

# Comprehensive examination of etiological factors and clinical manifestations of maxillofacial traumas in forensic cases: A five-year retrospective study

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## ABSTRACT

**BACKGROUND:** Maxillofacial injuries, due to their diverse etiological causes, are often considered a component of multi-trauma and constitute a significant portion of trauma. This study aims to elucidate the incidence of maxillofacial traumas, particularly among military personnel, various clinical courses, and characteristics, thereby contributing to the literature.

**METHODS:** Forensic reports, primarily related to military personnel and organized between 2011 and 2016 at the Forensic Medicine Department of Gülhane Medical Faculty, Health Sciences University, were retrospectively examined. The study involved a detailed analysis of cases with maxillofacial injuries resulting from trauma, focusing on aspects such as age, gender, the origin of the trauma, degree of injury, the presence of bone and dental fractures, and the occurrence of psychiatric disorders as a result of the trauma.

**RESULTS:** This study demonstrated that maxillofacial traumas predominantly occurred in young male individuals, particularly among military personnel. The most common etiological factor identified was interpersonal violence. The majority of injuries were soft tissue damages, with the nasal bone being the most frequently fractured area. Injuries to the head and upper extremities were also detected in some of the cases, showing that multiple injuries are common in such cases. Post-traumatic psychological disorders developed in some cases, with anxiety disorders being the most commonly observed.

**CONCLUSION:** It has been determined that maxillofacial injuries can affect multiple body regions, necessitating a multidisciplinary approach. This study underscores the importance of developing comprehensive strategies and policies for understanding and managing maxillofacial traumas, providing a fundamental reference for future studies in this field.

**Keywords:** Forensic medicine; Maxillofacial trauma; military personnel.

## INTRODUCTION

Trauma is a process caused by external factors that disrupt the structure and form of a tissue or organ, leading to serious damage to an individual's physical and psychological integrity. [1] It is frequently encountered and recognized as one of the leading causes of mortality and morbidity. According to data from the World Health Organization, trauma cases account for approximately 9-10% of all deaths in both women and men and are estimated to constitute about 30% of patients

admitted to intensive care units.<sup>[2]</sup> Maxillofacial injuries also constitute a significant portion of traumas, and it is reported that in cases of multiple traumas, the incidence of these injuries can rise to as much as 30%.<sup>[3]</sup> Due to the sensitivity of this anatomical region, maxillofacial injuries present as a significant clinical issue. The prevalence of these injuries, being associated with a range of variables including social, cultural, and environmental factors, is considered a major problem worldwide.<sup>[4-7]</sup> In developing countries, an increase in the incidence of such traumas in recent years has been observed.<sup>[8]</sup>

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The maxillofacial region is anatomically divided into three main parts: the upper face, which includes the frontal bone and frontal sinus; the midface, consisting of the nasal, ethmoid, zygomatic, and maxillary bones; and the lower face, where the mandible is located.<sup>[9]</sup> This region is directly associated with vital functions frequently used in daily life, such as vision, smell, eating, breathing, and speaking. Maxillofacial injuries can seriously disrupt these functions, potentially leading to a decline in quality of life.<sup>[10]</sup> Although maxillofacial injuries often do not pose a life-threatening risk, they are known to cause more loss of labor than the total cases of heart disease and cancer.<sup>[11]</sup> With technological advancements, the changing nature of firearms and the replacement of heavy, hand-held objects with knives and other sharp instruments have increased the number and diversity of maxillofacial injuries.<sup>[12]</sup> The unprotected structure of this region and the thin subcutaneous structure of the facial bones can lead to severe consequences from traumas impacting the maxillofacial area.

Maxillofacial injuries can be extensive, affecting not only the skin and soft tissues on the surface but also the underlying bone tissues and vital organs they contain. As a result of such traumas, patients may experience distortions in facial shape, functional losses, serious health problems, or even the risk of death. Complications such as bone fractures, airway obstructions, brain damage, bleeding, shock conditions, and secondary infections can occur due to the effect of multisystem trauma.<sup>[3,13,14]</sup>

Maxillofacial injuries can severely disrupt the social and emotional functioning of individuals, leading to psychological problems.<sup>[11]</sup> While physical damages are apparent, psychiatric effects are more challenging to identify and can become chronic if not recognized and treated. Individuals suffering from maxillofacial injuries are at risk of psychiatric disorders such as anxiety, depression, Acute Stress Response (ASR), and Post-Traumatic Stress Disorder (PTSD).<sup>[15]</sup> It is indicated that injuries to the head and face more frequently lead to mental illnesses compared to injuries in other parts of the body.<sup>[16]</sup> In light of all these assessments, understanding the etiology and outcomes of injuries to the maxillofacial region contributes significantly to the improvement of health services (emergency interventions, diagnosis, and treatment processes) and the implementation of preventative measures (traffic speed limits, road safety precautions, strategies to prevent workplace accidents, etc.) to minimize such injuries.<sup>[1,17]</sup>

Our study aimed to detail the injury characteristics of maxillofacial trauma cases, predominantly involving military personnel, and contribute to the literature in this field.

## MATERIALS AND METHODS

Forensic reports, mostly related to military personnel and prepared between 2011 and 2016 at the Health Sciences University, were retrospectively examined. Cases with traumatic maxillofacial injuries were included in the study.

The study thoroughly investigated cases with traumatic maxillofacial injuries, focusing on the age at the time of the event, gender, origin of the trauma, degree and type of injury, presence of bone and dental fractures, whether the trauma led to permanent facial scarring, the occurrence of any mental disorders following the trauma, and whether there were other traumatic injuries in addition to the maxillofacial injuries. This study was carried out with the approval of the University of Health Sciences Non-invasive Research Ethics Committee (18.12.2018, 18/339).

### Statistical Analysis

The data obtained from the cases were analyzed using Microsoft Office Excel 2010 and IBM SPSS Statistics version 23.0 (IBM SPSS Statistics for Windows, IBM Corp., Armonk, New York, USA). Descriptive statistics included number (%) and mean standard deviation for continuous variables.

## RESULTS

A total of 2,983 forensic reports were examined over six years from 2011 to 2016, and we determined that 28.6% (n=855) of the cases had maxillofacial trauma and were included in our study.

Of the examined maxillofacial trauma cases, 99.4% (n=850) were male and 0.6% (n=5) were female. The mean age of these cases was calculated to be 22.8 ( $\pm$ 5) years. Of all the cases, 95.8% (n=819) were military personnel (privates, non-commissioned officers, officers, warrant officers, military students), while 4.2% were civilians (Fig. 1).

The most common cause of maxillofacial trauma was assault (n=687, 80.4%), followed by traffic accidents (n=55, 6.4%) and explosion injuries (n=46, 5.4%). Causes of maxillofacial trauma are stated at Figure 2.

The majority of maxillofacial trauma consisted of simple soft tissue injuries (n=417, 48.7%), such as ecchymosis and abrasion. Maxillofacial bone fractures were determined in 25.8% (n=221) of cases. While lacerations smaller than 5 cm were detected in 179 cases (20.9%), lacerations larger than 5 cm were detected in 18 cases (2.1%). Injury degrees of maxillofa-

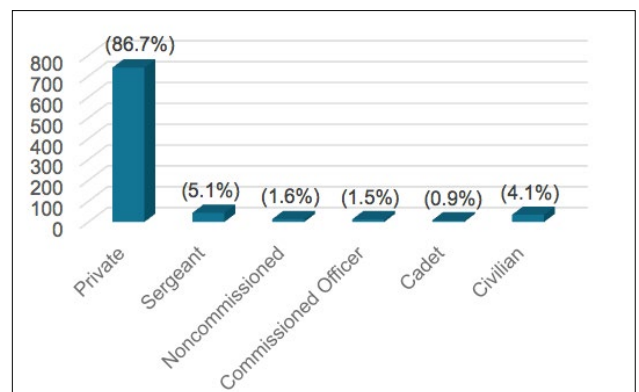


Figure 1. Ranks of the cases.

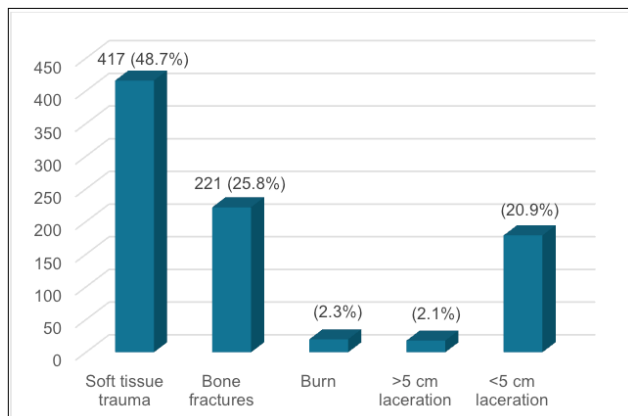


Figure 3. Injury degrees of maxillofacial trauma.

cial trauma are presented in Figure 3.

Of the bone fracture cases reported (n=221), isolated nasal bone fractures (n=137, 61.9%) were the most prevalent type, followed by isolated mandible bone fractures (n=30, 13.5%) and multiple bone fractures (n=26, 11.7%). Types of bone fractures that develop after maxillofacial trauma are presented in Table 1.

There were a total of 145 nasal bone fractures and 33 mandibular fractures among all cases. Among unilateral mandibular fractures, the most fractured region was the angulus mandibulae (n=7, 26.9%), followed by the condyle (n=6, 23%), corpus mandibulae (n=5, 19.2%), parasymphysis mandibulae (n=4, 15.3%), and ramus mandibulae (n=4, 15.3%), respectively. The fracture types of nasal and mandibular fractures are stated in Table 2.

Orbital wall fractures were identified in 23 (2.7%) cases, with left inferior wall fractures (n=8, 34.7%) being the most common fracture region, followed by right inferior wall fractures (n=5, 21.7%) (Table 3).

Dental traumas were detected in 22 (2.5%) cases; 11 cases (50%) had crown fractures, 7 cases (31.8%) had dental avulsions, and 4 cases (18.2%) had both crown fractures and dental avulsions.

While no injuries were detected in any other body parts

**Table 1.** Types of bone fractures after maxillofacial trauma

Bone Fractures	Number of Cases	%
Isolated Frontal Bone	7	3.1%
Isolated Nasal Bone	137	61.9%
Isolated Maxilla	17	7.6%
Isolated Zygomatic Bone	2	0.9%
Isolated Mandible	30	13.5%
Isolated Ethmoid Bone	2	0.9%
Multiple Bone Fractures	26	11.7%
Total	221	100%

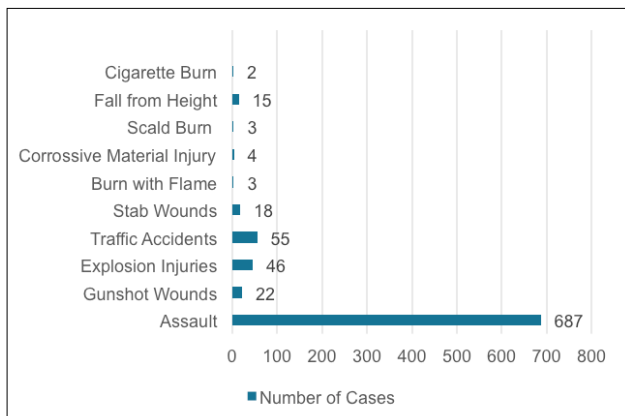


Figure 2. Causes of maxillofacial trauma.

apart from the maxillofacial area in 692 cases (80.9), injuries in other parts of the body were present in 163 cases (19.1%). The most common injuries involved the upper extremities (n=57, 34.9%), the head region (n=50, 30.6%), and the lower extremities (n=20, 12.2%).

Only 3.7% (n=32) of cases developed a psychiatric disorder after maxillofacial trauma, with Anxiety Disorder being the most frequent diagnosis, accounting for 53.1% (n=17), followed by Post-Traumatic Stress Disorder (n=4, 12.5%) and Acute Stress Disorder (n=4, 12.5%). Other psychiatric diagnoses included Adjustment Disorder (n=2, 6.2%), Depressive Disorder (n=2, 6.2%), Anxious Personality Disorder (n=1, 3.1%), Antisocial Personality Disorder (n=1, 3.1%), and Organic Mental Disorder (n=1, 3.1%). Explosion injuries (n=13, 40.6%) were the most common cause of psychiatric disorders. Upon investigating the relationship between the severity of the injury and psychiatric disorder, it was determined that

**Table 2.** The fracture types of nasal bone and mandibular bone

Bone Fractures	Number of Cases	%
<b>Nasal Bone</b>		
Linear	113	77.9
Displaced	23	15.8
Comminuted	9	6.2
Total	145	100
<b>Mandible Bone</b>		
Linear	22	66.6
Comminuted	8	24.2
Compound (Open)	3	9.1
Total	33	100
Right Unilateral	9	27.3
Left Unilateral	17	51.5
Bilateral	7	21.2
Total	33	100

**Table 3.** Characteristics of orbital wall fractures

Bone Fractures	Number of Cases	%
Right Inferior Wall	5	21.7
Left Inferior Wall	8	34.7
Right Medial Wall	2	8.6
Right Lateral Wall	1	4.3
Left Superior Wall	2	8.6
Bilateral Inferior Wall	2	8.6
Multiple Wall Fractures	3	13
Total	23	100

50.1% (n=16) of the cases with facial laceration and 40.6% (n=13) of those with bone fractures were most affected.

In our study, facial nerve injuries were identified in 7 cases (0.8%). In the evaluation conducted six months after the date of the incident regarding whether lesions in the facial region left a permanent scar, it was found that 64 cases had permanent scarring, and one case involved a continuous change in the face.

## DISCUSSION

The majority of cases analyzed were young (mean age  $22.8 \pm 5$  years) and predominantly male (99.4%). Similarly, the literature on both military personnel and civilians consistently indicates that these cases are predominantly young (mean age: 25-31 years) and almost exclusively male.<sup>[18-27]</sup> The incidence of maxillofacial trauma varies according to several factors; however, it generally tends to be more prevalent among young individuals, particularly males. This trend may be associated with factors such as the pursuit of personal independence, the quest for social excitement, an active lifestyle, reckless driving, and higher exposure to violence. Additionally, particularly in developing countries, men's greater participation in the active workforce places them at higher risk, likely exposing them to more risk factors associated with an active social life and other hazards. The chosen profession can also influence the frequency of traumas. Our hospital frequently receives these patients from these groups, particularly soldiers and security forces. Consequently, nearly all (95.8%) of the cases in our study comprise soldiers and security forces. The predominance of males in professions that demand physical strength and endurance, and where traumas are frequently encountered, such as military service and security forces, is considered a significant factor influencing these rates.

The maxillofacial region, being exposed and unprotected, is frequently subjected to trauma. Injuries in this area can vary in severity from mild blows to severe trauma, depending on the etiology of the trauma. Maxillofacial trauma has a multifactorial etiology, including assaults, traffic accidents (Road Traffic Accidents, RTAs), firearm injuries, falls, and more.<sup>[26]</sup>

The level of development of countries, socio-economic differences, and the occupational characteristics of the cases included in the study create diversity in the etiology of trauma. A review of the literature reveals variations in the etiology of maxillofacial injuries. In studies conducted in developing countries on civilian individuals, traffic accidents are most frequently identified as the cause of maxillofacial trauma,<sup>[5,6,13,28,29]</sup> whereas in developed countries, the most common cause is found to be assault.<sup>[6,28,30-33]</sup> In our study, the most frequent etiological cause of injuries in civilian individuals was found to be assault, accounting for 50% of cases, while traffic accidents constituted 36%. Studies on military personnel indicate that the most common causes outside of war include assault, traffic accidents, and blunt injuries. During wartime, penetrating injuries are significant, and due to the relative vulnerability of this region, blast injuries are also impactful.<sup>[19-22,27,34-36]</sup> Although the majority of cases in our study involved military personnel, it was determined that most injuries occurred outside of a war setting, hence assault being the most frequent etiological cause. The literature suggests that the most common causes of non-combat injuries in military personnel and civilian injuries are assaults and traffic accidents, and our study presents similar findings. In our research, the most prevalent cause of maxillofacial injuries was assault (80.4%), followed by traffic accidents (6.4%) and explosions (5.4%). Although most cases in our study involved military personnel, it was determined that the majority of injuries occurred outside of a war setting, making assault the most frequent etiological cause. The literature suggests that the most common causes of non-combat injuries in military personnel and civilian injuries are traffic accidents and assaults, which aligns with the findings of our study.

The maxillofacial region, comprising diverse tissues such as skin, muscle, and bone, as well as critical organs, is notably one of the most susceptible and trauma-prone areas of the body. Injuries in this region can range widely in severity, from minor skin abrasions to complex multiple bone fractures. Extensive research involving both civilian and military populations consistently indicates that maxillofacial injuries predominantly manifest as soft tissue trauma at the skin level, including bruises, abrasions, and lacerations, followed by bone fractures.<sup>[19,20,24,36,37]</sup> In alignment with the existing literature, our study similarly found that the most prevalent type of injury was soft tissue trauma, followed by bone fractures.

Maxillofacial injuries can result in bone fractures, which vary in occurrence depending on the trauma's severity. In our study, the most commonly fractured bone was the nasal bone, followed by the mandible. The literature reveals differing reports on the most frequent sites of maxillofacial fractures post-trauma. Some studies indicate the mandible as the most commonly fractured bone, while others report higher incidences of fractures in the maxilla or nasal bones.<sup>[20-22,27,33,36,38-44]</sup> The facial bones are notably thinner and more fragile compared to those forming the cranial vault, making

them particularly susceptible to fractures.<sup>[45]</sup> Maxillofacial trauma can affect various regions, including the orbits, nasal bones, zygomatic bone, maxilla, and mandible. Moreover, due to its prominent position in the facial anatomy, the nasal bone is especially prone to trauma and is often the first to be impacted during an injury.

In maxillofacial injuries, dental fractures can accompany bone fractures, particularly in traumas directed at the oral region. Our study observed a comparable incidence of dental fractures (2.6%) in both civilian and non-combat military injuries, with crown fractures being the most prevalent. Dental trauma typically affects the anterior teeth, manifesting as crown and avulsion fractures in severe cases.<sup>[46]</sup> Literature on civilian cases reports a low incidence of dental fractures following trauma, ranging from 1.6% to 12%.<sup>[36]</sup> It has been noted that the incidence of dental fractures in non-combat military personnel is similar to that in civilian cases, whereas combat-related injuries exhibit significantly higher rates of dental fractures (28%-39%).<sup>[18,20,41]</sup> Studies indicate that crown fractures are more common in civilian and non-combat military injuries, while avulsion fractures predominate in combat injuries.<sup>[18,36]</sup> High-energy events, particularly explosions, are typically associated with more severe injuries and a consequently higher frequency of dental fractures. Consistent with the literature, our study identified dental fractures in 4 (8.7%) cases where explosions contributed to the etiology, and a higher incidence of dental fractures was detected in combat injuries (21 military personnel and 1 civilian case).

Maxillofacial injuries, given their diverse and numerous etiological factors, are frequently considered components of poly-trauma. As a result, it is common to observe concomitant injuries in other body regions alongside maxillofacial trauma. In our study, 19% of the cases exhibited additional injuries in regions other than the maxillofacial area. A study by Uçak et al. on civilians and military personnel injured during the Syrian civil war revealed that 52.5% of the cases had injuries in more than three body regions, and 39.2% had injuries in one to three body regions. This study also highlighted that head injuries most frequently accompanied maxillofacial injuries.<sup>[41]</sup> Similar research has reported varying rates (23%-47%) of concurrent injuries in other body regions in maxillofacial trauma cases, with a particular emphasis on the head and extremities.<sup>[18,20,24]</sup> Furthermore, our study identified that 24.7% of cases with additional injury sites were due to explosions and gunshot wounds, likely sustained during conflict, aligning with literature on combat-related injuries among military personnel.<sup>[47]</sup> Consistent with existing literature, our findings also indicate that the most frequently accompanying regions in maxillofacial injuries are the upper extremities (34.9%) and the head (30.6%).

Individuals who have experienced maxillofacial trauma can suffer from various psychological effects in addition to the physical impacts of the trauma. While physical injuries can be relatively easily diagnosed and treated, identifying psy-

chological injuries can be challenging. The impact of maxillofacial traumas on mental health is often overlooked. Such traumas can lead to psychological disorders, particularly post-traumatic stress disorder, depression, and anxiety disorders. Permanent disfigurements within the facial region, especially, can negatively affect mental health and delay the recovery process. Research indicates that maxillofacial traumas lead to psychological injuries in approximately 23% to 41% of cases, with post-traumatic stress disorder being the most commonly encountered condition.<sup>[48,49]</sup> However, in contrast to the literature, our study found that only 3.7% of cases exhibited psychiatric disorders, with anxiety disorder being the most common condition. This difference may be linked to the prevalence of interpersonal violence as the etiological factor, rather than high-energy events like traffic accidents and explosions. Additionally, post-traumatic stress disorder is likely to emerge, particularly following high-energy traumas, due to individuals repeatedly reliving the event in their minds. This highlights the complexity of post-traumatic psychological processes and the significant role of trauma severity in influencing mental effects. When examining the frequency and distribution of psychiatric disorders in cases with permanent facial scarring, we found that 27.7% of the cases were diagnosed with a psychiatric illness following the event, with anxiety disorder again being the most prevalent at 53.1%. Considering the necessity of post-traumatic psychological care, enhancing services in this area is anticipated to contribute to a reduction in these rates and to the faster recovery of individuals.

An increase in trauma severity is often associated with a corresponding rise in psychological injuries. Kishore et al. reported that anxiety disorders were more prevalent in patients with maxillofacial bone fractures compared to those with only soft tissue injuries.<sup>[50]</sup> Similarly, another study found that post-traumatic stress disorder (PTSD) was more common in cases involving bone fractures in the maxillofacial area.<sup>[51]</sup> However, some studies have found no significant correlation between injury severity and the incidence of psychological disorders.<sup>[52-55]</sup> In our study, we observed that psychological injuries did not consistently align with the severity of trauma. These findings highlight the nuanced and unpredictable nature of the relationship between trauma severity and mental health disorders.

## CONCLUSION

Our study provides a comprehensive perspective on the etiology, prevalence, and outcomes of maxillofacial traumas, emphasizing the characteristics of such injuries, particularly among military personnel. The high risk among youth is a crucial factor in determining the target audience for preventive strategies and public health interventions. The finding that interpersonal violence is the most common cause of maxillofacial injuries, significantly affecting both civilian young men and military personnel, highlights the necessity of military training

and security measures. It also mandates the development of specialized healthcare services and rehabilitation programs for military personnel.

Another important point revealed by the study is that most maxillofacial traumas occur as soft tissue injuries without fractures in facial bones. This emphasizes the importance of interventions aimed at preserving the aesthetic and functional structures of the face and accelerating healing processes for military personnel. The nasal and mandibular bones, being the most frequently fractured areas, have been identified as regions requiring the development of treatment protocols. The fact that maxillofacial traumas often occur alongside head and upper extremity injuries indicates that such traumas can involve multiple injuries. This necessitates a multidisciplinary approach in military health services and the acquisition of competencies in all necessary fields. A holistic treatment approach for military personnel should encompass not only physical recovery but also support for mental health and should not be neglected.

In conclusion, this study reveals that maxillofacial traumas represent a multidisciplinary problem that necessitates the adoption of holistic strategies and solutions in clinical practices and public health policies, both for the general population and military personnel. Education, awareness creation, and effective preventive measures must play a vital role in reducing the incidence of these traumas and mitigating their consequences. Research and findings in this field, especially for military personnel, will be fundamental in better understanding and managing maxillofacial traumas.

**Ethics Committee Approval:** This study was approved by the University of Health Sciences, Gulhane Faculty of Medicine Ethics Committee (Date: 18.12.2018, Decision No: 2019/01).

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**Conflict of Interest:** None declared.

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## ORJİNAL ÇALIŞMA - ÖZ

## Adli olgularda maksillofasial travmaların etiyolojik faktörleri ve klinik belirtilerinin kapsamlı incelenmesi: Beş yıllık retrospektif bir çalışma

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**AMAÇ:** Maksillofasial yaralanmalar, çeşitli etiyolojik nedenleri sebebiyle sıklıkla çoklu travmanın bir bileşeni olarak kabul edilir ve travmanın önemli bir bölümünü oluşturur. Bu çalışmanın amacı, özellikle askeri personelde görülen maksillofasial travmaların görülme sıklığını, çeşitli klinik seyirini ve özelliklerini aydınlatarak literatüre katkıda bulunmaktır.

**GEREÇ VE YÖNTEM:** Sağlık Bilimleri Üniversitesi Gülhane Tıp Fakültesi Adli Tıp Anabilim Dalı'nda (Gülhane Askeri Tıp Fakültesi) 2011-2016 yılları arasında düzenlenen ve öncelikli olarak askeri personele ilişkin adli raporlar retrospektif olarak incelendi. Çalışma, travma sonucu maksillofasial yaralanması olan vakaların yaş, cinsiyet, travmanın kaynağı, yaralanma derecesi, kemik ve diş kırıklarının varlığı ve travma sonucu psikiyatrik bozuklukların ortaya çıkışı gibi hususlara odaklanarak ayrıntılı bir analizini içermektedir.

**BULGULAR:** Bu çalışma, maksillofasial travmaların ağırlıklı olarak genç erkek bireylerde, özellikle de askeri personelde meydana geldiğini gösterdi. Tespit edilen en yaygın etiyolojik faktör kişilerarası şiddetti. Yaralanmaların çoğunluğu yumuşak doku hasarlarıydı ve en sık kırılan kemik burun kemiğiydi. Bazı vakalarda baş ve üst ekstremitelere yaralanmaları da tespit edildi; bu gibi durumlarda birden fazla yaralanmanın yaygın olduğunu göstermektedir. Travma sonrası psikolojik bozukluklar bazı durumlarda gelişmiş olup, en sık görüleni anksiyete bozukluklarıydı.

**SONUÇ:** Maksillofasial yaralanmaların birden fazla vücut bölgesini etkileyebileceği ve multidisipliner bir yaklaşım gerektirdiği belirlenmiştir. Bu çalışma, maksillofasial travmaları anlamak ve yönetmek için kapsamlı strateji ve politikalar geliştirmenin önemini vurgulayarak bu alanda gelecekte yapılacak çalışmalara temel bir referans sağlamaktadır.

**Anahtar sözcükler:** Adli tıp; askeri personel; maksillofasial travma.

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