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PRESENTATION PATTERN OF FIREARM INJURIES AT ORAL & MAXILLOFACIAL SURGERY UNIT IN A PUBLIC SECTOR TERTIARY CARE HOSPITAL AT KARACHI.

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ABSTRACT

OBJECTIVE: To evaluate patterns of firearm injuries of oral & maxillofacial region, in terms of demography, etiology, clinical features presenting at the Oral and Maxillofacial Surgery Unit, Shaheed Mohtarma Benazir Bhutto Institute of Trauma (SMBBIT) Karachi. **STUDY DESIGN:** Descriptive, Cross-sectional study. **PLACE AND DURATION OF STUDY:** Department of Oral & Maxillofacial Surgery, SMBBIT from December 2022 to July 2024. **METHODOLOGY:** The current study included sixty (60) patients who were identified having firearm injuries in oral & maxillofacial region. Data were collected regarding patient's age, gender, etiology, associated hard and soft tissue injuries and analyzed using SPSS version 24. **RESULTS:** The mean age was 36.52±11.14 years and majority of the patients were male's n = 56 (93.3%) as compared to female's n = 4 (6.7%). Most of the events occurred at roadside n = 44 (73.3%) and at daytime n = 48 (80%). The most common reason for injury was robbery n = 24 (40%). Perforating injuries were commonly observed n = 52 (86.7%). The most common site of entry wound was middle & lower third of face (31.7%, n = 19). The most affected dental hard tissues between entry and exit wounds were lower anterior teeth n = 12 (20%). **CONCLUSION:** Scientific values from our study shows that young males and roadside incidents were prevalent. An injury entry site from left side and right sides exit were commonly observed. Future studies need to be conducted on a larger scale to find detailed dynamics about firearm trauma.

KEY WORDS*:* Firearm injuries (FAI), Karachi, Oral & Maxillofacial Region, Pakistan.

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INTRODUCTION

Violence is a worldwide phenomenon and has been categorized as a major public health concern due to increase in its global incidence, especially those that are caused by firearm projectiles[1]. Firearm injuries are a significant public health concern globally, contributing to substantial morbidity, mortality, and economic burden[2]. According to the World Health Organization (WHO), firearm-related deaths account for over 250,000 fatalities annually worldwide, with non-fatal injuries affecting millions more [3]. In the United States alone, the Centers for Disease Control and Prevention (CDC) reports that firearm injuries are among the leading causes of traumatic injuries, with approximately 85,000 non-fatal firearm injuries[4]. In Pakistan, FAI are also common and mainly concomitant with poverty, unemployment, illiteracy, ease of access to illegal weapons, cultural norms as well as due to poor law and order[5]. Studies conducted at Khyber Pakhtunkhwa, Karachi, and Lahore reported the frequency of firearm related maxillofacial trauma to be 20.3 %, 12.8 %, and 01.24 % respectively[6-8]. In particular, firearm injuries to the oral and maxillofacial region are increasingly prevalent due to the anatomical prominence, vulnerability of the face and its exposure during violent encounters[3]. Studies have shown that a significant proportion up to 15-25%, of these injuries involve the head, face, and neck region [9]. Sequelae of Maxillofacial firearm injuries not only involve physical morbidity possibly but it also harbors mental, psychological and economical disability on individual as well as of families and communities[10]. In lower-income and conflict-prone regions, the prevalence of maxillofacial firearm injuries is often higher due to limited access to protective measures and a greater prevalence of interpersonal violence. The pattern and severity of injuries are influenced by factors such as the type of firearm, the range of fire, and the ballistic properties of the projectile[11]. The causality of FAIs spotlights the critical importance of essential preventive programs and policies to lower the incidence of FAIs [12]. Dearth of reports has been published for the patterns of FAIs in Karachi and in addition our national data bank and incidence of FAI is also unclear. Our OMFS Unit located at SMBBIT is one of the major tertiary care referral centers where we manage a high volume of patients that sustain Maxillofacial injuries due to various causes and mechanisms. This study aims to analyze the patterns of firearm injuries presented in oral and maxillofacial surgery unit located at SMBBIT, Karachi and by publishing this local study we also contribute to strengthen national data. By identifying trends and characteristics of these injuries, this research seeks to provide valuable insights into their epidemiology and highlight the social dynamics faced by Karachi and the associated significance of maintaining law and order.

METHODOLOGY

Upon taking approval from the Ethical review board of the institute (ERC-000055/SMBBIT/Approval/2022), a prospective, cross-sectional study was conducted in the Department of Oral & Maxillofacial Surgery, Shaheed Mohtarma Benazir Bhutto Institute of Trauma (SMBBIT), for a duration of 20 months from December 2022 to July 2024. This study was conducted over a defined study window rather than utilizing calculated sample size. A non-probability consecutive sampling technique was used. The patients attending the Accident and Emergency Department as well as Outpatient Section/Department of Oral and Maxillofacial Surgery at Shaheed Mohtarma Benazir Bhutto Institute of Trauma Center, Karachi with a history of firearm injury (FAI) were thoroughly assessed. All the consecutive adult patients

(≥18 years) and either gender sustaining firearm injury in the Oral & Maxillofacial region were included in the current study. Patients younger than 18 years of age, cases of maxillofacial blast injuries, old cases with history of firearm for more than one year, firearm injuries occurring elsewhere in the body, known pregnancy status and patients refusing treatment/consenting and LAMA (Leave Against Medical Advice) cases were excluded.

After providing primary emergency treatment in accordance with the Advanced Trauma Life Support (ATLS) guidelines[13], and once patient condition is stabilized, an informed consent was taken from the patient or next of kin (in case if patient is not in a state of giving consent). History followed by thorough clinical examination with relevant investigations like X-rays of face or CT scan plain of face with 3D reconstruction were carried out to determine facial bone(s) involved with FAI. All the data collected was recorded on a predesigned proforma. Every patient requiring care under OMFS team was admitted to our ward and managed according to a prioritized sequence of interventions. Multidisciplinary approach, when required, ensued.

The data were analyzed by using statistical package for the social sciences (SPSS) version 24 using descriptive statistics. The frequencies and percentages were calculated for qualitative variables like gender, occupation, marital status, education status, residential region, location of incident, estimated time of incident, cause and mechanism of injury, entry and exit sites. Mean and standard deviation were calculated for numerical variables like age.

RESULTS

A total of 60 patients were included in this study who met the inclusion and exclusion criteria during the study period. The mean age was 36.52±11.14 years. Majority of the patients were males as compared to females, n = 56 (93.3%) and n = 04 (6.7%), respectively. Married patients were n = 38 (63.3%) and unmarried patients were n = 22 (36.7%). The most common comorbid condition was diabetes mellitus, n = 8 (13.3%,).

Most of the events occurred at roadside n = 44 (73.3%) and at daytime n = 48 (80%). The most common cause of reason was robbery n = 24 (40%). On-purpose homicide n = 49 (81.7%) was the most common mechanism of injury and most of the foreign bodies were passed n = 49 (81.7%). [Graph 1 & 2, Table 2]

GRAPH 01: DISTRIBUTION OF SUBJECTS ACCORDING TO THE PLACE OF EVENT OCCURRED (N = 60)

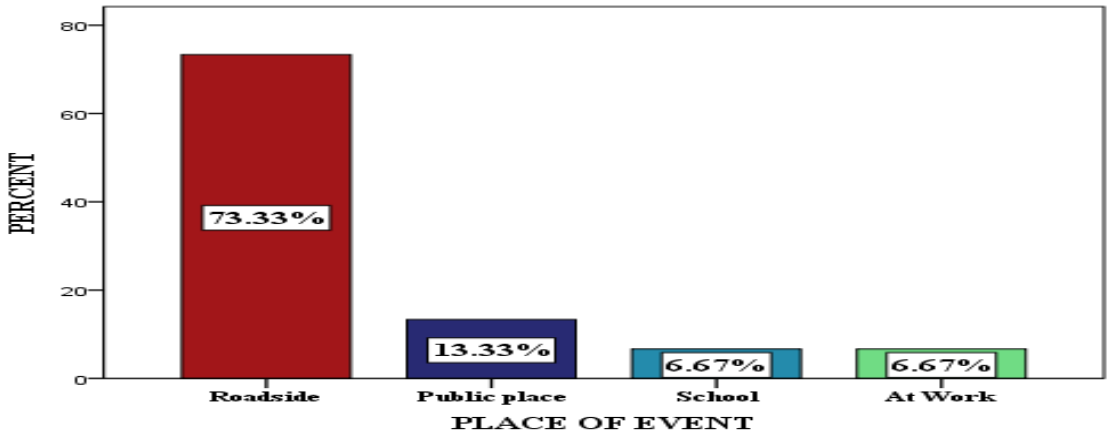


TABLE NO. 01: BASELINE PARAMETERS OF STUDY SUBJECTS (N = 60)

Parameters	Frequency	Percent
Age – years	36.5±11.1	
Gender		
Male	56	93.3
Female	4	6.7
Marital status		
Unmarried	22	36.7
Married	38	63.6
Comorbid	28	10.1
NKCM	48	80
Diabetes mellitus	8	13.3
Hypertension	4	6.7
Addiction habits		
Addicted	12	20
Not addicted	48	80
Occupation		
Farmer	18	30
Business	4	6.7
Student	12	20
Landlord	4	6.7
Laborer	22	36.6

NKCM = No known comorbid

TABLE NO. 02: FIREARM INJURY RELATED DISTRIBUTION OF PATIENTS (N = 60)

Parameters	Frequency	Percent
Mechanism of injury		
Homicide / on purpose	49	81.7
Self-inflicted / accidental	4	6.7
Homicide / accidental	7	11.7
Time of incident	22	36.7
Day time	48	80
Nighttime	12	20
Status of foreign body		
Present	11	18.3
Passed	49	81.7

In terms of characteristics of firearm injuries, in 100% of the firearm injuries the number of entry wounds were single while number of single exit wounds were n = 45 (75%). The most common site of entry wound was middle & lower thirds of face equally n = 19 (31.7%) with left side dominant, n = 34 (56.7%) while common site of exit wound was lower third of face n = 23 (38.3%) and on right side, n = 30 (50%). Perforating pattern was commonly observed for entry wounds, n = 52 (86.7%) and avulsion for exit wounds, n = 26 (43.3%).

GRAPH 02: DISTRIBUTION OF SUBJECTS ACCORDING TO THE CAUSE OF INJURY (N = 60)

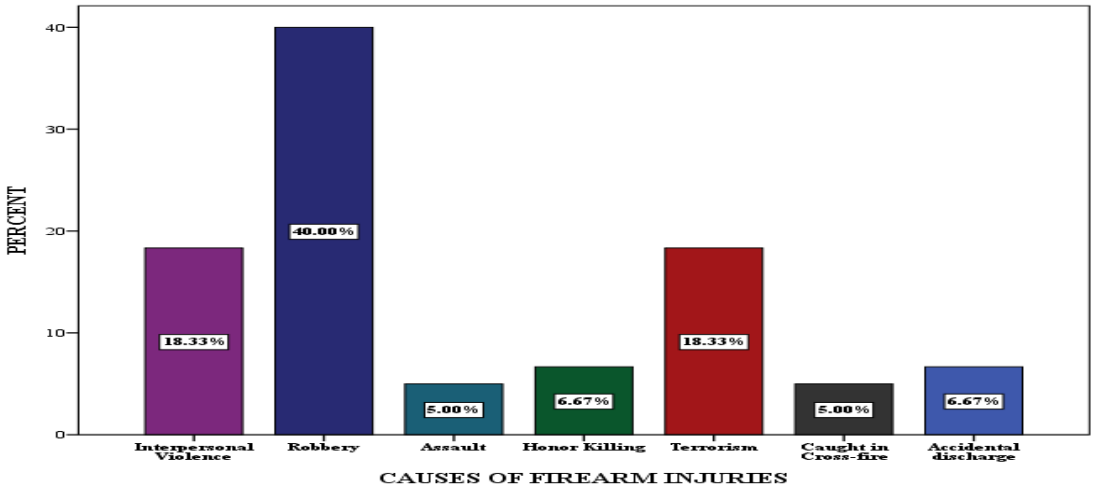


TABLE 03. CHARACTERSTICS OF FIREARM INJURIES (N = 60)

Pattern	Frequency	Percent
Type of entry wound		
Penetrating	8	13.3
Perforating	52	86.7
No. of entry wound		
Single	60	100
Site of entry wound		
Upper third of face	12	20
Middle third of face	19	31.7
Lower third of face	19	31.7
Zone 3 neck	10	16.7
Side of entry wound		
Right	26	43.3
Left	34	56.7
Type of exit wound		
None	11	18.3
Perforating	23	38.3
Avulsion	26	43.3
No. of exit wound		
None	11	18.3
Single	45	75
Multiple	4	6.7
Site of exit wound		
Not available	11	18.3
Middle third of face	18	30
Lower third of face	23	38.3
Zone 3 neck	8	13.3
Side of exit wound		
Not available	11	18.3
Right	30	50
Left	19	31.7

Entry wound of extra oral soft tissue firearm injuries was more commonly observed on left side of the middle facial third and zone 3 of neck equally with upper half of lower facial third of right-side, n = 11 (18.3%). While exit wound of extra oral soft tissue firearm injuries was more commonly observed in upper half of lower facial third of right-side n = 10 (16.7%). [Table 5-7 & Graph 04]

TABLE 06. SOFT TISSUE FIREARM INJURIES – EXTEA ORAL (N = 60)

Pattern	Frequency	Percent
Extra oral soft tissue entry wound		
Upper facial third right side	4	6.7
Upper facial third left side	8	13.3
Middle facial third right side	3	5
Middle facial third left side	11	18.3
Lower facial third right side	4	6.7
Upper half of lower facial third of right side	11	18.3
Upper half of lower facial third of left side	4	6.7
Lower half of lower facial third of right side	4	6.7
Zone 3 neck left side	11	18.3
Extra oral soft tissue exit wound		
None	11	18.3
Middle facial third right side	8	13.3
Pre-auricular area right side	7	11.7
Upper half of lower facial third of right side	10	16.7
Upper half of lower facial third of left side	8	13.3
Lower half of lower facial third of right side	8	13.3
Zone 2 neck right side	4	6.7
Zone 3 neck left side	4	6.7

Intra-oral soft tissue entry firearm injuries were equally common at all areas (6.7%, n = 4). However, exit soft tissue injuries of intra-oral cavity was more common at right buccal mucosa & lower labial vestibule (18. 3%, n = 11). The upper anterior gingiva and 2nd of anterior tongue were equally affected (13.3%, n = 8).

GRAPH 04: AFFECTED INTRA ORAL SOFT TISSUES BETWEEN ENTRY AND EXIT WOUNDS (N = 60)

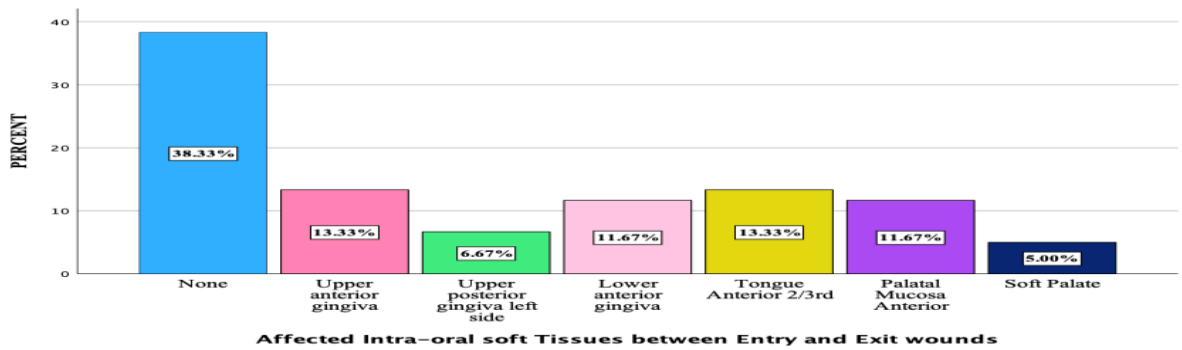


TABLE 07 SOFT TISSUE FIREARM INJURIES – INTRA ORAL (N = 60)

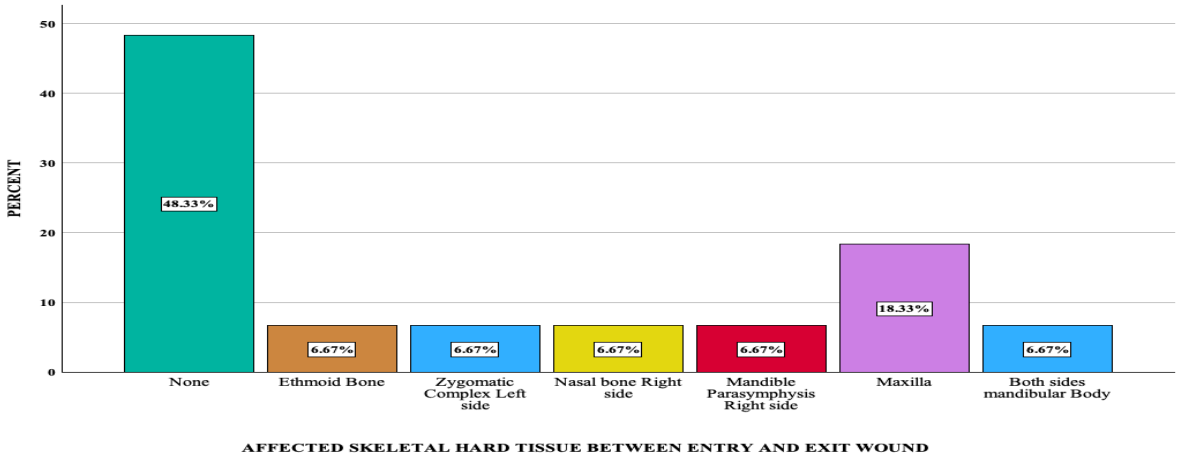
Pattern	Frequency	Percent
Intra oral soft tissue entry wound		
None	36	60
Lower labial mucosa	4	6.7
Right buccal Mucosa	4	6.7
Left Buccal mucosa	4	6.7
Palatal Mucosa Anterior	4	6.7
Left Upper Buccal Vestibule	4	6.7
Left Buccal Lower Vestibule	4	6.7
Intra oral soft tissue exit wound		
None	26	43.3
Lower anterior gingiva	4	6.7
Right buccal Mucosa	11	18.3
Left Buccal mucosa	4	6.7
Left Buccal Lower Vestibule	4	6.7
Lower Labial vestibule	11	18.3
Zone 2 neck right side	4	6.7
Zone 3 neck left side	4	6.7

In relation to firearm injuries related to skeletal hard tissue, we have observed that entry wound was more at right side of mandible angle region n = 14 (21.7%) and exit wound was more common at right side of the zygomatic complex n = 12 (20%). [Table 5]

TABLE 05. FIREARM INJURIES RELATED TO HARD SKELETAL TISSUES (N = 60)

Pattern	Frequency	Percent
Skeletal hard tissue entry wound		
Zygomatic complex right side	3	5
Zygomatic complex left side	2	3.3
Orbital floor right side	3	5
Orbital floor left side	4	6.7
Maxilla right side	4	6.7
Maxilla left side	4	6.7
Mandible Para symphysis right side	7	11.6
Mandible angle right side	14	23.3
Mandible angle left side	9	15
Left orbit	4	6.7
Left ear	1	1.6
Skeletal hard tissue exit wound		
Zygomatic complex right side	12	20
Maxilla right side	4	6.7
Maxilla left side	3	5
Mandible symphysis	4	6.7
Mandible Parasymphysis right side	4	6.7
Mandible body right side	3	5
Mandible body left side	4	6.7
Mandible angle left side	8	13.3
Mandible condyle right side	3	5
Base of skull	3	5

Graph 04: AFFECTED SKELETAL HARD TISSUE BETWEEN ENTRY AND EXIT WOUND (N = 60)

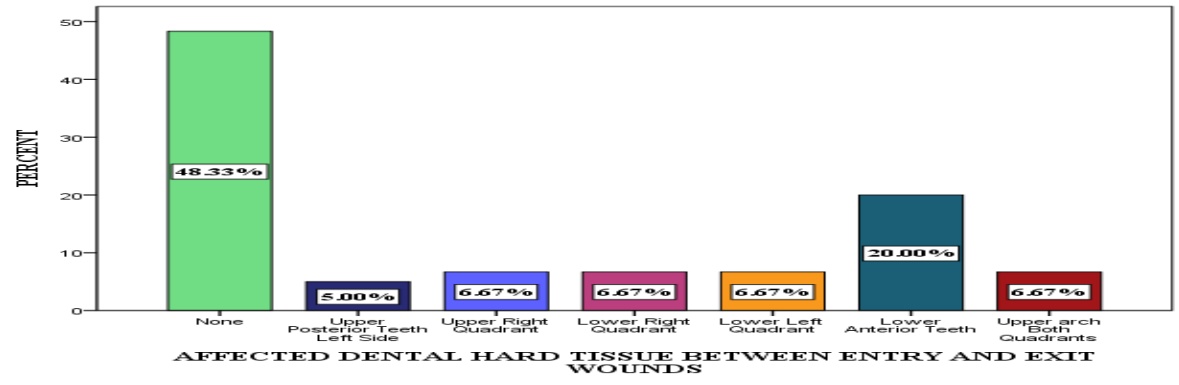


The most affected dental hard tissues between entry and exit wounds were lower anterior teeth n = 12 (20%).

TABLE 04. FIREARM INJURIES RELATED TO DENTAL TISSUES (N = 60)

Pattern	Frequency	Percent
Hard tissue entry wound		
None	48	80
Upper Posterior Teeth Left Side	4	6.7
Lower Right Quadrant	4	6.7
Upper arch Both Quadrants	4	6.7
Hard tissue exit wound		
None	42	70
Upper Left Quadrant	3	5
Lower Right Quadrant	3	5
Lower Left Quadrant	4	6.7
Upper Anterior Teeth	4	6.7
Lower Anterior Teeth	4	6.7

GRAPH 03: AFFECTED DENTAL HARD TISSUE BETWEEN ENTRY AND EXIT WOUNDS (N = 60)



DISCUSSION

Firearm injuries becoming common since the access of firearms to the common people is easy. Oral and maxillofacial region is the common site affected by firearm injuries surgeons encounter at emergency department on regular basis. In Pakistan, a definite figure is difficult to put forth because of very sporadic studies which fail to take a population cohort as a representative sample. In this study, 60 patients were enrolled who encountered firearm injuries. The most common mechanism of injury was homicide (on purpose) accounted for 81.7% (n = 49) of the total study subjects. Relatively higher percentage of people residing in Peshawar, Pakistan had same cause of firearm injury (91.87%) [14]. On the other hands, another study conducted in Bahawalpur Pakistan has shown homicide was the second most common cause of firearm injuries [15]. While the international data shows disparity in the mechanism of firearm injuries. Study conducted by Shankar U and colleagues from India have observed the most common causes of firearm injuries to the face were interpersonal violence, assaults, and suicide attempts [16]. The differences in the mechanism of injury among studies could be due to multiple reasons such as rate of depression, rate of crime in a particular area, and also, access to the firearms.

The patterns of firearm injuries in Karachi have evolved significantly over the years, reflecting the shifting landscape of violence in the city. Previously dominated by street crime and gang-related conflicts, firearm-related injuries are now increasingly linked to targeted assassinations, terrorist attacks, and organized extremist violence. The rise in high-impact assaults, including suicide bombings and mass-casualty incidents, has led to more severe injury patterns, requiring advanced trauma management strategies. In our study we also observed causes of firearm injuries. The most common cause of firearm injury in our study was robbery (40%) followed by interpersonal violence (18.33%), and terrorism (18.33%). The similar findings were observed from a study conducted in Karachi by Nasrullah M and colleagues where 40% of the firearm injuries were caused by robbery[17]. Similar results were observed from another study conducted in Karachi where more than half of the cases (64.4%) were reported after robbery attempt[18]. Not surprisingly, studies from developed nations such as America, United Kingdom, and Canada the most common cause of OMF firearm injuries were accidental (42.4%)[19]. The reason is quite obvious, developing nations have higher rates of crime due to poverty that is why rates of robbery is higher than developed countries. Another reason of higher rates of robbery could be due to improper law & order and people less likely to get punished after they caught doing crime.

In our study, soft tissue injury was predominant than hard tissue injuries. Similar results were observed from a previously published study[20]. Higher rate of soft tissue injuries are due to when projectile object hit bone, it can deform or fragment, causing greater damage to the surrounding soft tissue as it ricochets and tears through muscle and other delicate structures[21]. However, a study conducted by Motamedi MHK and colleagues have observed higher prevalence of hard tissue injuries [22]. This difference could be due to the type of firearm used because high impact projectile firearms are more likely to damage hard tissue than soft tissues [23]. Also, contact injuries causes similar damage as riffle and injure more hard tissues than soft tissues[11].

The actual prevalence of facial gunshots is unknown, but it has been reported that 6% of gunshot wounds located in the maxillofacial region. In addition, 50% of suicide attempts, 14% of assaults, and 12% of accident injuries have been reported to take place in this area and 22% of maxillofacial gunshot wound (MGSWs)

include mandibular gunshots. The individuals with firearm wounds to the face in the present study exhibited different clinical characteristics and patterns. Regarding gender and age group, the findings agree with those reported in the literature, revealing a predominance of the male gender and young adults[24]. A retrospective study on gunshot wounds and explosions reports 1,155 injuries, 36% of which were gunshot wounds; the male gender was affected in 71% of the cases (84% of gunshot injuries); 53% of the sample was between 15 and 29 years of age (59% of whom received gunshot wounds); and there were greater proportions of open wounds (63%) and fractures (42%)[25]. A longitudinal study conducted in Karachi for a period of 5 years also observed male predominance with a 2:1 ratio and also, affected individuals were belongs to young group of people. The reason behind this cause is obvious, as youngsters are more attracted towards such activities which make them prone to firearm injuries. Also, similar findings are also observed in multiple national and international studies that justify the reasoning[26].

In terms of co-morbidities, majority of the victims have no medically compromising condition, but few, of which diabetes mellitus and hypertension are prevalent. This is consistent with the previous studies, conducted in the city, observing common presenting medical conditions [27]. Our study population shows a significant number of patients with addiction history. However, the importance of concomitant medical conditions along with the history of addiction, in individuals sustaining fire-arm injuries, relates to the systemic condition, fracture pattern and healing of the wounds, ultimately predicting prognosis of the case. The fact that most of the victims of gun injury in the study were laborers highlights the vulnerability of this group, which also belongs to lower socioeconomic classes and is subject to poor working conditions or environments within their residential areas. Laborers continuously face heightened risks of violence in the form of economic deprivation, poor infrastructure, and diminished access to education and health. That roadsides are the most common location for gun injury highlights public space vulnerability. Busy and visible roadsides also attract a heterogeneous group of individuals, creating the backdrop for arguments, robberies, or premeditated attacks. Poor lighting, few police, and socioeconomic factors make these locations particularly susceptible to violence. The finding that robbery is the leading cause of firearm injuries, followed by interpersonal violence and terrorism, suggests multiple drivers of gun harm. Harm from robbery suggests financial troubles [28] and criminality as drivers of violence, with firearms used to threaten or harm victims.

The midface—nose, maxilla, and cheekbones—is vulnerable due to its thin bone structure, while the lower third, especially the jaw, is often hit due to positioning in self-inflicted or assault-related cases. These findings are also in agreement with the previously published study in which authors have shown upper third of the face was most common site of firearm injuries [29]. Shah K and colleagues found lower third area was the most common site of firearm injuries[30].

Recording and publishing current injury trends is crucial for several reasons. First, it provides critical data for healthcare systems to improve emergency preparedness and resource allocation. Second, it helps law enforcement and policymakers identify emerging threats and implement targeted interventions. Most importantly, by shedding light on these evolving patterns, such research contributes to a broader discourse on violence prevention and public safety, ultimately guiding efforts to reduce firearm-related morbidity and mortality in Karachi.

CONCLUSION

In our study we have observed that firearm injuries at maxillofacial region poses a great importance. Scientific values from our study shows that young males are common and roadside incidents were also prevalent. Injury entry site from left side and right sides exit were commonly observed. Future studies need to be conducted on larger scale to validate our study's findings.

STUDY STRENGTHS

Karachi is Pakistan's mega Economic Capital city having multi-dimensional, multi linguistic and multiethnic population (31). Our study reports the present dynamics of firearm injuries related to head and neck region from the largest tertiary care referral teaching hospital in Karachi, Sindh province.

STUDY LIMITATIONS: The patterns are recorded from limited sample size due to constraint in the study window period. Similar studies at large scale may suffice further information on the topic.

ETHICS APPROVAL: The ERC gave ethical review approval.

CONSENT TO PARTICIPATE: written and verbal consent was taken from subjects and next of kin.

FUNDING: The work was not financially supported by any organization. The entire expense was taken by the authors.

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AUTHORS' CONTRIBUTIONS:

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated in the work to take public responsibility of this manuscript. All authors read and approved the final manuscript.

CONFLICT OF INTEREST: No competing interest declared

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