Review Article

PREVENTION OF CHILDREN'S SPORTS RELATED INJURIES: A REVIEW

Linthoingambi Arambam[1], Harsimran Kaur[2], Rishika[3], Ramakrishna Yeluri[4]
Post Graduate[1], Professor[2], Senior Lecturer[3], Professor & Head[4]
Department of Pedodontics and Preventive Dentistry, Teerthanker Mahaveer Dental College and Research Centre, Moradabad, India

Abstract
Sports dentistry is one of dentistry's newest and most promising fields. It primarily focuses on the prevention and treatment of orofacial injuries and disorders connected with athletics. The most prevalent sort of orofacial injury received while participating in sports is dental injuries. Many young sportsmen are unaware of the health risks associated with a traumatic mouth injury or the possibility of suffering severe head and orofacial injuries while playing. So wearing basic protective gear such as correctly fitting helmets, face masks, and/or mouth guards is the most important factor in reducing sports-related orofacial injuries. A dentist can help young athletes, coaches, and patients understand the importance of preventing orofacial injuries in sports. The purpose of this paper is to raise professional knowledge and interest in young children to provide an insight into prevention measures for sports related injuries.
Keywords: Mouth guards, Sports injury, STL (Standard Tessellation Language).

INTRODUCTION

Sports dentistry is quickly becoming one of the most popular dental specialties. It includes information on how to avoid and treat orofacial sports injuries, in addition to the gathering and transmission of a wealth of knowledge about dental athletic injuries. [1] Various dental traumatic injuries come across during sports-related activities are extrusion, luxation, intrusion, and avulsion of teeth, facial bone fractures, and temporomandibular joint injuries (TMJ), and the concussion is the most lethal of the injuries.[2]These injury to the teeth, which are the main prevalent kind of oro-facial injury, have become more widespread as a result of the rising contact sports popularity and the children's desire to contribute at a young age. However, numerous young sportsmen are unaware of the health risks associated with a traumatic mouth injury while playing. [3] The dentist is an important source of information for sportsmen in instructing coaches, athletes and patients and their parents about the importance of oro facial injury prevention, diagnosis, and treatment in sports.[3] Wearing basic shielding gears such as face masks, properly fitting helmets and mouth guards is the most important factor in reducing sports-related oro-facial injuries. [1] The use of these protective devices by young athletes has been shown to provide effective safeguard against the injuries. Use of these preventive devices during sports activities has reduced the incidence of the injuries to many athletes. For many young players participating in various body contacts sports, semi contact sports, the mouth guards are considered to be as an essential part of equipment by most authorities. Mouth guards are pliable devices that, when worn within an athlete's mouth, protect against tooth injuries, mouth lacerations, and jaw fractures and dislocations. [4]

The following article addresses recent developments in mouth guard technology and fabrication. It also attempt to provide an insight into prevention measures for sports related injuries.

Discussion

Wearing protection gear such as facemasks, properly fitting helmets, and/or mouth guards is the most important aspect in preventing sports-related orofacial dental injuries. [1] When there is a chance of body-to-body
or body-to-equipment contact, mouth guards should be worn. [5]

Mouth guards

The American Society for Testing and Materials (ASTM) claims that, a mouth guard is a robust device or appliance that is worn inside the mouth (or both inside and outside) to prevent injury to the teeth and surrounding structures. Mouth guards protect the lips, teeth gingiva, mucosa, and tongue against injury.They deflect strikes that could result in jaw dislocations, fractures, or temporomandibular joint injuries. [6]

Woolf Krause a London dentist invented mouth guard as a protecting device against lip lacerations for boxers. [7]

Unprotected sports involving potential threat for dental trauma mandate the use of mouth guards or faceguards among players.[8]

Functions of mouth guard

Mouth guard prevent the athlete from sports-related traumatic injuries as: [9]

1. It serves as a barrier between the soft and hard dento-oral structures, thus preventing any laceration and bruising during trauma.
2. It protects the opposing dentition from seismic contact against each other.
3. It prevents the fracture or damage to the unsupported angle of the mandible during impact.
4. It act as shock absorber and reduce the chance of neurologic injury.
5. It fills empty spaces, thereby providing support to adjacent teeth.

Sports which need mouthguard:[10]

Acrobatics	Gymnastics	Skiing
Bandy	Handball	Skydiving
Baseball	Ice hockey	Soccer
Boxing	Martial art	Surfing
Field events	Rugby	Volleyball
Field hockey	Skateboarding	Wrestling

The American Society of Testing and Materials has reapproved the categorization of Mouth Guard Classification for athletic mouth guards. [3]

Stock Mouth guards (Type I) (least preferred)
Mouth formed mouth guards (Type II)
Custom fabricated (over a dental cast) mouth guards (Type III)(most preferred)

1) Stock mouth guards (SMGS)

The SMGs are composed of rubber, polyvinyl chloride or a polyvinyl acetate copolymer. This type of mouth guard can be bought from the pharmacy, sporting goods store, or a departmental store.[11]

Kerr [12] conducted research on the primary benefits and drawbacks of these types of mouth guards for the avoidance of damages in contact sports.

Advantages include:

1. Economical and affordable by the patient.
2. Easy availability.
3. Available in the number of shapes, sizes and flavoring agents.
4. Suitable for emergency use when customized mouth guard may not available.

Disadvantages include:

1. Availability in limited sizes result in improper fit inhibition in speech, discomfort and irritation while wearing by an athlete and difficulty in breathing which forces the athlete to modify it for better fit and function.[13]
2. If the wearer becomes unconscious, the appliance may be lifted from its position causing an airway obstruction.[14]
3. Provide a low level of protection comparatively.

2) Mouth-formed protectors (MFPS)

MFPs available in two varieties:

a) The shell liner and

b) The thermoplastic mouth guard.

a) A prefabricated shell having a plastic acrylic or silicone rubber lining .The liner is kept in the athlete's outh and shaped around his or her teeth before being set.

b) The premade thermoplastic mouth guard features a lining that is soaked in hot water for 10-45 seconds, following which it is transferred to cold water and subsequently suited to the teeth. This type of MFPs is also known as 'boil and bite' guard. This type of mouth guard is the most popular of the available three types and is used by more than 90% of athletes. [15] These mouth guards are the most popular, but they lack the necessary thickness, comfort, and protection for the back teeth. Often, because of the inaccurate fit, clenching pressure is required for adequate retention.

3) Custom-made mouth guards (CMMs)

CMMs are the superior among the three types of the mouth guards. This mouth guards has been recommended widely for athletes to prevent sports-related injuries by ADA. [11] CMMs are manufactured over a stone model of the athlete's teeth and are comprised of thermoplastic polymer. It is constructed to fit the competitor's mouth exactly by a dental practitioner.

Benefits of this type of mouth guard include[16]:

1. Perfect fit
2. Speech easiness
3. Retaining and comfort
4. Because the mandible is positioned forward, it reduces the risk of a concussion.[17]

Disadvantages include:

1. Relatively expensive to the athlete

CMMs are of two types: custom vacuum formed mouth guard (CVFMs) and pressure-laminated mouth guards (PLMs).

a) Custom vacuum formed mouth guard (CVFMs)

These are the most common and widely fabricated mouth guard by the dental professional by providing adequate protection from the sports-related traumatic dental injuries. It also allows for the least amount of speech and breathing disturbance. These are constructed from a single sheet of ethylene vinyl acetate, a copolymer of polyvinyl acetate and polyethylene (EVA). The sheet is heated and then vacuum suctioned over the stone model to fit the mouth and teeth. As a result of this operation, there is a reduction in the thickness of the tooth by 25% on the occlusal side and more than 50% on the buccolingual side.[18]These mouth guards are only effective for a few weeks after being worn and long-term protection is not provided.

b) Pressure-laminated mouth guards (PLMs)

They are produced using a stone model and multiple sheets of laminating ethylene vinyl acetate (EVA) materials that have been heated and put over it, and pressed with a maximum pressure of 6 atmospheres onto the model. After that, the sheets are attached together to form a thick, protective mouth guard. When compared to other forms of mouth guards, it is more retentive and allows for a more evenly distributed occlusion. When worn over an extended of a time frame, it shows very little distortion. These are typically fabricated by dental professional or dental laboratories.

Advantages of PLMs include: Effective communication, there is no obstruction to breathing, chewing and biting cause less

wear, the guard is more relaxed to wear, and allows uniform thickness of guard material. During all types of sporting activity, PLMs provide the finest protection for children's teeth.

Material selection

Mouth guards can be prepared out of a variety of materials, including[19]:

Copolymer of polyvinyl acetate with polyethylene or ethylenevinyl acetate (EVA).

(i) Polyvinylchloride
(ii) Latex rubber
(iii) Acrylic resin and
(iv) Poly urethane

According to Knapik et al, [20] ethylene vinyl acetate (EVA) has been widely used for mouth guard manufacturing because of its simplicity and formability of manipulation, albeit it has limits in terms of shock absorption and rigidity. Del Rossi et al [21] reported that dark-colored material can give better adaptability and a more secure fit than clear material. Jagger et al [22] reported that a novel silicon material has considerable promise for use as a mouth guard.

Maintenance of mouth guard

Whether prefabricated or custom made, the mouth guard must be cared as follows:

a. It should be washed with cool water or a mouth rinse before and after each usage. Toothpaste and a tooth brush can also be used to clean it.
b. A strong container with vents for air circulation should be used to store and transport the mouth guard.
c. The wearer should avoid exposing the mouth guard to extreme temperatures in order to keep it in good form.
d. It is advised to not to chew on or cut pieces off the mouth guard and the mouth guard should be regularly checked for tears or holes and appropriate fit.
e. Schedule regular dental visits so the dentist ensure the accurate fit of mouth guard.

Recent advancement in fabrication of mouth guard using digital technology

Yanagi et al [23] fabricated mouth guard using a digital technology. An optical impression using a dental scanner (KaVo ARCTICA Auto Scan®, KaVo Dental Systems) with an existing plaster model as the master model was taken. The model data was stored as STL data (Figure 1), and the MG shape and periphery were designed with organic 3D engineering software (Geomagic Freeform Plus®, 3D Systems, Inc.) using the model data to create a 2.5 mm thick MG (Figures 2&3).

At present the typical CMG production method involves taking an impression with an alginate material to prepare a model, and then heating and compressing an EVA sheet, etc., using a vacuum forming unit. However, in growing patients, an impression must be taken for every CMG and this place a heavy burden on the patient. For adults, storing the model is sufficient, but that occupies much space. Therefore, optical impression scheme was applied to solve these problems. Because the oral cavity data can be read by a scanner, there is no risk of accidental swallowing the impression material, and this eases patient distress. Another advantage of this method involves reduced time and material required for making a plaster model, and also obscuring the need for model storage space. Therefore, it is believed that optical impression taking will become essential in the future. In addition, a technology that applies this scanned data using CAD/CAM and 3D printers is currently advancing. Differences in thickness occur in CMG fabrication due to various conditions, and this problem is hard to control. With CAD/ CAM and 3D printing, however, milling and molding are performed based on scanned data, so the final product has high precision and excellent reproducibility. Therefore, a high-quality CMG can be fabricated by applying these digital techniques.

Figure 1:Standard Tessellation Language (STL) data of the plaster model

Figure2: Design of MG with organic shape 3D modeling CAD software

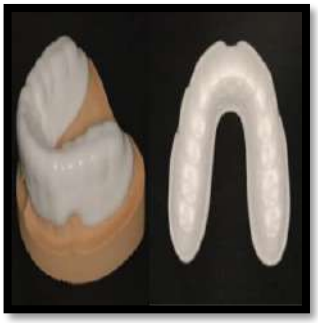

Figure3: Completed CMG and inside

Role of a pediatric dentist in sports dentistry

Since, injuries sustained during mixed dentition or early permanent dentition have long term impact on the esthetic and functional status of individual, it is essential for paediatric dentist to have thorough knowledge about diagnosis, prevention and management of such trauma.

Conclusion

Mouth guards protect against orofacial injuries and reduce the frequency and seriousness of sports-related injuries that occur during sporting practise and competition. Paediatric Dentist must emphasize to focus on enhancing the safety of sportsmen by the quality of mouth guards.

Last but not the least, starting at the local and state levels, sports dentistry should edict the use of protective gear, particularly mouth guards, in all sports, thereby ensuring a safe future for prospects of the nation.

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Corresponding author

Dr.LinthoingambiArambam
Post Graduate
Department of Pedodontics and Preventive Dentistry. Uttar Pradesh, India
Email Id: linthoingambiarambam@gmail.com
Contact No. 7630941954

How to cite this article: Arambam L, Kaur H, Rishika, Yeluri R. Prevention of children's sports-related injuries: A review. TMU J Dent. 2022;
9(1):1-4.