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Review Article

Dentistry Section

Sports Dentistry- A Review of Prevalence and Awareness of Sports Injuries, Dental Implications and Opportunities in Dentistry

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ABSTRACT

Sports dentistry is a branch of oral sciences concerned with the treatment, management, and prevention of the trauma to the orofacial region sustained while participating in any sports activity. Sports have been frequently reported to be an important cause of overall oral trauma in children, as well as adults. There is an evident lack of knowledge in the general population regarding how sports injuries are to be prevented and dealt with. Dentists, if included in sports teams and schools, can help penetrate this knowledge and awareness barrier. Lifestyle, eating habits, stress, etc., have an impact on the performance of the athletes. Stress in athletes can lead to substance abuse, more precisely, tobacco abuse which can affect their performance. Like physiotherapists, even dentists can be made a part of a professional sports team where they can help prevent the complications arising due to facial traumas by the administration of various protective appliances and handle maxillofacial trauma. The present study aimed to evaluate and comprehend the current opportunities for dentists in the field of sports dentistry, whilst emphasising their significance in the professional sports system.

Keywords: Dental trauma, Mouthguard, Oral health, Orofacial trauma

INTRODUCTION

As stated by International Academy for Sports Dentistry-'Sports dentistry is referred to as the sports medicine division that deals with the prevention and treatment of dental injury and related oral diseases associated with sports and exercise' [1]. To provide comprehensive care to patients, a dentist must be discerning and skilled in all areas of dentistry. All dentists should understand the concept of protecting and preserving the orofacial structures from trauma and injuries. They should be familiar with common emergencies, as well as, patient behaviour management. This is critical in cases of injuries related to trauma especially in the head, face and neck region. Dentists should be aware of the mechanisms behind the occurrence of traumatic injuries and their prevention [2]. The International Olympic Committee has stated that athlete health is a priority, and international sporting bodies advocate a holistic approach in ensuring athlete well-being and performance [3,4].

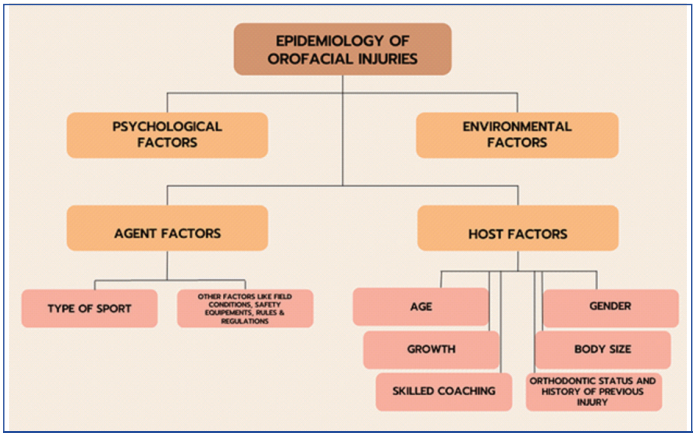
As the nation is progressing on multiple grounds such as commerce, economy, education, technology as well as sports, more and more people are finding their way onto the fields. Sports are a stress buster and play a crucial role in maintaining a healthy lifestyle. However, it also exposes one to muscle injuries, concussion, soft tissue laceration, and broken teeth. To summarise, athletes are at a higher risk of developing any sort of injury but most importantly, injuries to the oral and maxillofacial region can leave a lifelong psychological impact on the athletes. Fortunately, most of these are avoidable by understanding sports physiology, use of appropriate techniques and gears facilitated by the assistance provided by sports dentists. Such injuries can be addressed in two ways: one is to provide immediate treatment for any injury that may occur on the field and the other method is the use of preventive devices and measures to protect the athletes during the event. Immediate diagnosis and evaluation along with proper management of the injuries to athletes' dentition as well as the entire maxillofacial region can result in saving or restoration of teeth and the treatment of the injury (if any) to the orofacial region [2]. Preventive appliances come in the form of helmets, face shields, mouthguards, etc., Mouthguards are of many types like stock, mouth-formed, custom-made, etc.

Prevalence of Orofacial Injuries during Contact Sports

Pasternack JS et al., concluded that 27% of baseball players were affected by orofacial injuries during contact sports [5]. In 2008, Wenli M stated that, the prevalence of orofacial injuries in basketball players was 80.6% amongst professional players and 37.7% amongst semi-professionals [6]. Caglar E et al., reported that 16.6% football athletes were affected [7]. Handball affected 21.8% of the athletes, according to Galic T et al., [8]. In the same year, with respect to hockey, Praveena J et al., showed that the prevalence rate was 33.8% [9].

Epidemiology of Orofacial Injuries

The host-agent environment can be amended to study the epidemiology of sports injuries [Table/Fig-1]. Host factors like age, gender, skilled coaching and developmental stage of an individual, body proportion along with orthodontics of previous injuries affect the chances of occurrence of orofacial injuries in the athletes. Psychological status of the athlete as well as sports type also affects the performance [10].



[Table/Fig-1]: Different epidemiological factors involved in the occurrence of orofacial injuries.

Oral Health Related Quality of Life (OHRQoL) of Athletes

Oral Health Related Quality of Life (OHRQoL) has been described as a multifaceted concept that reflects (among other things) comfort of the people during certain activities such as eating, sleeping, and engaging in social interaction, their self-esteem, and their satisfaction with respect to their oral health [11]. It can also affect their satisfaction levels of their oral health. Pain, discomfort, tooth discolouration and missing teeth, especially the anterior teeth are the sequelae of Traumatic Dental Injuries (TDI) common in contact sports, which results in a poor OHRQoL status amongst the athletes [12].

According to Needleman I et al., 33-66% of athletes who have faced physical trauma during sports activity, reported that it negatively impacted their oral health. Of this, 28-40% were bothered due to their oral health or reported of having an effect on their QoL. A 5-18% had an effect on their performance [13]. Thus, oral health is considered to be one of the determinants of QoL [14]. Some commonly used scales for the measurement of OHRQoL in athletes includes Beck's Depression Inventory (BDI), Oral Health Impact Profile-14 (OHIP-14), etc.

A study done using OHIP-14 and BDI scale amongst elite athlete students in Kerman revealed low OHRQoL and high depression [15]. Another study done using just the OHIP-14 scale, revealed that the most prevalent condition with respect to the oral cavity included dental erosion and malocclusion in Brazilians, which in combination with tooth sensitivity were most likely to impact or affect the OHRQoL of the athletes [16]. A study focused on athletes with disabilities found that most affected domain was physical pain, followed by psychological discomfort along with periodontal disease, need for complete dentures and number of sound teeth, Decay-Missing-Filled Teeth (DMFT) index and its component. These clinical parameters are usually related to impaired OHRQoL [17].

Does Oral Health Affect the Performance of Athletes?

One of the determining factors of QoL is oral health [14]. There is a myriad of literature present stating the effects of oral diseases such as caries [18], periodontal disease [19], and pericoronitis [20] on QoL. With pellucid psychosocial effects of oral health, it would be astonishing if physical training and performance in athletes with poor oral health were unaffected. Furthermore, in an environment where the 'aggregation of marginal gains' is condemning, subtle effects on training and performance could be extremely important. Oral diseases may have an impact on performance due to pain [21], increased systemic inflammation [22], and decreased confidence and socialisation [14]. In conclusion, poor oral health may have a direct impact on performance through pain caused by disease conditions, but it may also have a more subtle impact through effects such as increased systemic inflammation and psychosocial effects that athletes may be unaware of.

According to a study done in 2018, 32% of athletes reported that the state of their oral health impacted their sports performance, while 5.8% admitted that performance was truly affected. According to the study, 29.9% of athletes experience oral pain, 9% have difficulty training/competing, and 3.8% have had to reduce their training sessions. Moreover, athletes reported difficulty eating (34.6%), smiling (17.2%), and relaxing (15.1%) as a result of their poor oral health [13].

Athletes and Dental Trauma during Sports

Despite accounting for 1% of the human body, injuries in the oral region account for 5% of total bodily injuries among all ages, according to a one-year longitudinal prospective Swedish survey [23]. Traumatic forces are one of the four most common oral diseases. They can disrupt the supporting periodontal apparatus, including bone and peripheral soft tissues, as well as the tooth structure. Crown and/or root fractures involving or not involving the pulp are examples of TDI related to teeth [Table/Fig-2] [24-30]. Different degrees of periodontal support alteration, such as concussion, subluxation, luxation, and avulsion, can occur depending on the severity of the injury [31].

Athletes should be aware of the risks that are usually associated with participation in sports activities and pay close attention to the health of their oral environment, as changes in the oral health may have a negative impact on the athlete's overall health and well-being, as well as physical performance [32]. Trauma, joint disorders and alterations are associated with athletic performance and have a significant impact on athletes' QoL.

Athletes and Salivary Factors

Intense physical training and exercise at the start of sports competitions as well as during the training hours can significantly reduce the salivary flow rate and secretory immunoglobulin A (s-IgA) load that can result in a decreased host defence response and increase the risk to specific pathologies such as Upper Respiratory Tract Infections (URTI) and, more specifically, pathologies of the oral cavity [33]. Salivary cortisol levels as well as salivary Alpha-Amylase (sAA) are higher in athletes who experience more stress during the sports activity [34].

In a study where athletes were sampled in the middle of the season had longer Telomere Length (TL) on average than those sampled in the beginning of the season, possibly reflecting the physiological effects of different training contexts or regimes. Females had shorter TL than males, which could be attributed to hormonal differences or the presence of the female athlete Triad of Relative Energy Deficiency in Sport (RED-S). Female athletes in sports where weight and/or leanness are emphasised for performance or competition categories (e.g., wrestling or track and field for this study) are thought to be more vulnerable to the Triad, potentially influencing TL data [35,36].

Sports injury	Code as per WHO	Commonly Seen in	Treatment	Reference
Orofacial fracture	N 502.42 (maxilla) and N 502.61 (mandible)	21-30 years old age group	Initial hospitalisation followed by surgical intervention	[24]
Temporomandibular dysfunction	-	13-21 years old age group	NSAIDS, physiotherapy and mouthguards	[25]
Tooth fracture	N 502.54 (uncomplicated crown-root fracture)	15-30 years old age group	Endodontic therapy followed by prosthetic treatment	[26]
Tooth avulsion	N 502.22	7-11 years old age group	Storage in proper media and immediate re-implantation of tooth	[27]
Concussion	N 503.20	18-21 years old age group	Rest for 1-2 days both mentally and physically, following an SRC to minimise energy demands to the brain and allow post-concussive symptoms to resolve	[28,29]
Tooth luxation	N 503.20	10-15 years old age group	Orthodontic correction if vital or else endodontic therapy followed by prosthetic treatment if non-vital	[30]

[Table/Fig-2]: : Different Maxillofacial Sports Injuries Seen along with their treatment and common age groups.

A study targeted towards kickboxing athletes found significant increases in indicators of lipid peroxidation activity and the concentration of lactic acid (4-fold); analysis of correlation matrices confirmed the absence of expressed changes. At the same time, there was a significant decrease in the levels of catalase (10-fold from 3.69 μkat/L to 0.39 μkat/L) and pyruvic acid (from 3.92 μL/l to 0.55 μL/l) [37].

Link between Athletes, Systemic Health and Oral Health

The oral environment is impacted by the athlete's lifestyle, hygiene, and eating habits, as well as medications and sports participation. A review done to understand the relationship physical activity has with the athletes' oral health revealed that the oral health is poor especially in athletes who partake in competitive activities, although it is reported to be significantly lower in a variety of sports individuals. Thus, types of sports an athlete plays has a major role in their poor oral health [13,38].

Oral Pathologies Observed in Athletes

Sport activities, according to Needleman I et al., can be considered as a major cause for the onset of various oral pathologies such as dental caries, with an incidence rate ranging from 15% to 70% which includes dental erosion (36%), pericoronitis (5-39%), dental trauma (14-70%) and periodontal disease (upto 15%) [13].

Athletes and Wasting Diseases of the Oral Cavity

Dental erosion is a very common pathology encountered in athletes, and it has been linked to the increased consumption of food and soft drink by the young individuals and athletes. The internet and social media have promoted the widespread use of energy providing soft drinks which are primarily based on electrolytes and carbohydrates aimed to compensate for dehydration, mineral salt depletion, hypoglycaemia, and muscle glycogen depletion that are encountered in athletes during the physical activity. However, there is no valid scientific evidence to support the use of nutritional supplements, and a healthy diet does not necessitate the use of mineral supplements [39-42].

Stress and Habit Formation in Athletes

Overtraining syndrome is an aggregation of training as well as/or non training stress that leads to a decrease in the long-run performance capacity of the athlete, which may or may not display signs and symptoms of physiological and psychological maladjustment, with recovery taking several weeks or months [43]. Higher stress levels are associated with substance abuse in athletes, especially tobacco abuse [44]. Tobacco is harmful for all. In athletes, it can exhibit immediate to long-term consequences. Carbon monoxide, a harmful chemical present in nicotine products disturbs the oxygen uptake of muscles, constricts the blood vessels, which can lead to easy fatigue in athletes leading to a significant decrease in their endurance. This can ultimately lead to an increased susceptibility to injuries [45].

When focusing on the oral cavity, it can increase the caries incidence. Since almost all athletes already suffer from hyposalivation and have a frequent carbohydrate rich diet and consume sports drinks, tobacco abuse can act as an adjuvant in the occurrence of dental decay, erosion, abrasion, gingival recession. It also hinders the maintenance of periodontal health which in turn can affect the systemic health [46].

Prevention of Orofacial Injuries

Wearing mouth guards and headgear is the most common method for avoiding orofacial injuries during sports.

i. **Stock mouthguards:** Stock mouthguards are easily available but in limited sizes. They are made from rubber, polyvinyl chloride, or a copolymer of polyvinyl acetate [47].

ii. **Mouth-formed protectors:** These consist of two sub-types. The shell-liner and the other one being the thermoplastic mouthguard. The shell-liner type is created by placing freshly mixed ethyl methacrylate in a hard shell, which is then placed in the athlete's oral cavity and moulded over the maxillary teeth and the associated soft tissues [48]. The thermoplastic or preformed (also known as "boil and bite") is immersed in boiling water for 40-45 seconds before being transferred to cold water and adapted to the teeth.

iii. **Custom made mouth protectors:** This is the most effective and best of the three options available. It is fabricated using a thermoplastic polymer and is built over a dentition model of the athlete designed by the dentist, and it perfectly fits the athlete's mouth [49].

iv. **Helmet:** Helmets are aimed to shield the skin on athletes' scalp and ears from abrasions, contusions, and lacerations. They guard the head, face and neck region against skull fractures and protect the brain and Central Nervous System (CNS) from severe concussions, loss of consciousness, cerebral haemorrhage, paralysis, brain damage, and death [50].

v. **Facemasks:** It offers various degrees of horizontal defence to the maxillary bone and the region by including an extended finger, a closed fist followed by a forearm, or a helmet pointed at the zygomatic nasal pyramid or mandibular arch, respectively [51]. One significant drawback of the facemasks is that they have a protruding object that an opponent can easily grab. During a fight, if an opponent pulls or twists the facemask, it could seriously hurt them physically and cause injury to their muscles, neck, or spinal column [52].

According to Pawar P et al., custom-fitted mouthguards are the best protective options for the athletes [53]. A study done by Tjønndal A and Austmo Wågan F revealed that most of the athletes believed that headgear is the best option as it can save from severe injuries like concussion. However, very few of them reported wearing this protective headgear unless extremely necessary [54].

Sports Dentistry Awareness in India

A cross-sectional survey done on 2000 school children aged between 8-11 years comprising of male and female gender attending private schools in Ludhiana, Punjab, India revealed that the prevalence of the use of mouthguard was only 4.25%. A 78% of the children believed mouthguards can protect them from injuries [55]. Similarly, a study done on athletes aged 6-18 years revealed that 86% of them were aware of the mouthguard device, however, only 27% of them ever used it [56]. Tiwari V et al., in their study on athletes showed that the awareness pertaining to mouthguards was higher (67.5%) in athletes participating in contact sports than those who participated in non-contact sports (34.4%) [57]. However, when combined, the awareness percentage is higher than children and adolescents. This projects the fact that there is a need to increase the awareness of mouthguards in younger population of India.

A study done exclusively on physical instructors in Sullia reported that only 58% of 50 included physical instructors were aware about the mouthguard appliances. This enlightens the fact that there is need for creating awareness not only amongst the athletes but also the instructors [58].

Four different PubMed searches conducted by the authors revealed a lack of awareness in the general population regarding sports dentistry, particularly in India. A PubMed search with the term "Sports" revealed a plethora of articles on sports and health [Table/Fig-3a][59]. This indicated that as time passed, people became more aware of the importance of conducting sports-related research. There are 705 PubMed-indexed articles in 2021 alone, followed by

698 articles in 2022. The second and third searches, which used the terms "Sports Dentistry" [Table/Fig-3b] [60] and "Sports Dentistry Awareness", revealed that there is still an exponential growth in the literature, corresponding to the growing awareness globally [Table/Fig-3c] [61]. However, the fourth and final search using "Sports Dentistry Awareness India" revealed that there is a severe lack of articles on Sports Dentistry in India [Table/Fig-3d] [62]. There are no clinical trials on the subject. When compared to the rest of the world, India has a dearth of reviews, with only two systematic reviews on preventive measures in sports dentistry completed in 2021 and 2022 [59,60]. When the data is compared to the number of people who participate in sports each year from India, it becomes clear that Indians' awareness of sports-related trauma is very low. As a result, it is critical to raise public awareness about the plethora of sports-related injuries and their prevention. Participation in Olympics events over the years has increased at both, international as well as national level [61]. However, the number of dentists to suffice the oral health care needs of this population is still lagging.

[Table/Fig-3]: PubMed search carried out for evaluation of awareness: (a) "Sports" search showing an exponential growth over the years; (b&c) "Sports Dentistry" and "Sports Dentistry Awareness" search again showing exponential growth; (d) "Sports Dentistry Awareness India" search showing scarcity of articles corresponding to low awareness.

Dentists as a Part of Sports Team

Physiotherapists, doctors and nutritionists have long been an integral part of sports teams, be it national or international. Cricket, a sport most familiar to the Indian community, has employed several physiotherapists, both Indian and International. For several decades now, the community has recognised the importance of professional support in the field of physiotherapy, with chiropractors being the most recent addition. Dentists, if in a similar way are made a part of the sports teams-whether amateur or professional, can use their knowledge and expertise to help provide the team members with a variety of aforementioned safety equipment. A study done by Goswami M et al., pointed out that of the 71.3% aware athletes, only 20.9% used mouthguards. The authors implied that the reason for this was lack of motivation and encouragement on the coaches' end. Thus, a sports dentist will be able to encourage and motivate the athletes to wear, them pointing out the need and benefits of the same [62]. Their presence will also ensure that any emergency will be taken care of immediately and in a professional way. This will ensure the athlete's well-being both on and off the field, since the aesthetic appearance of one's teeth plays a pivotal role in his or her confidence. The need for sports dentists has also been substantiated by winters in his study he emphasises their need in high schools and professional teams [63].

Studies show that of the 13-39% dental injuries, 11-18% are maxillofacial injuries related to sports accidents [64]. A 10-year longitudinal study of mouth and jaw injuries found that approximately around 32% of facial trauma cases in children occurred during sports activities [65]. Few other studies show that around 50% of children have their primary or permanent dentition affected by traumatic injuries during their school going years [66]. The most frequently damaged tooth is the maxillary central incisor, which is traumatised twice as frequently in men as in women [67]. Orofacial sports injuries include both soft tissue wounds like lacerations and hard tissue wounds like luxations, tooth intrusions, crown and/or root fractures, total avulsions, and/or dental-facial fractures. The athlete's oral and maxillofacial health can be monitored long-term and managed by a sports dentist, which invariably has an impact on the athlete's physical and mental health.

Opportunities for a Sports Dentist

The Academy of Sports Dentistry, USA has specified the qualification requirements for a Sports Team Dentist. However, there are no such specific requirements in India, apart from the obvious, i.e., a valid licence. Currently in India, only two institutes are offering Sports Dentistry programmes, i.e., the Indian Dental Association (IDA) which provides a fellowship in Sports Dentistry and the Institute of Sports Science and Technology, Pune (ISST, Pune) provides a Certificate Course in Sports Dentistry.

The fellowship offered by IDA is available in both classroom and online format. Minimum requirement is BDS or equivalent degree from a recognised institution in India or overseas. The certificate course offered by ISST, Pune is Distance Diploma in Sports Dentistry (DDSD), which was started in the year 2008 and is for six months duration. BDS degree from any recognised university in India is the minimum eligibility criteria. Candidates can enroll throughout the year by registering on the official website of the respective institutes. With the exponential increase in the nation's population, and its ever-increasing demand for oral healthcare, it is imperative that more educational institutions offer specialisation in the field of dentistry to better cater to the community [Table/Fig-4].

[Table/Fig-4]: Diverse role of sports dentist.

Summary

To summarise, a sports dentist will be an excellent resource for both school and professional sports teams. They can assist athletes and students in recommending and prescribing safety clothing for their sporting activities. They will make certain that there is sufficient awareness of this topic in schools and sports teams. Due to a custom mouthguard's triple function as a reservoir of substances protective for the oral ecology, protection against sports-related injuries, and enhancement of athletic performance, these risks can be avoided. Additionally, assessing the athletes' risk status for contracting various diseases through clinical examination, salivary analysis, oral health promotion programmes, and monitoring their oral health may be possible. Similar to school and professional doctors, psychiatrists, and others, sports dentists can play a crucial role in the system that can enhance athletes' oral health.

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