THE PHYSICIAN AND SPORTSMEDICINE
https://doi.org/10.1080/00913847.2020.1768451

Taylor & Francis
Taylor & Francis Group

ORIGINAL RESEARCH

Tennis-related adult maxillofacial trauma injuries

John Pueringer[a], Jason E. Cohn [b], Sammy Othman [c], Tom Shokri[d], Yadranko Ducic[e] and Mofiyinfolu Sokoya[f]

[a]Medical Student, Philadelphia College of Osteopathic Medicine, Philadelphia, PA, USA; [b]Department of Otolaryngology-Head and Neck Surgery, Philadelphia College of Osteopathic Medicine, Philadelphia, PA, USA; [c]Medical Student, Drexel University College of Medicine, Philadelphia, PA, USA; [d]Department of Otolaryngology-Head and Neck Surgery, Penn State Hershey Medical Center, Hershey, PA, USA; [e]Department of Otolaryngology- Head & Neck Surgery, Otolaryngology and Facial Plastic Surgery Associates, Fort Worth, TX, USA; [f]Department of Otolaryngology-Head and Neck Surgery, University of Arizona College of Medicine, Tucson, AZ, USA

ABSTRACT

Objectives: Tennis participation continues to increase amongst adults across the United States. The purpose of this study was to analyze trends in adult tennis-related facial injury epidemiology, demographics, diagnoses, and locations of injury.

Materials and methods: The National Electronic Injury Surveillance System was evaluated for tennis-related facial injuries in adults from 2009 through 2018. Number of injuries were extrapolated, and data were analyzed for age, sex, specific injury diagnoses, locations, and discharge disposition. Descriptive statistics were used to present and describe variables of interest. Chi-squared testing ($\chi 2$) was performed to compare categorical variables.

Results: During the study period, 342 tennis-related facial trauma ED visits were analyzed. Lacerations were the most common injury (45%), followed by contusions or abrasions (33.3%), concussions (11.7%), and fractures (8.5%). The most common sites of injury were the face (47.4%) and head (27.2%) regions. Males accounted for 62.0% of injuries, while females accounted for the remaining 38.0%. Patients between 34–65 years-old accounted for 47.7% of all injuries, and athletes over 65 years-old had the highest rate of fractures (10.1%).

Conclusions: Facial trauma incurred secondary to tennis may follow patient-specific patterns. The incidence of tennis-related facial trauma is smaller compared to other sports, but the severity of such injuries remain a danger. Facial protection and enforcement in tennis is virtually absent, and these findings strengthen the need to educate athletes, families, and physicians on injury awareness and prevention.

ARTICLE HISTORY
Received 18 March 2020
Accepted 8 May 2020

KEYWORDS
Tennis; maxillofacial trauma; facial trauma craniofacial trauma; sports trauma; NEISS

Introduction

Tennis is an internationally popular sport, with an estimated 87 million players globally, with both males (53.1%) and females (46.9%) participating at near equivalent levels [1]. In the year 2018, total tennis participation grew 0.9% from a total of 17.68 million players to 17.84 million players in the United States. In addition, people of all ages participate in tennis; 13.5% aged 6–12, 12.6% 13–17, 13.3% 18–24, 20.4% 25–34, 17.0% 35–44, 12.4% 45–54, and 10.6% >55 years of age [2]. Based on past and recent trends, participation in tennis is likely to continue.

Popular sports in the United States include football, basketball, soccer, baseball and hockey, golf, and tennis. With such high national participation, injuries secondary to sports are common amongst participants. Participants are especially at risk for facial trauma, particularly in contact and ball-based sports. Due to the complex anatomy of the craniofacial region, documented facial trauma injuries have included lacerations/abrasions, sprains, concussions, and maxillofacial fractures [3–18]. Facial trauma has previously been analyzed by sport. For example, fractures and concussions are common facial trauma injuries in American football [9,19]. Contusions, lacerations, and facial fractures are can be seen in baseball, hockey, basketball and soccer participants [3,5,14,20]. Orbital injuries including fractures have also been reported in golf [21].

An increased awareness of facial trauma-related injuries has led to the use of facial protection in many sports [3]. There is also a heightened awareness of the risk of facial trauma in tennis amongst both providers and participants. Equipment has previously been developed in order to prevent facial injuries within tennis [22], although this is not as prominent as it is for other sports. Accordingly, while there have been many studies on facial trauma sustained during sporting activities, few current studies have examined tennis-specific injuries. Although previous research has studied tennis-related injuries, those specific to the facial region have been outlined only to a limited degree [23].

The epidemiological data on these types of injuries as well as strategies to help mitigate them have not been well described. Describing the data on tennis-related facial trauma will allow for recommendations and adaptations to reduce future injury and devise protocols for more efficient and effective treatment. Therefore, the primary objectives of this study were to determine the incidence of tennis-related facial

CONTACT Sammy Othman sothman13@gmail.com Drexel University College of Medicine, 2900 West Queen Lane, Philadelphia, PA 19129, USA

injuries and further describe their patterns in regard to age, gender, area of injury, and type of injury.

Methods and materials

An analysis of tennis-related facial trauma was conducted using the National Electronic Injury Surveillance System (NEISS). The NEISS is a database under the United States Consumer Product Safety Commission that collects information from approximately 100 emergency departments (EDs). This database presents demographics (age, gender, and ethnicity), medical injury information (diagnosis, injury type, and injury location), and the disposition of the patient in the ED. The data are extrapolated to give a national representative sample. This database has been of great importance in numerous similar analysis of different sports [3,5,10,14].

The NEISS was accessed in January 2020 and searched for adult tennis-related head and facial injuries from the previous 10 years (2009–2018). Data surrounding each event were collected including age (stratified into age groups: 19–34, 35–65, >65 years of age), race (white, Hispanic, African American, Asian, and not stated), diagnosis (laceration, fracture, abrasion/contusion, dental injury, concussion), injury location (head, eyeball/globe, face [eyelid, eye area and nose], neck, mouth [lips, tongue, and teeth], and ear), and discharge disposition (treated and admitted, treated and released, held for observation, and signed out AMA).

Descriptive statistics were used to present and describe variables of interest. Chi-squared testing ($\chi 2$) was performed to compare categorical variables. Statistical significance was set as $p \leq 0.05$. Statistical analysis was performed using IBM SPSS® (Armonk, NY).

Results

From 2009 to 2018, 342 tennis-related facial trauma ED visits were recorded in the database, with a national estimate of 14,489 total cases. Age group 35–65 years incurred the most injuries, comprising 47.7% of the sample. The smallest incidence of injuries was in the 19–34 year-old age group (20.5%). The majority of the patients during this 10-year period were male (62%), with the remaining being female (38%). With respect to types of injuries incurred, lacerations accounted for the majority (45%), followed closely by contusion/abrasions (33.3%). Fractures represented a small minority (8.5%), while dental injuries served as the smallest group (1.5%). Location of injury included face (47.4%), head (27.2%), globe (15.5%), mouth (8.8%), neck (0.9%), and ear (0.3%) [Table 1].

There was a correlation between type of injury and location. The face had the highest occurrence of lacerations (68%), followed by the head and mouth regions (15.7% for both). The globe was the most common location for contusions and abrasions (46.0%). This was followed by the face (34.5%), head (18.6%) and mouth (0.9%). Finally, fractures most commonly involved the face (70.4%), with the remainder involving the head (29.6%). As expected, all concussions (100%) were concentrated to the head and dental injuries (100%) were focused in the mouth. Neck and ear injuries were excluded due to the small number of occurrences [Table 2].

Table 1. Patient demographics.

Age group (y)	Percentage (%)
19–34	20.5%
35–65	47.7%
> 65	31.9%
Sex	
Female	38.0%
Male	62.0%
Injury type	
Concussion	11.7%
Contusion/abrasion	33.3%
Dental injury	1.5%
Fracture	8.5%
Laceration	45.0%
Location of Injury	
Ear	0.3%
Globe	15.5%
Face (eyelid, eye area and nose)	47.4%
Head	27.2%
Mouth (lips, tongue and teeth)	8.8%
Neck	0.9%

Table 2. Patient injury type by anatomic location.

Anatomic location	Concussion	Contusion/ abrasion	Dental injury	Fracture	Laceration
Globe	0.0%	46.0%	0.0%	0.0%	0.7%
Face	0.0%	34.5%	0.0%	70.4%	68.0%
Head	100.0%	18.6%	0.0%	29.6%	15.7%
Mouth	0.0%	0.9%	100.0%	0.0%	15.7%

Table 3. Patient injury type by gender.

Gender	Concussion	Contusion/ abrasion	Dental injury	Fracture	Laceration
Female	37.5%	50.0%	60.0%	34.5%	29.9%
Male	62.5%	50.0%	40.0%	65.5%	70.1%

Gender yielded significant differences in type of injury. Males were most likely to sustain lacerations, concussions, and fractures (70.5%, 62.5%, and 65.5%, respectively), while females were more likely to incur dental injuries (60%). However, the incidence of contusion/abrasion was equal between men and women [Table 3].

Most injury types were most prevalent in the 35–65 age group. Head and face were the most common injuries for those individuals > 65 years old (36.8% and 48.1%, respectively). The 19–34 age group was more likely to incur a globe injury (27.1%), in comparison to those aged 35–65 and > 65 years old (17.3% and 5.7%, respectively). Individuals > 65 years old was far more likely to incur a head injury (36.8%) compared to the 19–34 and 35–65 year-old age groups (20.0% and 24.7%, respectively). Neck and ear injuries were once again excluded due to the small number of occurrences [Table 4].

Lacerations comprised the majority of injuries for the 35–65 and > 65 year-old age groups (43.3% and 55.0%, respectively),

Table 4. Anatomic injury location by age.

age (y)	globe	face	head	mouth
19–34	27.1%	45.7%	20.0%	7.1%
35–65	17.3%	48.8%	24.7%	9.3%
> 65	5.7%	48.1%	36.8%	9.4%

Table 5. Patient injury type by age.

Age (y)	Concussion	Contusion/ abrasion	Dental injury	Fracture	Laceration
19–34	14.3%	42.9%	2.9%	7.1%	32.9%
35–65	11.7%	35.0%	1.8%	8.0%	43.6%
> 65	10.1%	24.8%	0.0%	10.1%	55.0%

while contusions/abrasions (42.9%) made up the largest proportion of injuries in the 19–34 year-old age group. Contusion rates were highest in the 19–34 year-old age group (42.9%), while the >65 year-old age group incurred significantly more fractures compared to the other groups (10.1%) [Table 5].

Discussion

Over the last several years, there has been an increase in prevalence of sports-related facial injuries [13,16–18]. It has been demonstrated that sports account for 3–29% of all facial injuries and 10–42% of all facial fractures [17]. This is naturally a product of individuals showing more interest in sports activities leading to their participation. This is particularly true for young adults in their twenties [13,16]. However, these trends depend on which sports are engaged in and the country in which those individuals live [13,16,18]. As a result of this knowledge, measures have been proposed to reduce the incidence and severity of sports-related maxillofacial trauma such as protective equipment for its participants [13,17].

With the international participation in tennis becoming so popular, it is crucial that providers reach a comprehensive understanding of the injuries related to the sport. These injuries have been documented in several studies, however, they have mainly focused on musculoskeletal injuries of the upper and lower extremities [24]. On the other hand, studies have shown that the head and face regions are the most common injury locations in tennis, behind upper and lower limb [24]. Despite this, the report of craniofacial injuries related to tennis have been limited.

Overall, our study focused primarily on the adult population and found that the 35–65 and > 65-year-old populations accounted for most craniofacial injuries related to tennis. This is consistent with studies on alternate sports [3,5,10]. The risk of severe injury is known to increase with age, and this may be due to decreased reflexes, as well as soft-tissue and bone resorption [25,26]. Furthermore, males seem to be more at risk for craniofacial injuries as opposed to females in our study as well as other sport studies [3,5,10].

Our data demonstrated that lacerations comprise most of the injuries, followed closely by contusions/abrasions then concussions. Fractures only accounted for a small portion of the injuries to tennis players. While lacerations are the most common injury reported in other sports including basketball, soccer, baseball, and hockey, they are not as common an injury in tennis [3,5,10,14]. Since tennis is not a high contact sport, mechanism of injury for craniofacial fracture may be limited to the ball. In comparison to other sports studies, the tennis ball may be softer than a baseball, hockey puck, basketball, or soccer ball. Perhaps more importantly, adults playing tennis are largely coordinated to have perspective of the court and the ball at all times, potentially limiting such injuries. Nonetheless, lacerations are prevalent and can be caused by the ground, ball, or racket. The high prevalence of lacerations around not only the face, but also the head and mouth suggests that preventative measures beyond eye protection may need to be taken to prevent such injuries [22].

This data showed that contusions/abrasions were very common in the eye region. Eye safety equipment is the only well-documented racket sports equipment being utilized and recommended to this day [27–29]. However, the high volume of contusions/abrasions to the eye region in our study suggests that more appropriate safety equipment should be recommended while playing tennis. Following this, recommendations can be made to redesign this equipment for marketing and increased use. Basketball and soccer participants have started to use masks as preventative measures for facial trauma [3,30], although their observance and success are less clear. Despite facial fractures being less frequent, they still come with a variety of complications including compromised airway, nerve injury, permanent deformity, and susceptibility to soft-tissue infections and osteomyelitis [31].

The authors recognize several limitations of this study. The NEISS collects data from ED visits, such that less severe injuries, injuries managed at home, or those managed in an outpatient setting are not captured. Furthermore, data is collected in a non-standardized manner across these various health systems, creating possible inconsistencies. As maxillofacial trauma providers, we also acknowledge the less-than-perfect reporting of facial injury regions. The database reports these injuries as involving the head, face (including the eyelid, eye area and nose), eyeball, mouth (including the lips, tongue, and teeth), neck and ear. There is significant cross-over with these structures which could potentially skew the results. Despite these, the NEISS provides a nationwide sample size for addressing an externally valid population.

Conclusions

An understanding of facial trauma while participating in tennis is crucial in optimizing safety and preventative measures. In order to address these preventative measures, it is crucial that providers understand the epidemiological patterns of craniofacial trauma as they relate to tennis injuries.

Declaration of interest

No potential conflict of interest was reported by the authors.

ORCID

Jason E. Cohn http://orcid.org/0000-0001-5132-9832
Sammy Othman http://orcid.org/0000-0002-8814-1048

References

1. International Tennis Association. ITF global tennis report 2019: a report on tennis participation and performance worldwide. Published 2019. [cited 2020 Jan 12]. Available from: http://itf.uberflip.com/i/1169625-itf-global-tennis-report-2019-overview/0?

2. Tennis Industry Association. 2019 TIA Tennis Participation Report. Published 2019. [cited 2020 Jan 12]. Available from: http://www.tennisindustrymag.com/issues/201908/TIA-report.pdf
3. Bobian MR, Hanba CJ, Svider PF, et al. Soccer-related facial trauma: a nationwide perspective. Ann Otol Rhinol Laryngol. 2016;125(12):992–996.
4. Buzas D, Jacobson NA, Morawa LG. Concussions from 9 youth organized sports: results from NEISS hospitals over an 11-year time frame, 2002-2012. Orthop J Sports Med. 2014 Apr 2;2(4):2325967114528460.
5. Carniol ET, Shaigany K, Svider PF, et al. "Beaned": a 5-year analysis of baseball-related injuries of the face. Otolaryngol Head Neck Surg. 2015;153(6):957–961.
6. Delaney JS. Head injuries presenting to emergency departments in the United States from 1990 to 1999 for ice hockey, soccer, and football. Clin J Sport Med. 2004;14(2):80–87.
7. Exadaktylos AK, Eggensperger NM, Eggli S, et al. Sports related maxillofacial injuries: the first maxillofacial trauma database in Switzerland. Br J Sports Med. 2004;38(6):750–753.
8. Fraser MA, Grooms DR, Guskiewicz KM, et al. Ball-contact injuries in 11 national collegiate athletic association sports: the injury surveillance program, 2009-2010 through 2014-2015. J Athl Train. 2017;52(7):698–707.
9. Jacobson NA, Buzas D, Morawa LG. Concussions from youth football: results from NEISS hospitals over an 11-year time frame, 2002-2012. Orthop J Sports Med. 2013 Dec 27;1(7):2325967113517860.
10. Lawrence LA, Svider PF, Raza SN, et al. Hockey-related facial injuries: a population-based analysis. Laryngoscope. 2015;125(3):589–593.
11. Mello MJ, Myers R, Christian JB, et al. Injuries in youth football: national emergency department visits during 2001-2005 for young and adolescent players. Acad Emerg Med. 2009;16(3):243–248.
12. Miller BL, Waller JL, McKinnon BJ. Craniofacial injuries due to golf cart trauma. Otolaryngol Head Neck Surg. 2011;144(6):883–887.
13. Murphy C, O'Connell JE, Kearns G, et al. Sports-related maxillofacial injuries. J Craniofac Surg. 2015;26(7):2120–2123.
14. Othman S, Cohn JE, McKinnon B. On the court: a comprehensive analysis of basketball facial trauma. Craniomaxillofac Trauma Reconstr. 2019;12(4):266–270.
15. Plawecki A, Bobian M, Kandinov A, et al. Recreational activity and facial trauma among older adults. JAMA Facial Plast Surg. 2017;19(6):453–458.
16. Ruslin M, Boffano P, Ten Brincke YJ, et al. Sport-related maxillo-facial fractures. J Craniofac Surg. 2016;27(1):e91–e94.
17. Viozzi CF. Maxillofacial and mandibular fractures in sports. Clin Sports Med. 2017;36(2):355–368.
18. Boffano P, Kommers SC, Karagozoglu KH, et al. Aetiology of maxillofacial fractures: a review of published studies during the last 30 years. Br J Oral Maxillofac Surg. 2014;52(10):901-906.
19. Kim SY, Chan CL, Hyam DM. Facial fractures in football: incidence, site, and mechanism of injury. Br J Oral Maxillofac Surg. 2016;54(8):936–940.
20. Hostetler SG, Xiang H, Smith GA. Characteristics of ice hockey-related injuries treated in US emergency departments, 2001-2002. Pediatrics. 2004;114(6):e661–e666.
21. Hwang K, Kim JH. Orbital fracture and eyeball rupture caused by golf-club injury. J Craniofac Surg. 2014;25(3):e267–e269.
22. Diamond GR, Quinn GE, Pashby TJ, et al. Ophthalmologic injuries. Clin Sports Med. 1982;1(3):469–482.
23. Pluim BM, Staal JB, Windler GE, et al. Tennis injuries: occurrence, aetiology, and prevention. Br J Sports Med. 2006;40(5):415–423.
24. Humphrey JA, Humphrey PP, Greenwood AS, et al. Musculoskeletal injuries in real tennis. Open Access J Sports Med. 2019 May 23;10:81–86.
25. Boskey AL, Coleman R. Aging and bone. J Dent Res. 2010;89(12):1333–1348.
26. Fatovich DM, Jacobs IG, Langford SA, et al. The effect of age, severity, and mechanism of injury on risk of death from major trauma in Western Australia. J Trauma Acute Care Surg. 2013;74(2):647–651.
27. Rodriguez JO, Lavina AM, Agarwal A. Prevention and treatment of common eye injuries in sports. Am Fam Physician. 2003;67(7):1481–1488.
28. Stock JG, Cornell FM. Prevention of sports-related eye injury. Am Fam Physician. 1991;44(2):515–520.
29. Vinger PF, Tolpin DW. Racket sports. An ocular hazard. JAMA. 1978;239(24):2575–2577.
30. Gandy JR, Fossett L, Wong BJ. Face masks and basketball: NCAA division I consumer trends and a review of over-the-counter face masks. Laryngoscope. 2016;126(5):1054–1060.
31. Parashar A, Sharma RK. Unfavourable outcomes in maxillofacial injuries: how to avoid and manage. Indian J Plast Surg. 2013;46(2):221–234.