to hand and wrist injuries, with a particular emphasis on its prevalence among adolescent patients.

These findings highlight the several key aspects, including demographic characteristics of the patient population, common causes and types of injuries observed, and the association between alcohol use as well as the specific injury profiles. The most commonly fractured bone, injured tendon, injured nerve, and injured artery were 5th metacarpal, EDC, ulnar nerve, and ulnar artery, respectively. Satisfactory results can be achieved with both conservative and surgical treatment for punch injuries. If patient has alcohol use, the risk of lacerations injury by punching glass increases. After punching joint dislocations are less than 1%.

Ethical review committee statement: *This study was approved by the institutional ethics committee (Marmara University Medical School, Ethic Committee for Clinical Research).*

Level of evidence: *Level 3*

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