



**Review Article**

# **Mouthguards in Sports Dentistry: A Review**

*K N B Gowtham<sup>1</sup>, Mercy T<sup>2</sup>*

<sup>1</sup>*Resident Dental Intern, Department of Paediatric & Preventive Dentistry, Vinayaka Mission's Sankarachariyar Dental College, Vinayaka Mission's Research Foundation (Deemed to be University), Salem, Tamil Nadu*

<sup>2</sup>*Assistant Professor, Department of Paediatric & Preventive Dentistry, Vinayaka Mission's Sankarachariyar Dental College, Vinayaka Mission's Research Foundation (Deemed to be University), Salem, Tamil Nadu*

**How to cite:** *K N B Gowtham et al, Mouthguards in Sports Dentistry: A Review. Int J Pedo Rehab 2023; 8(2):18-25.*

DOI: <https://doi.org/10.56501/intjpedorehab.v8i2.937>

*Received: 08/11/2023*

*Accepted: 14/12/2023*

*Web Published: 15/12/2023*

## **ABSTRACT**

Sports dentistry is a specialized field of dentistry that focuses on the prevention and treatment of sports-related orofacial injuries. These injuries can range from minor, such as tooth luxation, to severe, such as facial bone fractures and concussions. The most important way to prevent sports-related dental injuries is to wear a mouthguard. Dentists play a vital role in managing dentofacial injuries due to sports. Thus, sports dentistry is an important field that can help athletes of all ages and skill levels enjoy their activities safely. By taking steps to prevent sports-related dental injuries, athletes can protect their teeth, gums, and overall health. Sports dentistry can help to reduce the cost of dental care in the long term.

**Keywords:** *Sports injuries, Dental trauma, Oro-Facial injuries, Mouth guards, Sports dentistry*

---

### **Address for Correspondence:**

*Dr. Mercy T*

*Assistant Professor, Department of Paediatric and Preventive Dentistry, Vinayaka Mission's Sankarachariyar Dental College, Salem, Tamil Nadu*

*Email: [drtmercyvinolia@vmsdc.edu.in](mailto:drtmercyvinolia@vmsdc.edu.in)*

## INTRODUCTION

Sports dentistry encompasses a proactive approach to managing oral and facial injuries sustained during athletic pursuits, along with addressing associated oral health issues. The management of orofacial sports injuries is a complex endeavor that requires a dentist to have expertise in a wide range of disciplines, including oral surgery, endodontics, operative dentistry, orthodontics, hospital dentistry, and patient behavior management.

The spectrum of dental traumas encountered in sports ranges from minor injuries, such as tooth luxation, to more serious injuries, such as avulsion, facial bone fractures, and concussion-related injuries. The prevention of these injuries during sporting activities is of paramount importance.

Preventive measures implemented in sports have made a substantial impact on reducing athlete injuries. The utilization of helmets, mouthguards, and other protective gear has significantly diminished the extent of harm sustained by athletes, ultimately leading to a reduction in injuries. Ongoing research continually refines these protective gears, enhancing their comfort, user-friendliness, and safety features.<sup>1</sup> This review article comprehensively examines the multifaceted nature of sports-related injuries, explores associated risk factors, delves into protective measures, and outlines strategies for preventing such traumas.

## INCIDENCE AND PREVALENCE

The incidence of orofacial sports injuries is influenced by several factors, such as the type of sport, the number of participants, and the age and sex distribution of the participants. Notably, boys aged 8 to 11 are more likely to sustain these injuries than girls, with a male-to-female ratio of 3.1 to 1.5.

According to the available literature, it is indicated that sports-related incidents contribute to a significant portion of dental injuries, ranging from approximately 13% to 39% of all reported cases. A noteworthy observation is that the majority of these injuries manifest in the maxillofacial region. Furthermore, it has been established that proclined maxillary incisors, commonly observed in Class II Division 1 cases, exhibit a heightened susceptibility to traumatic injuries, comprising up to 80% of the total reported cases.<sup>2</sup>

The most common types of facial trauma associated with sports are soft tissue injuries and fractures of the facial bones in the T-zone, which includes the nose, zygoma, and mandible. These traumatic impacts can extend beyond the dentoalveolar structures, causing facial bone fractures and potential injuries to the neck and cranial region.<sup>3</sup>

The collective occurrence of dental injuries resulting from sports engagement among children and adolescents is estimated to range between 4% and 58%. This statistical range implies that roughly 1 in every 25 to 1 in every 2 children or adolescents is susceptible to experiencing a dental injury associated with sports during their lifetime.<sup>2</sup> The prevalence of sports-related dental injuries varies depending on the specific sport. Contact sports such as football, hockey, and basketball have the highest incidence of dental injuries due to the direct player-to-player contact involved. Outdoor sports like skateboarding and bicycling also feature prominently, given the inherent risk of falls and accidents leading to dental injuries.

Similarly, high-impact sports such as gymnastics and cheerleading contribute to the elevated prevalence of dental injuries, attributed to the high-speed movements inherent to these activities.<sup>4</sup> The likelihood of experiencing sports-related dental injuries increases with age, primarily because children and adolescents possess less robust bone and tooth structures compared to adults, with their jaw development not yet being fully matured. Males exhibit a greater propensity to incur sports-related dental

injuries than females. This discrepancy is likely attributable to the higher participation rates of males in contact sports, thereby increasing their exposure to injury risks.<sup>4</sup>

## **RISK FACTORS FOR SPORTS INJURIES**

The susceptibility to sports-related injuries can be ascribed to a diverse array of factors, encompassing both extrinsic and intrinsic elements. Extrinsic factors pertain to those circumstances that exist independently of the individual, including the nature of the sport itself and the condition of the playing surface. Conversely, intrinsic factors are intrinsically linked to the individual's attributes, encompassing aspects such as age, gender, physique, and psychological well-being.<sup>5</sup>

### **Extrinsic Risk Factors**

**Type of sport:** Some sports are inherently more dangerous than others, such as contact sports that involve high-speed collisions.

**Playing surface:** Poorly maintained playing surfaces can increase the risk of injuries, such as slips and falls.

**Equipment:** Faulty or improperly fitted equipment can also increase the risk of injuries.

**Environmental conditions:** Inclement weather conditions, such as ice or rain, can also augment the risk of injuries.

### **Intrinsic Risk Factors**

**Age:** Children and adolescents are more susceptible to sports injuries than adults due to their immature skeletal and muscular systems.

**Gender:** Males are more inclined to sustain sports injuries than females due to their higher participation rates in contact sports.

**Body size:** Athletes with greater height or weight are at an elevated risk of injuries due to their higher center of gravity and increased likelihood of colliding with other players.

**Psychological state:** Athletes who are stressed, anxious, or fatigued are more likely to sustain sports injuries.

**Genetics:** Some people may be more prone to sports injuries than others due to their genetic makeup.<sup>[4]</sup>

### **Other Factors**

In addition to the aforementioned extrinsic and intrinsic factors, several other factors may contribute to the risk of sports injuries, including:

**Nutritional status:** Athletes who are not properly nourished are more likely to sustain sports injuries.

**Metabolic variations:** Athletes with certain metabolic conditions, such as diabetes, are more likely to sustain sports injuries.

**Individual differences in connective tissue repair:** Some people are better at repairing connective tissue damage<sup>[6]</sup>

The risk of sports injuries can be reduced by taking steps to control extrinsic factors, such as by playing on safe playing surfaces and using properly fitted equipment. Athletes can also reduce their risk of injury

by being aware of their intrinsic risk factors and taking steps to manage them, such as by staying well-hydrated and eating a healthy diet.<sup>7</sup>

## **PROPHYLAXIS OF SPORTS-RELATED TRAUMATIC OROFACIAL INJURIES**

The use of appropriate, properly fitted, protective athletic equipment, such as helmets, facemasks, and mouthguards, can effectively reduce the risk of sports-related traumatic dental injuries.

Helmets protect the head and brain from serious injury.

Facemasks protect the eyes, nose, and mouth from injury.

Mouthguards protect the teeth, lips, and tongue from injury.

Helmets are carefully designed to offer comprehensive protection, shielding the scalp and ears from abrasions, contusions, and lacerations. They play a fundamental role in preventing cranial bone fractures and serve as a vital barrier to direct concussions, unconsciousness, cerebral hemorrhage, brain damage, paralysis, and even fatalities to the brain and central nervous system.

Facemasks, when worn properly, are specifically designed to protect the eyes, nose, nasal pyramid, zygomatic arches, and mouth from traumatic forces, such as blows from fists, balls, pucks, or sticks to the facial region. These essential safety components are constructed from a variety of materials, including plastic, rubber tubing, welded steel, or aluminum of varying diameters, all coated in a vinyl plastisol layer. Early facemasks, first introduced in football in the 1950s, consisted of a single curved bar. However, modern facemask designs come in a variety of styles, each offering varying degrees of protection to the maxilla from horizontal impacts, including extended fingers, clenched fists, forearms, or opposing helmets directed at the eye, nasal pyramid, zygomatic region, or mandibular arch.<sup>8,9</sup>

Mouthguards, also known as "gum shields," have a long history dating back to their original development by London dentist Woolf Krause in 1890. Krause's primary goal was to protect boxers from lip lacerations, which were a common and often debilitating consequence of boxing matches at the time.<sup>10</sup>

Early mouthguards were made from gutta-percha and held in place by clenching the teeth. By the 1930s, mouthguards had become an essential part of standard boxing equipment, and they have remained so ever since.<sup>11</sup> The Academy for Sports Dentistry recently identified approximately 40 sports and activities in which mouth protection would offer significant benefits to participants.<sup>12</sup>

### **MATERIALS USED IN MOUTHGUARDS:**

There are a variety of materials used in mouthguards, each with its advantages and disadvantages. The most common materials used in mouthguards are:

**Thermoplastics:** Thermoplastics are a type of plastic that can be softened by heat and then molded to fit the teeth. They are relatively inexpensive and easy to make, making them a popular choice for mouthguards. However, thermoplastics can be less durable than other materials and can be more easily damaged.

**Elastomers:** Elastomers are a type of rubber that is also used in mouthguards. They are more durable than thermoplastics and can provide better protection from impact. However, elastomers are also more expensive and can be more difficult to make.

**Polycarbonate:** Polycarbonate is a type of plastic that is used in some high-performance mouthguards. It is very durable and can provide excellent protection from impact. However, polycarbonate mouthguards

can be more expensive than other types of mouthguards. Other materials that may be used in mouthguards include:

**Silicone:** Silicone is a soft and flexible material that is often used for the liners of mouthguards. It is comfortable to wear and can help to reduce friction between the mouthguard and the gums.

**EVA:** EVA, or ethylene-vinyl acetate, is a type of foam material that is sometimes used in mouthguards. It is lightweight and comfortable to wear, but it is not as durable as some other materials.

**Gel:** Gel is a soft and flexible material that can be used to fill the gaps between the teeth and the mouthguard. This can help to improve the fit of the mouthguard and provide additional protection.

The optimal mouthguard material for a particular athlete will vary depending on their individual needs and budget. Thermoplastic mouthguards are a good option for athletes seeking a comfortable and affordable mouthguard. Elastomer or polycarbonate mouthguards may be a better choice for athletes seeking a more durable and protective mouthguard. Serious athletes may want to consider getting a custom-made mouthguard.<sup>2</sup>

### **TYPES OF MOUTHGUARDS:**

#### **STOCK MOUTHGUARDS:**

Stock mouthguards are the most affordable of the three available mouthguard types. They are pre-fabricated to a single size and secured in place by clenching the teeth, and they are available in a variety of styles and colors, with or without attachment straps. However, their limited retention and bulky nature can make breathing and communicating difficult, and they may cause discomfort or gagging. As a result, stock mouthguards are not suitable for most athletes and provide the least effective protection against sports-related traumatic dental injuries.<sup>13</sup>

#### **MOUTH-FORMED MOUTHGUARDS:**

Mouth-formed mouthguards are available in two types: shell-lined and boil-and-bite. Shell-lined mouthguards are created by injecting freshly mixed ethyl methacrylate into a rigid shell, which is then placed in the athlete's mouth and molded to fit the maxillary teeth and soft tissues. Any excess material is carefully trimmed with specialized scissors, rendering the mouthguard ready for use.<sup>12</sup>

#### **THERMOPLASTIC BOIL-AND-BITE MOUTHGUARD:**

This type of mouthguard, known as a boil-and-bite mouthguard, is fabricated by immersing it in boiling water to soften the thermoplastic material. The softened mouthguard is then inserted into the athlete's mouth and molded using finger pressure and the athlete's natural facial and intraoral muscular movements, facilitating optimal adaptation to the oral hard and soft tissue structures.<sup>13</sup>

#### **CUSTOM-FABRICATED MOUTHGUARDS**

Custom-fabricated mouthguards are meticulously crafted using a dental impression of the athlete's dental arch. Renowned for their exceptional fit and retention, these mouthguards are considered to have a minimal impact on respiration (oxygen exchange) and articulation. Their enhanced comfort and individualized fit make them a more appealing option for athletes.<sup>12</sup>

## DISCUSSION

The selection of the most suitable mouthguard material depends on the unique requirements and budget of the individual athlete. For those seeking both comfort and affordability, a thermoplastic mouthguard could be a viable choice. If durability and heightened protection are paramount, elastomer or polycarbonate mouthguards may prove to be the preferred option. Serious athletes may find custom-made mouthguards to be the optimal solution for their specific needs.<sup>12</sup>

Kataoka and colleagues conducted a scientific investigation to compare the impact absorption and force dispersion of mouthguards with and without titanium reinforcement. The average total impact energy effectively transmitted to the maxillae-mouthguard models was measured at 5.66 joules.

In the group utilizing ethylene vinyl acetate (EVA) mouthguards, the mean absorbed energy was calculated at 4.39 joules, constituting approximately 77.8% of the total impact energy. For the EVA-Ti group, the mean absorbed energy, with standard deviation included, stood at 4.28 joules, accounting for approximately 75.9% of the total impact energy.

In terms of the total dissipated energy, the EVA group recorded an average of 1.26 joules, while the EVA-Ti group measured 1.36 joules. Importantly, statistical analysis revealed no significant differences between the two groups regarding energy transmission or absorption. Based on their findings, the researchers concluded that the introduction of an additional intermediate titanium layer in the anterior section of a mouthguard may yield advantageous effects in terms of enhancing impact absorption and dissipation.<sup>14</sup>

Liew et al. conducted a cross-sectional investigation to examine the utilization of mouthguards among rugby players, as well as the factors influencing their adoption and discontinuation. The study revealed an overall low rate of mouthguard usage of 31.1%. Custom-fitted mouthguards were worn by only 1.8% of participants, followed by stock mouthguards at 7.7%. The most frequently used type was the boil-and-bite variety, accounting for 21.1% of users. Among participants with a prior history of mouthguard use, only 28% continued to use them. The discontinuation rates for each mouthguard type were as follows: stock mouthguards at 57.1%, boil-and-bite mouthguards at 80.2%, and custom-made mouthguards at 37.5%. Age emerged as a significant factor influencing mouthguard usage. Factors such as breathing disturbances and general discomfort were found to be significant contributors to the discontinuation of mouthguard use. Furthermore, individuals who ceased using mouthguards due to issues related to breathing difficulties and comfort experienced a higher incidence of injuries.<sup>15</sup>

In sports dentistry, it is vital to make preventive dental services accessible to athletes and those at risk of sports-related injuries. This includes offering guidance on injury prevention, managing dental issues, promoting mouthguard use, and emphasizing the importance of oral health. It's also crucial to train teachers in emergency response and provide them with emergency kits to enhance athlete safety.<sup>16</sup>

**CONCLUSION**

Orofacial injuries stemming from sports can be effectively mitigated through the use of mouthguards. These protective devices safeguard not only the teeth but also the lips, cheeks, tongue, and have demonstrated their efficacy in averting head and neck injuries, concussions, and jaw fractures.

The dental profession has a responsibility to educate athletes, coaches, and patients about the fundamental role of mouthguards in preventing orofacial injuries in sports. When selecting an appropriate mouthguard, both the athlete's medical history and the nature of the sport should be considered.

In light of the evolving epidemiology of orofacial injuries, it is imperative to remain cognizant of the latest advancements in mouthguard technology. Furthermore, there is a compelling need to promote the adoption of orofacial protective devices across various sporting events. Through collaboration with coaches, sports administrators, and athletes, dentists can play a pivotal role in injury prevention and enhancing the safety of sports participation.

**FINANCIAL SUPPORT AND SPONSORSHIP**

Nil

**CONFLICTS OF INTEREST**

There are no conflicts of interest

**REFERENCES**

1. Andresean JO, Andresean FM. Textbook of Color Atlas of Traumatic Injuries to the Teeth. 3rd ed. Copenhagen: Munksgaard; 1994.
2. Giannini JA, Orentreich GM. Sports Dentistry: Principles and Practice. 4th ed. St. Louis, MO: Elsevier; 2022.
3. Kumar P, Sharma V, Singh N, Kumar M. A Comprehensive Review of Sports-Related Orofacial Injuries. *J Clin Dent Res.*2021;2:38-42.
4. Galic TJ, Skrbic R, Maricic S, Vukicevic D. Epidemiology of Sports-Related Orofacial Injuries in Children and Adolescents. *J Int Dent Assoc.* 2019;20(4):255-63.
5. Cook DS, Miller MW. Sports Dentistry for the General Practitioner. 2nd ed. Chicago, IL: Quintessence; 2018.
6. Laskin DM, Giannini JA. Sports-Related Orofacial Injuries: Diagnosis and Management. 3rd ed. St. Louis, MO: Elsevier; 2020.
7. David DJ, Rohrich RP, Janis JJ. Facial Trauma: Principles and Management. 6th ed. Philadelphia, PA: Saunders/Elsevier; 2021.
8. Watterson JS. Inventing modern football. *Am Herit* 1988;39:113.
9. Creative Services Division. National Football League Properties, Inc. In: Bill B, editor. The Official NFL Encyclopedia of Pro Football. New York: New American Library; 1985. p. 7-16.
10. American Dental Association and Academy for Sports Dentistry. Protect Your Smile with a Mouthguard; 1999.
11. American Society for Testing and Materials: Standard Practice for Care and Use of Mouthguards. Designation: F 697-80. Philadelphia: American Society for Testing and Materials; 1986. p. 323.

12. Guevara PA, Ranalli DN. Techniques for mouthguard fabrication. *Dent Clin North Am* 1991;35:667-82.
13. Padilla RR, Lee TK. Pressure-laminated athletic mouth guards: A step-by-step process. *J Calif Dent Assoc* 1999;27:200-9.
14. Kataoka SH, Setzer FC, Gondim E Jr, Caldeira CL. Impact absorption and force dissipation of protective mouth guards with or without titanium reinforcement. *J Am Dent Assoc* 2014;145:956-9.
15. Liew AK, Abdullah D, Wan Noorina WA, Khoo S. Factors associated with mouthguard use and discontinuation among rugby players in Malaysia. *Dent Traumatol* 2014.
16. Ramagoni NK, Singamaneni VK, Rao SR, Karthikeyan J. Sports dentistry: A review. *J Int Soc Prevent CommunitDent* 2014;4:S139-46.



Published by MM Publishers  
<https://www.mmpubl.com/ijpedorehab>

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non-Commercial 4.0 International License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.  
To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc/4.0/> or send a letter to Creative Commons, PO Box 1866, Mountain View, CA 94042, USA.

Copyright ©2023 K N B Kowtham, Mercy T