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Sports Dentistry: A Clinical Review

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REVIEW

ABSTRACT

Dental trauma in sports is the major linking channel between sports and dentistry. Sports dentistry is the prevention of oral/facial athletic injuries and related oral diseases and manifestations. In children, sports activities were found to be responsible for 13 % of overall oral trauma. Dental injuries are the most common type of orofacial injury sustained during participation in sports. The dentist can play a crucial part in informing athletes and their families, coaches, and patients about the importance of preventing orofacial injuries in sports.

KEYWORDS

Sports, Facial trauma, Mouthguards, Dentistry

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INTRODUCTION

Sports dentistry is the prevention of oral/facial athletic injuries and related oral diseases and manifestations. It has two major components: First is the treatment of orofacial injuries and the second is the prevention of sports-related orofacial injuries. To provide comprehensive care, a dentist must be knowledgeable and adept in the areas of oral surgery, endodontics, operative dentistry, orthodontics, hospital dentistry, and patient behavior management.[1] It is common for the kids to get hurt during any form of sports, especially contact sports, and face is the main area of damage. As dentists, we have to deal with patients with various kinds of fractures of tooth and facial bones.[2] Dental trauma in sports is the major linking channel between the sports and dentistry. The combined impact of violence, traffic accidents, and sporting activities has contributed to the establishment of traumatic dental injuries as a public dental health problem.[1]

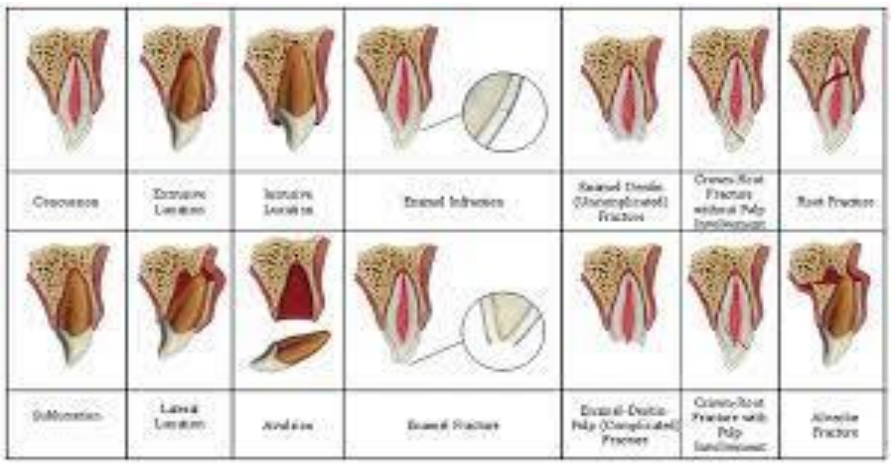

Figure 1: Dental trauma.

Sports dentistry is the prevention of oral/facial athletic injuries and related oral diseases and manifestations. It has two major components: First is the treatment of orofacial injuries and the second is the prevention of sports-related orofacial injuries. To provide comprehensive care, a dentist must be knowledgeable and adept in the areas of oral surgery, endodontics, operative dentistry, orthodontics, hospital dentistry, and patient behavior management.[3,4]

Preventive aspects during sports have changed the incidence of the injuries to the athlete. The preventive measures like usage of helmets, mouthguards, and other protective gears have reduced the impact on the athlete, thereby reducing the injuries.[5] Modifications of these protective gears also have been studied and changes have been made to make them more comfortable, user friendly, and also safer. In this review article, we discuss the various aspects of sports related injuries, the risk factors associated, protection, and prevention of trauma.[6]

Mouth guards also may reduce the rate and severity of concussions. Sport, leisure and recreation activities are the most common cause of dental injuries. Dental injuries can be painful, disfiguring and expensive to treat. [7] Dental injuries may result in time off work or school to recover, and lengthy (and expensive) dental treatment. A mouth guard, custom-fitted by your dentist and worn every time you play or train, will protect against dental injury.[8]
This article gives a brief review on the mouth guards to be used to protect smile.

HISTORY

Figure 2: Mouthguard type 2.

The exact origins of the mouth guard are unclear. Most evidence indicates that the concept of a mouth guard was initiated in the sport of boxing. Originally, boxers used to wear mouth guards out of cotton, tape, sponge, or small pieces of wood. They bite the material between their teeth.[9] These devices proved impractical, a British dentist, began to fabricate mouthpieces for boxers in 1892. Krause placed strips of a natural rubber resin, gutta-percha, over the maxillary incisors of boxers. [10] Philip Krause was an amateur boxer used his own device before 1921.[11] In the early 1900's, Jacob Marks created a custom fitted mouth guard in London.[12] In 1927 boxing match between Jack Sharkey and Mike McTigue. McTigue was winning for most of the fight, but a chipped tooth cut his lip, and he was forced to forfeit the match. From that point on, mouth guards were acceptable.[13,14] In 1947, a Los Angeles dentist, made a breakthrough by using transparent acrylic resin to form an "acrylic splint". In the 1948 issue of the Journal of the American Dental Association, the procedure for making and fitting the acrylic mouth guard was described in detail by Dr. Lilyquist.[15] He was awarded nationwide as the father of the modern mouth guard for athletes. [16,17] In the 1940s and 1950s, dental injuries were responsible for 24-50 % of all injuries in American football. In 1952, Life magazine did a report on Notre Dame football players without incisors.[17]

In the 1950s, the American Dental Association (ADA) began conducting research on mouth guards and soon promoted to the public.[18] In 1960, the ADA recommended the use of latex mouth guards in all contact sports. The National Collegiate Athletic Association (NCAA) followed suit in 1973 and made mouth guards mandatory in college football. Since the introduction of the mouth guard, the number of dental injuries has decreased dramatically.[19] Mouth guards have become a standard in many sports.

EPIDEMIOLOGY OF DENTAL TRAUMA

In the area of sports-related dental traumatology the disease occurrence is traumatic injury to the teeth and related supporting structures and soft tissue. Since the etiology and immediate cause of sports-related traumatic dental injuries are well-established—the transfer of mechanical energy to the teeth and mouth due to contact with the ground or some other fixed structure, contact or collisions with another participant, or being struck by an object, either a projectile such as a ball or puck or the device used to launch the projectile, like a stick or racket [20]—attention in analytical observational studies focuses on contributing and preventive factors. Analytical epidemiologic studies of preventive factors associated with sports-related traumatic dental injuries have traditionally focused on the use of intraoral mouthguards and/or face protection to prevent injuries. Since most high- risk sports, football, hockey, lacrosse, field hockey, and rugby, or high-risk positions in sports with a moderate risk of dental trauma—catchers in baseball and softball—require one or both types of protection for participants, attention has turned to sports with a comparatively moderate risk for traumatic dental injuries, such as soccer, baseball, and basketball, and to factors other than mouthguards that are associated with the prevention of traumatic dental injuries. While the dental injury rates for these sports do not approach the rate for the high-risk sports prior to mandatory mouth and face protection, they exceed the current rate of dental injury in protected athletes for high-risk sports [21,22].

mFactors contributing to risk of sports-related dental trauma can be classified as intrinsic and extrinsic

Intrinsic factors include the physical characteristics and psychological profile of individual athletes.[23] Age, gender, anatomic anomalies, motor abilities, and sports-specific skills are examples of physical characteristics. Psychological profile includes motivation and risk-taking behavior.[24] Of the intrinsic risk factors, sports-related traumatic dental injuries are associated most strongly with age (higher risk through adolescence, then decreasing with age) and anatomic features (higher risk with increasing occlusal overjet and lip incontinence). [25]

The association between gender and sportsrelated traumatic dental injuries is weakening steadily as sports participation by girls and women increases [22]. Extrinsic factors include type of sport, position played, exposure time, level of competition, coaching, referees, and protective equipment.[26] The association between extrinsic risk factors and sports- related traumatic dental injuries is strongest for protective equipment (lower risk when using mouthguard and face mask protection) and type of sport (higher risk when competing in contact sports and sports involving sticks and balls). [27]. The

list of factors contributing to the risk of traumatic dental injuries in sports underlines the complexity of the issue of risk mitigation [22]. Each athlete has a unique set of intrinsic variables that may confer greater or lesser risk for injury, and the interplay among and between intrinsic and extrinsic factors results in an almost infinite range of risk for participants in athletic events [22,27].

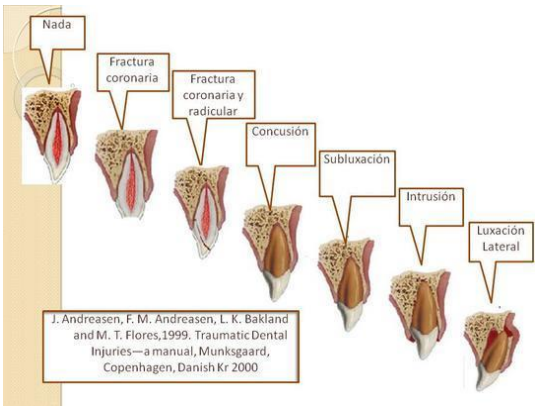

Figure 3: Traumatic dental injuries.

PREVALENCE OF TRAUMATIC DENTAL INJURIES

Prevalence of traumatic dental injuries is the proportion of a given population with evidence or history of a traumatic dental injury at a specific point in time. Since traumatic dental injuries are not necessarily sports-related, researchers must rely on the recollection of the subjects to record those injuries that are sports-related. As a result, prevalence of dental injuries in a population is of limited value in documenting sports-related dental injuries. It is instructive to consider a prevalence study to demonstrate the scope and limitations of prevalence data. NHANES III, the Third National Health and Nutrition Examination Survey, 1988–1994, included dental examinations on and interviews with 13,057 individuals between 6 and 50 years old.[22] This representative sample of the US population, adjusted for sociodemographic variables including gender and race- ethnicity, and occlusal characteristics, specifically overjet and overbite, yielded an overall prevalence for incisal trauma of 23.45 %, although prevalence in subjects between 21 and 50 was 27.09 %. The odds of traumatic injury increased with increasing overjet.[22]

Incidence of traumatic dental injuries

Incidence of sports-related traumatic dental injuries is the number of injuries that occur in a specific at-risk population over a specified period of time. To record an incidence rate, an accurate count of the number of people at risk is essential, since the rate is reported as injuries per population at risk.[28,29] Clinical incidence differs from incidence rate.[11,22] Clinical incidence is simply the ratio between new injuries and the population at risk. It does not take into account time of exposure, so it does not give good information on actual risk. Incidence rate measures injuries against total time at risk, which gives a more accurate measure of true risk.[30]

Dentoalveolar trauma

Trauma to the dentoalveolar complex is a major focus of modern sports dentistry. These types of injuries are not uncommon in sports and athletic competition. Many times these are complex injuries of multiple types of tissues that require careful examination, thoughtful diagnosis, and formulation of a treatment plan, at times, all within a matter of minutes [1,31]. For this reason, it is imperative that all dental professionals as well as sports medicine personnel, coaches, school nurses, and parents be familiar with basics in dental anatomy and dental trauma first aid.[11] Community dentists should stay abreast of the latest methods of managing dentoalveolar trauma and provide in-service lectures to school nurses, coaches, trainers, and parents. Team dentists must update their dental trauma management skills on a yearly basis as they have a duty to the athletes that they serve to provide optimal care when dental trauma occurs (Figure 3).[32] This paper serves as a basis for such review for dentists as well as sports medicine personnel. It is estimated that half of all children will suffer a dental injury by the time that they graduate from high school and that sporting activities cause the greatest percentage of these injuries in children [2,11,22]

This complex of tissues consists of five tissue compartments, and together they make up the dentoalveolar complex.[33] First the gingival-periosteal complex is composed of the gingiva, free gingiva, attached gingiva, and junctional epithelium as well as the periosteum covering the alveolar process. Second, the compartment is the periodontal ligament cementum complex. [34] Third is the alveolar bone and marrow complex. The fourth is the dentin-pulp complex, and finally there is the oral mucosa-skin complex. [35] The dentoalveolar complex is a very specialized area that allows the emergence of the dentition from the alveolar bone and consists of unique and specialized cells and tissues .[11]

Figure 4: Uncomplicated crown fracture.

Energy is transferred from an object to the dentoalveolar structures, and as these structures absorb the energy transferred, the damage to normal anatomy occurs. Sporting objects such as balls, pucks, sticks, and opponents' body parts are the major causes of this energy transfer through the dentoalveolar complex, and these same sporting objects and body parts can trap the soft tissues of the oral cavity against the teeth causing soft tissue damage.[1,3] These injuries to the dentoalveolar complex can occur in two basic ways, first by direct trauma where a ball, stick, elbow, knee, or other sports implement directly strikes the teeth. [36] Direct trauma injuries usually affect the maxillary anterior teeth, and the injuries most likely encountered in direct trauma are luxation injuries, tooth avulsion, and all types of dental fractures. The energy of impact may also determine the type and the severity of damage as a result of trauma to the oral cavity.[37] High- velocity low-mass-type injuries such as a ball striking the teeth tend to cause damage to the dental hard tissues and less damage to the supporting structure such as the periodontal ligament (PDL) or the alveolar process.[38] The energy of the impact is dissipated in creating the tooth fracture and is not transferred to the supporting tissues. [39] Conversely, low- velocity, high-mass-type injuries such as the teeth striking the ground or other playing surfaces tend to cause more damage to the supporting structures causing fewer dental fractures and more damage to the supporting structures leading to more luxation and avulsion injuries. [38] A second mechanism of dental injury is indirect trauma. This is seen when the mandibular teeth are forcefully crashed into the maxillary teeth. Indirect trauma causes more damage to the posterior teeth than direct trauma, as well as trauma to other craniofacial structures. Injuries resulting from indirect trauma include crown/root fractures of posterior teeth, mandibular fractures [3], temporomandibular joint injuries, and brain concussion (see more in 7 Chap. 5). Dentoalveolar trauma creates complex injuries affecting multiple tissues. There is potential damage to dental hard tissues, osseous hard tissues, dental pulp, periodontal ligament, mucosa, nerves, vessels, intercellular components, and cellular systems.[40] Successful treatment of dentoalveolar trauma must be aimed at resolving damage to all the cellular and intercellular systems.[41] To do this effectively, the sports dentist needs to have a working knowledge of basic wound healing principles.[42]

COMMON ATHLETIC INJURIES

Soft tissue injuries

Figure 5: The consequences of trauma may appear obvious, but time may reveal lesser injuries, including those in adjacent teeth.

Often in athletic competition, the face is the highly vulnerable area. Injuries to the body and surrounding tissues throughout the face are often seen. Abrasions, bruises and lacerations are frequent and therefore should be investigated for the purpose to rule out fracture or other severe underlying injury.15 These usually occur over a bony prominence of the facial skeleton such as the brow, cheek, and chin. Lip lacerations are also common.[11,22]

Fractures

Facial bone fractures are an even more complex issue. A zygoma (cheekbone) is perhaps the most specific site of injury.[43] Zygoma fractures account for about 10 percent of fractures in the maxillofacial region that occur during sport injuries due to the overt sharp damage resulting from fall, elbow, or fist.8 In a research by Linn et al., of the 319 subjects treated for sports-related damages, males were much more vulnerable to zygomatic trauma than females due to heavy body interaction during sports.[43] The prominent form and elevation of the mandible, like the zygoma, also contributes to traumatization. About 10 per cent of fractures of the maxillofacial region happens in the mandible whenever the player hits, another player or equipment.[44] The most vulnerable area of the mandible in both kids and adults is the condyle and therefore can produce serious facial disfigurement as the development of the lower face.[43,44]

TMJ injuries

Most hits to the jaw don't really lead to injuries, but considerable force transferred to the temporo-mandibular disc as well as the mechanisms sustaining it can cause permanent injury, to a degree that perhaps the retrodiscal tissue is strained across and the condyle may then be forced posteriorly. [45] This trauma sometimes results in bruising that could be intracapsular and can lead to joint ankylosis.[46]

Tooth intrusion

Tooth intrusion happens, by an axially directed effect, when the tooth has been pushed into the alveolar process. [47] This is perhaps the most extreme type of injury from displacement. Pulpal necrosis is far more probable to appear in full-formed rooted teeth and happens in 96 % of cases of invasive displacement. Immature development of the root usually involves spontaneous re-eruption.[46] The progression of mature root requires repositioning and splitting or orthodontic extrusion.[22,48]

Figure 6: Re attachment of crown fragment using a dentin bonding agent.

Figure 7: Fracture of a fragile, immature tooth during efforts to preserve it by root canal treatment.

Crown and root fractures

A most widespread permanent dental injury is crown fracture, which can happen in a variety of directions. Crown infarction is the easiest type.[11,31,32] There is an enamel craze without losing the structure of tooth. [33] No treatment is needed but appropriate pulpal vitality tests are necessary.18 Fracture extended to dentine are usually sensitive to high temperature as well as other stimuli.[34,40,41] A severe crown fracture induces the exposure of pulp completely and leads to contamination inside a closed apex tooth or can trigger a root fracture. Mobility is the major clinical predictor of a root fracture. To assess the site and seriousness of the fracture and the likelihood of related alveolar fracture, radiographic assessment and evaluation of adjacent teeth must be conducted. The extent of injury defines treatment.[11,31-33,40,42]

Figure 8: Flexible splinting with composite resin and wire.

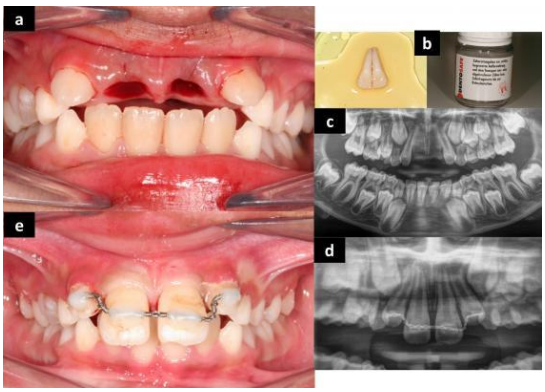

Figure 9: Avulsion injuries.

Avulsion

Amongst the most severe sports-related dental accidents is the full avulsion of a tooth. Of all oral injuries, two to sixteen percent contribute to an avulsed tooth. [49-55] A tooth completely depending on the length of the period outside the tooth socket, pushed out from the socket may be substituted with various degrees of performance.[56,57] If, by improper treatment, periodontal fibres bound to the root surface have not been damaged, an avulsed tooth is likely to regain full function. [58,59] The risk of success is considerably reduced after two hours. The fibres turn necrotic and the substituted tooth is resorbed and then lost.[55-60]

PREVENTION OF SPORTS-RELATED TRAUMATIC OROFACIAL INJURIES

Many sports-related traumatic dental injuries are preventable; the risk-to-benefit ratio can be improved by the use of appropriate, properly fitted, protective athletic equipment. Furthermore, as the predictive risk factors associated with such injuries are more clearly identified and defined, the design and development of new protective devices may contribute positively to future athletic injury prevention.[61] At present, helmets, facemasks, and mouthguards are required in some sports to reduce both the likelihood and the severity of sports-related traumatic injuries to the head, face, and mouth of an athlete.[62] The imperative for future independent scientific research is emphasized to transform current clinical empiricism into

statistically significant, evidence-based knowledge. Helmets are designed to protect the skin of the scalp and ears from abrasions, contusions, and lacerations.[61,63] They protect the bones of the skull from fractures, and the brain and central nervous system from direct concussions, unconsciousness, cerebral hemorrhage, brain damage, paralysis, and death. Facemasks are designed to protect the eyes, nose, nasal pyramid, zygomatic arches, and mouth from traumatic forces such as a fist, ball, puck, or stick directed toward the face.[64] When used properly, helmets and facemasks enhance player safety and reduce morbidity. Facemasks are manufactured from plastic or rubber tubing or welded steel or aluminum of different diameters and are covered with a coating of vinyl plastisol. The earliest style of facemask introduced into football in the 1950's consisted of a contoured single bar.[65] All styles of facemasks provide varying degrees of protection to the maxilla horizontally from an extended finger, a clenched fist, a forearm, or a helmet directed respectively toward the eye nasal pyramid zygomatic region or the mandibular arch.[32,33] One major disadvantage of the facemask is that it has a protruding object within the ready grasp of an opposing player.[62] When the facemask is pulled or twisted by an opponent during the course of a play, serious physical consequences such as muscle, neck, or spinal column damage can result.[34.63]

Figure 10: Periapical radiograph of fractured permanent maxillary incisors. Apices are open and there is no evidence of concomitant injuries.

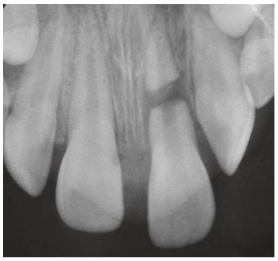

Figure 11: Root fracture in the middle third of the maxillary left central incisor with significant separation between the segments.

Mouthguards or "gum shields" were originally developed in 1890 by Woolf Krause, a London dentist, as a means of protecting boxers from lip lacerations. Such injuries were a common and often disabling accompaniment of boxing contests in that era.[35] These gum shields were originally made from gutta percha and were held in place by clenching the teeth. By 1930's, mouthguards were part of the standard boxers' equipment and have remained so since that time.[36] The Academy for Sports Dentistry recently listed some 40 sports in which mouth protection would be advantageous for the participant; the list includes the following sports and activities.[37,65] There are many types of mouthguards, e.g. stock mouthguards. They are the least expensive of the three types of mouthguards available and come in different styles and colors, with or without straps. They are ready to wear because one size is intended for all users, and they must be held in place by biting the teeth together. Because they are the least retentive and often bulky, stock mouthguards interfere the most with the athlete's ability to breathe and speak and often cause the athlete to gag. Because of all these factors, stock mouthguards are unacceptable to most athletes and offer the least protection for the prevention of sportsrelated traumatic dental injuries.[38,66] Mouth-formed mouthguards come in two varieties: Shell-lined and boil-and-bite. The shell-lined variety is fabricated by placing freshly mixed ethyl methacrylate into a hard shell, which is then inserted into the athlete's mouth and molded over the maxillary teeth and soft tissues. The excess is trimmed with crown and bridge scissors and the mouthguards are then ready for use.[37,54, 65]

Figure 12: Extrusive luxation of permanent right maxillary central incisor.

MOUTHGUARD

Boxing was the first sports activity to use mouth guard. Boxers used devices like cotton, tapes, sponge or small pieces of wood. [66] They clenched these materials between teeth believing that they will act as shock absorbent.[67] However it was thought that the players were distracted in order to keep these materials clenched between teeth and it is also stated that these materials were dislodged from oral cavity and entered larynx.Thus in 1930's the first description of mouth guards came into existence into dental literature [19, 20,67].

Mouth-formed, also known as "boil-and-bite", mouth guards are made from a thermoplastic material adapted to the mouth by finger, tongue, and biting pressure .Woodansey added that because they are formed at body temperature, they readily distort and wear off. They often lack proper thickness and extension leading to lesser protection and retention [23,68].

Classification of Mouth Guard ASTM (American society of testing and Materials) reapproved the classification for athletic mouth guards as follows ;

- Type I - Stock Mouth guards. (Least preferred)
- Type II - Mouth formed mouth guards.
- Type III - Custom fabricated (over a dental cast) mouth guards (Most preferred) [21].

Stock type

This is by far the simplest type of mouth protector. It is usually a device that is supposed to be used directly from the package with no attempt made at fitting for the individual. The use of this type of device results in a very loose-fitting appliance where the athlete must clench his or her teeth together to keep the device in place.[68] This obviously leads to unintelligible speech and difficulty in breathing through the mouth. It is also much more likely that the guard will be dislodged when the player is contacted during play (Figure 7). [69] These guards are usually designed for the upper arch, but often they are configured to cover both the upper and lower teeth. There are quite a few styles and shapes available and at best should be used only when an athlete can stop his activities often and when ongoing verbal communication is not important.

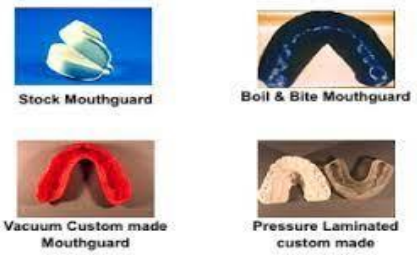

Figure 13: Classification of mouth guard.

Most sports dentists do not recommend these devices, but supporters note a few benefits. They are convenient and can be used immediately without fitting. [70] Orthodontists sometimes recommend these, as they do not restrict the ongoing movement of teeth during orthodontic treatment. They are generally inexpensive. They make easy "spare mouthguards" to be kept on hand in case someone has lost or destroyed their own guard. [71] Stock mouthguards should be used only in very specific circumstances and should not be thought to be an acceptable alternative for general use. They do not meet the basic requirements of a "properly fitted mouthguard" .[66-73]

Mouth-formed

This type is the most widely used mouthguard. They are accessible and cost-effective and come in a large variety of styles and designs to supposedly fill all needs. As it is defined, it is to be molded in the mouth and has two basic types: the shell-lined or the thermoformed type. [64] The shell-lined type is one where a resilient material is mixed and placed in a dental arch-shaped shell and then it is placed in the mouth to set. This type has largely disappeared from use. [67-69] The more common type is the thermally formed group usually termed the "boil and bite" group, as that is how it is most often fitted. This type is readily accessible, and in recent years an almost limitless number of varieties have been marketed. [70] They are generally affordable, and the creativity in their design and materials has led this to become a very significant industry in the sporting goods world.[71] Athletes often gravitate toward these as they are conveniently obtained and can be fitted without the intervention of a dental professional. Boil and bite mouthguards come in a wide range of prices depending on the features of a particular guard with a price to literally match every budget.[73] The mouthguard is individually fitted usually by heating the device in hot water (or in a microwave oven) and then placing inside the mouth to form it to the teeth. Once it is in the mouth, the participant molds in with his or her fingers to mold the outer side of the guard by pushing on the cheek and lips, by sucking hard on it while placing the tongue firmly against it, and by biting on it to fit it to the lower teeth.[67-69] The huge variety of these types of mouthguards makes it hard to assess whether accomplishing a good fit is possible or not. The fit largely depends on the individual doing the fitting. Dentists know how difficult it is to learn the skill of taking a good dental impression, and this fitting of a mouthformed guard can be compared to that.[64] Therefore it is difficult to categorically state whether or not this type of mouthguard is acceptable (Figure 7). Mouth-formed mouthguards may vary, but one particular mouthguard made of a unique material (a polyolefin polymer trade name Vistamaxx) applied for and received, in 2016, the American Dental Association's Seal of Acceptance. At the time of this writing, this mouthguard is the only one to have ever been awarded this designation.[73]

Custom-fitted mouthguards

These mouthguards are created by dental professionals fabricating specific materials over a cast of an athlete's teeth. These guards are usually made for the maxillary teeth except in prognathic Class III-type occlusions.[64] The internal adaptation achieved and the ability to create comfortable borders make these mouthguards the most comfortable and intimately fitted. [65] Studies have shown that these guards are the most desirable to players [21] (Figure 7) This type of mouthguard, most commonly, uses some type of ethylene vinyl acetate (EVA) that is heated and then formed over the dental cast. The two most common ways of forming these guards are to use a vacuum forming technique or a heat and pressure technique.[67-69] The advantages of the custom-fitted guard beyond the intimate fit are that (a) the guards are specific to the athlete, (b) they can be customized to suit the sport played and the athlete's requirements, and (c) the device is not easily dislodged during play. Also, because a custom guard is tailored to the athlete, speech considerations and the ability to breathe without detriment are not affected in any critical way. A significant number of studies have been conducted measuring VO2 max levels of an athlete wearing a mouthguard versus one without. VO2 max refers to the maximum amount of oxygen an individual can utilize during intense or maximal exercise; the result has found that there is no physiological effect on breathing with a mouthguard in place and that any complaints by the athlete are probably psychological.[64, 65] However there are studies done with stock mouthguards that do show a reduction in VO2 max [22–24]. For sports that are defined by continuous play, that are highly aerobic, and those sports in which athletes play without

break for extended periods of time, this type of guard is by far the most suitable. They are also the type usually preferred by athletes [21]. The major disadvantages of this type of guard are cost and accessibility. [73] They tend to be significantly more expensive than retail guards. An impression of the athlete's teeth needs to be taken. This is most commonly achieved at a dentist's office, but there are products available which allow the purchaser to fabricate their own impression.[64] This impression is then used by the dental professional to fabricate the guard, or it is sent to a professional dental laboratory for the fabrication of the mouthguard.[67-69]

The vacuum-formed type of custom guard has been used since first investigated in the early 1960s [13, 14]. A sheet of mouthguard material was heated and placed over a dental cast. A vacuum then pulls the material down over the cast. Currently a more modern version of this technique is still used with more sophisticated machines. This technique can be used to create a well-fitted mouthguard, and the machine that is used in its fabrication tends to be less expensive than the machine used in the heat and pressure technique.[65] While this technique can create a very acceptable mouthguard, it is difficult to laminate multiple sheets of mouthguard material in order to add strength and longevity. In addition, if only one sheet of material is used, as is the common practice, the guard tends to lose its shape after a certain period of time.[67-69]

The heat-pressure lamination technique takes advantage of a specific type of machine that heats a sheet of mouthguard material and then, with a special pressure chamber, pushes rather than pulls the sheet onto the cast. [67] This creates a very exact and detailed impression of the cast onto the internal aspect of the guard. Because of this detail, the fit of this guard is very snug and intimate. In addition, this technique allows for the addition of multiple layers of material onto one another. Each layer is directly fused or laminated to the previous one. [64] Customization of thickness in different parts of the guard is a distinct advantage. This lamination technique also gives the dental professional the ability to laminate a clear layer as the final layer.[67] This clear layer allows mouthguards to be decorated and personalized with logos, names, and decorations. In the authors' experience, it is not uncommon to see a laminated mouthguard last multiple seasons as compared to vacuum and boil and bite types that in most cases do not make it through one season of play.[65]

The athletic mouthguard and the treatment of the injured athlete are the most important connections of the sports dentist to the sports medicine team. [64] Athletic mouthguards are effective devices to lessen the severity and incidence of dental injuries. Mouthguards do not negatively affect performance and can be made comfortable and practical to athletes in sports that carry the risk of injury. [73] Today's sports dentist must be knowledgeable about the characteristics of the ideal mouthguard and how to fabricate an excellent mouthguard and must be creative enough to customize each mouthguard to fit the needs of his or her player/ patients. [74] Dentists must skillfully navigate the many different options for mouthguards for athletes and help players and their families obtain the best appliance for their activity and sport. There is no doubt that an athletic mouthguard is one of the most effective pieces of sports safety equipment. It is imperative that sports dentists know everything about the modern mouthguard.[75]

PROFESSIONAL RESPONSIBILITY OF DENTISTS

A rapid proliferation of sports programs for children and adolescents has taken place over the past few years. The participation has grown dramatically at both the recreational and organized sports levels. [76] The dentist has a professional responsibility to educate himself and the public regarding the issues related to sports dentistry, specifically to the prevention of sports-related orofacial trauma. Dentists should also take the lead in educational, research, and public service activities. It is the duty of dentists to create awareness among the people, teachers as well as students, and children. [77] Two recent studies showed that people are not much aware of the possible outcomes of the injury, and emergency management, and that only a few people knew the usage of protective gears like mouthguards and helmets during contact sports. A study done on school teachers showed that the incidence of injury and emergency management improved significantly after the sports injury management programs were conducted by the dentists.[76] In another awareness studya by Sepetet al., [77,78] it was found that 10.9 % had experienced a kind of dental trauma and 12.5 % would look for a dentist for treatment in emergency. 34.5 % would re-implant the avulsed tooth, 33.4 % would maintain the avulsed tooth in handkerchief, and 25.3 % would maintain it in saline solution. 41.1 % were aware of the possibility of oral injuries during sports practice, and 55.4 % knew about mouthguards but only 11.2 % of the participants reported using them. These studies show that proper guidance and awareness in people by dentists can improve the knowledge of protection, prevention, and incidence of sports injuries.[76-78]

Figure 14: Mouthguards.

PREVENTION

There is some evidence that preventive measures may be effective in reducing risk of dental trauma. For example, certain predisposing factors such as protruded maxillary incisors and insufficient lip closure may affect the extent of the trauma.[79] In these patients, the maxillary anterior teeth are exposed directly to any impact without interposition of soft tissue. [80] Therefore, early orthodontic treatment in predisposed children may be an effective prevention strategy. Protective devices such as mouthguards also may help reduce the incidence or severity of dental injuries if they are worn during participation in contact sports.[79,81] Mouthguards offer protection by absorbing high impact energy from potentially traumatic blows and dissipating that energy, which otherwise would be transferred directly to the underlying dentition. Mouthguards also can provide substantial protection to patients receiving orthodontic treatment. [82] Further research has been encouraged to better measure the nature and severity of sports-related oral injuries in orthodontic patients, especially adolescents.[83,84] By providing cushioning between the maxilla and mandible, mouthguards also may lessen the incidence or severity of condylar-displacement injuries and thereby reduce the potential for concussion.

CONCLUSION

Sports dentistry encompasses a wide range of preventive and treatment modalities of oral/facial athletic injuries and related oral diseases and their manifestations. The pediatric dentist must possess a sound clinical working knowledge regarding sports‐related orofacial injuries in children and adolescents and the various methods of prevention. With the increasing trend of sports participation in schools and colleges, protective devices and preventive options gain significance. Sports-related dental injuries are not uncommon during participation and they deserve our immediate attention. In this regard, the pediatric dentist must work in close association with the teachers, coaches/trainers, parents, and other health professional to ensure comprehensive dentfacial care. Preventive programmers should include information regarding sports‐related orofacial injuries, preventive measures like helmets and mouthguards, and their management, resulting in better awareness of the general population. It is also our responsibility to identify, educate, and provide the athletes preventive measures like mouthguards.

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