

DENTAL/OROFACIAL TRAUMA IN CONTACT SPORTS AND INTRAORAL MOUTHGUARD PROGRAMMES

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Abstract:

Since dental/orofacial injuries were the commonest type of injuries sustained during participation in sports activities in the 1980s, when it was apparent that one third of dental injuries was due to sporting involvement, with the remainder being due to accidents, especially at home, the role of the dental profession in relation to dental/orofacial sports injuries became very important. This has inevitably led to the rapid development of a new branch of dentistry called sports dentistry. In line with the development of sports dentistry the causes of dental/orofacial trauma have been examined and a number of studies on the prevalence and aetiology of sports-related injuries has been conducted. Mouthguards worn during participation in sports activities have been shown to provide the most effective protection against dental/orofacial injuries. Moreover, it has been concluded by a number of scientists that mandatory dental/orofacial and periodontal protection for all athletes involved in sporting activities would have major effects in preventing unnecessary injuries and associated life-long discomfort, as well as reducing the high prosthodontic treatment costs involved. Intraoral mouthguards include: stock, self-adapting, and custom-made. Ideally, the dentist should make a treatment plan for mouthguard fabrication. Subsequent care and maintenance should also be accomplished by the dentist alone. In other words, athletes should not wear mouthguards the physical and technological properties of which cannot offer a quality prevention against injuries to the dental/orofacial system. Only the custom-made mouthguard has proved to be the most effective means in the prevention against injuries to the orofacial system. Athletes consider the custom-made mouthguard pleasant to wear either during training sessions or when competing due to its technological properties and appropriate design. The profession should make efforts to promote the use of mouthguards by informing athletes of the possibilities of active prevention against injuries to dental/oral regions in order to reduce their number.

Key words: orofacial trauma, sports dentistry, custom-made mouthguards

Sports-related activity and dental/orofacial trauma

Not only is the sports-related activity of every person necessarily associated with the risk of injuries to parts of his/her locomotor system but also with other parts of his/her body which are not directly involved in it. The first awareness of the fact that traumatic injuries to the dental/orofacial region posed health problems in the past was associated with sports involvement in collision and contact sports such as boxing, American football, and more recently track-and-field events. Apart from the considerable risk for dentofacial trauma among the individuals participating in both team and individual sports activities in which athletes' bodies physically interact with each other thus enabling the release of uncontrolled strength as well as exertion of unfavourable forces on the opponent, especially those individuals involved in the so called "extreme" rec-

reational activities such as mountainbiking, skateboarding and rollerskating also have demonstrated a significant rate of dental/orofacial trauma (Ranalli, 2002; Jerolimov & Carek, 1997).

The rate of dental/orofacial injuries is relatively similar regardless of the sport or the level. Recreational athletes also sustain injuries because they are not as fit as professionally engaged athletes, accordingly the risk of dental/orofacial injuries is increased.

The aim of this review was to point to the need for protective devices such as mouthguards in order to avoid sustaining sports-related dental/orofacial injuries. It is neither easy to prevent such injuries nor to make guidelines on prevention. Nevertheless, an effort has been made in this review to raise the awareness of the athletic community of the need for protective mouthguards because they have proven to be an effective means of preventing traumatic injuries to the teeth and their supporting structures.

Sports dentistry

Since the risk of dental/orofacial trauma in top sports involvement, especially in contact sporting activities was in the 1980s assessed as being higher than the risk of such injuries sustained during children's play or the risk related to non-contact sporting activities, the role of the dental profession became very important. Consequently, a new branch of dentistry, sports dentistry, was born at that time. Sports dentistry is closely related to another dental discipline called dental traumatology. According to the International Academy for Sports Dentistry the main goals of sports dentistry include prevention and treatment of sports related dental/orofacial injuries, information collection, information dissemination and promotion of research on the preventive procedures related to injuries of such a specific aetiology (Škrinjarić, 1995; Ranalli, 2002; Kumamoto & Maeda, 2004).

Athletes who are potentially at risk should be well informed of the available means of appropriate protection. Also they should be informed of the temporary and permanent consequences of injuries sustained during sports involvement in order to use the available means of protection thus avoiding injuries to the dental/orofacial region. Greater emphasis on recreational sporting activities combined with the sporting public that is better informed of the potential hazards can lead to a continuing rise in the demand for, and the use of protective devices. The German Society for Dentistry and Oral Surgery (DGZMK) has made a strong recommendation for athletes who participate in American football, baseball, basketball, boxing, and other combat sports, ice-hockey, field-hockey, football, gymnastics, inline skating, biking, mountainbiking, horseback riding, rugby, skateboarding and water polo to use mouthguards and other protectors in an attempt to reduce the incidence of dental trauma (Mischkowski & Zöller, 1999; Kumamoto & Maeda, 2004).

Epidemiology of sports-related dental/orofacial trauma

Attitudes of respectable dental associations have been confirmed by a number of epidemiological studies. Inline skating, hang-gliding, cricket and diving have recently been added to the list of hazardous sports. The most frequent dental/oral injuries are sports-related (from 10 to 50%). These include soft tissue lacerations, loss of one tooth, loss of several teeth (most frequently loss of maxillary incisors) while less frequent trauma include mandibular fractures, alveolar fractures and traumatic injuries to the temporomandibular joint (Kvittem & Roettger, 1998; Knapik et al., 2007).

Appropriate mouthguard recommendations can be made relative to the type of sport and level of

competition. The rate of dental/orofacial injury depends greatly on the age of the selected sample, the sample's group geographical location and the importance of a specific sports activity to the country in which the study is being conducted. Not only do male athletes sustain dental/orofacial injuries but also female athletes (Kumamoto & Maeda, 2004; Sane & Ylipaavalnime, 1988; Tuli, Hachl, Hohlrieder, Grubweiser, & Gassner, 2002). The incidence of dental/orofacial injuries among basketball players varies between 5.2 and 69.4% (Kumamoto, Winters, Novickas, & Mesa, 1997; Jerolimov, Seifert, & Carek, 2000). The incidence among baseball players varies between 12.9 and 75.6%, which classifies baseball into a high-risk group for dental/orofacial trauma (Garon, Merkle, & Wright, 1986; Berg, Berkey, Tang, Altman, & Londeree, 1998; Mueller, Marshall, & Kirby, 2001). The results of a number of epidemiological studies on football players reveal that incidence depends considerably on the size of the subject group and varies between 2.8% and 68% (Kujala et al., 1995; Emshoff, Schoning, Rothler, & Waldhart, 1997; Berg et al., 1998; Tuli et al., 2002; Levin, Friedlander, & Geiger, 2003). The incidence decreases in ice-hockey players, field-hockey players and lacrosse players (between 1.3% and 12.7%) (Lee-Knight, Harisson, & Price, 1992; Soporowski, Tesini, & Weiss, 1994).

In a selected sample of top handball players soft tissue lacerations have been determined in 78.8% of the injuries while dental trauma and tooth loss amounted to 13.6%. In addition, the temporomandibular joint trauma amounted to 6.8% (Jerolimov, Seifert, & Carek, 2000). The majority of reports found higher incidence of dental trauma among cyclists than among participants in most other sports. The speed at which the cyclist travels and the use of toe clips has put cyclists at risk for dental/orofacial trauma. The incidence varies between 6% and 30% (Tuli et al., 2002; Levin et al., 2003; Emshoff et al., 1997; Soporowski et al., 1994; Blinkhorn, 2000). The incidence is high among rugby players. The reported dentofacial injury rates in rugby vary between 13% and 56.5% (Chapman & Nasser, 1996; Yamada, Sawaki, Tomida, Tohnai, & Ueda, 1998). Alpine skiing-related dental/orofacial injury rates amounted to 31.8% (Tuli et al., 2002), whereas gymnastics does not demonstrate a high dental injury incidence – 5.7% but accidents do occur (Soporowski et al., 1994). Water polo players exhibit the highest reported incidence. The greatest incidence among water polo players amounted to 96.4% out of which injuries to the soft tissues amounted to 80% while dental trauma amounted to 7.6% (Jerolimov & Jagger, 1997).

It is interesting to compare the results of different epidemiological studies on methods of prevention to sports-related dental/orofacial injuries

over the years. It is clear that the methods have undergone changes. In fact, they have improved. As a result, the number of dental/orofacial injuries in American athletes of all age groups prone to dental trauma has been reduced. The dental/orofacial injury rate for American football players has been reduced to only 1% due to the use of mouthguards (Chapman, 1989; Škrinjarić, 1995; Ranalli, 2002).

The preventive role of the mouthguard

The main aim of primary protection is prevention against injuries. It has been widely reported that participation in sports carries a considerable risk for sustaining injuries. One interesting aspect of high-risk sporting activities is the protective equipment available to present-day athletes. These include special helmets, vests, padding for the protection of shoulders, arms and legs, facial protectors and a variety of more or less expensive mouthguards. Wearing a mouthguard can reduce both the incidence and severity of dental injuries. Consequently, intraoral mouthguards protect athletes against injuries to the lips, the tongue and reduce chances of severe injuries such as mandibular fractures (Ranalli, 2002; Ferrari & Medeiros, 2002).

Although the first reported mouthguard was made in 1892, dental literature does not mention mouthguards again until 1915, when professional boxers were reported to have used mouthguards during championships. In the 1950s, several dental societies started making mouthguards for football teams. Simultaneously, the most rapid development of mouthguard technology occurred in the United States of America where extensive studies and material testing were undertaken. Early work identified the most appropriate types of mouthguards as well as the best positions for mouthguards in athletes' mouths. It also identified that mouthguards should be worn on the maxillary teeth, as it was evident that the maxillary anterior teeth were the most prone to injury except in class III malocclusion because in such a case the mouthguard should be worn on the mandibular teeth (Reed, 1994; Scott & Burke, 1994).

According to the placement, mouthguards can be extraoral, intraoral and combined. The extraoral mouthguard is attached to the helmet in the form of a protective net or grating. The intraoral mouthguard is placed on the dental arch. There are monomaxillary and bimaxillary mouthguards. The monomaxillary mouthguard has retention on one dental arch. The bimaxillary mouthguard, due to its construction, has retention on both dental arches thus ensuring normal breathing. It stabilizes the mandible in order to reduce the risk of fractures as well as injuries to the soft and hard tissues of the temporomandibular joints. The combined mouth-

guard incorporates constructional elements of the extraoral and intraoral mouthguards (Chapman, 1986; Škrinjarić, 1995).

Intraoral mouthguards

There are three general types of intraoral mouthguards currently available. They differ in adaptation, manufacture, protection, comfort and wearability (Guevara & Ranalli, 1991; Škrinjarić, 1995; Ranalli, 2002). These include stock, self-adapting and custom-made mouthguards.

- Stock or ready-made mouthguards are available at sports stores without a prior visit to the dentist. They are inexpensive and only provide a low level of protection and little retention and comfort. The athlete holds the mouthguard in place by clenching the teeth together. They fall out occasionally due to inappropriate individual adaptation. They interfere with breathing and speech and may even stimulate vomiting.
- Self-adapting (*boil and bite*) mouthguards or "mouthformed" mouthguards are relatively inexpensive and can be replaced more frequently over time. They are also available from sports shops and are softened in hot water and moulded to fit the teeth of the individual. They vary considerably in cost and quality. Retention is better if fitted by a dentist. Too frequently, however, the athlete himself/herself attempts to fit the mouthguard often with unsatisfactory results. Therefore the drawbacks of this type of mouthguard result from unprofessional manufacture. Most mouthguards of this type are made from ethylene vinyl acetate (EVA) material. They are often bulky and, with use, do not retain their shape.
- Custom-made mouthguards are the most highly recommended mouthguards. They are produced over a dental cast. In addition, they are of the highest quality and most retentive of the three types of mouthguards. Also, a good adaptation onto the teeth, gingiva and palate is achieved. Since the production and design require the services of a dentist to take an impression and to process it in a laboratory, they are the most expensive.

Materials used in the manufacture of mouthguards should satisfy a number of physical, mechanical and biological requirements. The essential properties of materials used in the manufacture of mouthguards include water absorption, density, thickness as well as temperature transmission, energy absorption and drawing strength (tensile strength) of custom-made mouthguards. Such materials should have an optimal consistency in order to cushion the traumatic impact. Currently the most commonly used materials in the manufacture of mouthguards are ethylene-vinyl acetate (EVA) copolymer, soft acrylic resin, polyvinyl chloride, poly-

vinyl acetate-polyethylene and elastomers (Guevara & Ranalli, 1991; Park, Shaull, Overton, & Donly, 1994; Waked, Lee, & Caputo, 2002).

Ideally, an individually adapted mouthguard should satisfy the following demands: it should fully cover the dental arches and adjacent mucosal tissues of the jaw, it should not change the habitual relationship of the teeth (occlusion), it should not interfere with sports activities, it should not interfere with speech and breathing, it should be adaptable over any dental appliances in the mouth, it should be adaptable over any orthodontic appliances, it should be applied to adolescents with mixed dentition. Custom made mouthguards are superior in quality, comfort, retention and prevention against injuries to either stock or self adapted types (Guevara & Ranalli, 1991).

Prior to the production of custom-made mouthguards the dentition should be examined and all the restorative procedures should be completed. An oral prophylaxis should be performed prior to the production to insure the best possible adaptation. There should not be any decayed teeth or any periodontal diseases in the oral cavity. The intraoral mouthguard is most commonly produced on the maxillary dental arch (class I, class II) while in athletes with pronounced prognathism it is placed on the mandibular dental arch (class III) (Oikarinen, Salonen, & Korhonen, 1993; Mischkowski & Zöller, 1999).

The shape and surface of the mouthguard which encloses the teeth, the gingival and the hard palate can vary depending on the anatomical features of the athlete's jaw, his/her dental arch, the type of sports activity, as well as the materials used in the manufacture of the mouthguard. Mouthguards should not extend distally further than the first molars because some athletes complain of a vomiting reflex. In addition, mouthguards may interfere with breathing. They should reach the mucogingival border labially and extend a few millimetres palatally in order to provide the best protection for the labial gingiva and good retention. The labial flange

should extend to within 2mm of the vestibular reflection. The palatal flange should extend about 10 mm above the gingival margin thus enclosing the greatest part of the anterior palate surface with a slight narrowing distally not further than the first molars (Figure 1).

Clinical and laboratory procedures used in the manufacture of the intra-oral mouthguard include the following working stages: a well-taken alginate impression of the maxillary and mandibular dental arch, the installation of the maxillary dental arch in the articulator and the centric occlusion registration, laboratory production, insertion in the patient's mouth, trimming, polishing, adaptation, subsequent care and maintenance.

Several procedures in the manufacture of custom-made mouthguards are available with respect to materials and developed techniques used in the manufacture of a mouthguard. Custom-made mouthguards differ in thickness, material, colour and configuration. A standard thickness is about 4mm. There are also bulkier mouthguards, about 5mm in thickness and thinner mouthguards which are only 3mm thick. An important characteristic such as energy absorption depends on the mouthguard's thickness. Thinner mouthguards provide less protection than do the thicker ones but are more comfortable. Mouthguards can be purchased in a variety of colours which makes them look attractive for the wearers (Dorney, Dreve, & Rickert, 1994; Waked et al., 2002).

According to their configuration mouthguards can be either single-layered or multi-layered (most commonly double-layered). The Erkoflex® (Erkodent) mouthguard is constructed of an ethylene copolymer or other similar materials. The sheets suitable for the multi-layered mouthguard are warmed and compressed against a cast model under a vacuum in the Erkoform® Erkodent vacuum device. The Erkoloc® (Erkodent) mouthguard is made of a dual laminate sheet the outer hard shell being styrolbutadine copolymerisate and the soft inner layer ethylene copolymer and vinyl acetate. Erkoloc sheets are transparent and are available in a number of different thicknesses. Both the manufacturer's technology and satisfactory manufacturing processes should ensure a good mutual bonding of the layers (Oikarinen & Salonen, 1993; Dorney et al., 1994).

The critical regions in terms of energy absorption and transmitted forces are the incisal edges and the cusps of the incisors as well as the attached (marginal) gingiva. Therefore, an optimal thickness of a mouthguard is achieved by the application of the vacuum forming pressure-lamination technique in two layers of a thermoplastic sheet (EVA copolymer) and if needed, by placing two layers of protective air-cells against the critical area (Figures 2, 3). An acrylic resin based on elastomer (SR-Ivo-

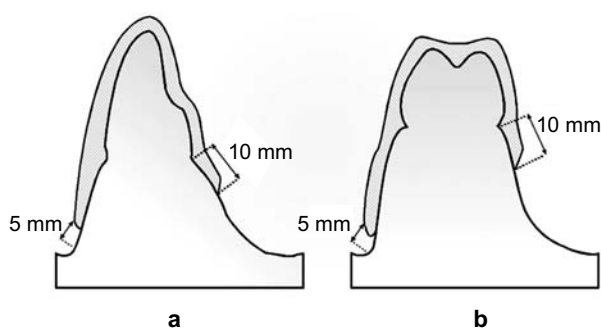


Figure 1. Relationship of edges and base of custom-made mouthguard in relation to supporting tissues on the maxillary anterior (a) and posterior (b) teeth.

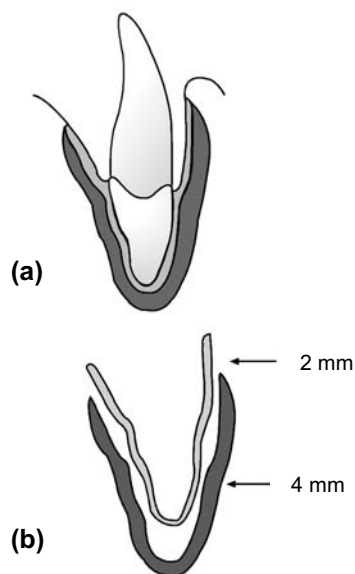


Figure 2. Custom-made mouthguard (two layers). Playsafe® (a) on the maxillary teeth (b).

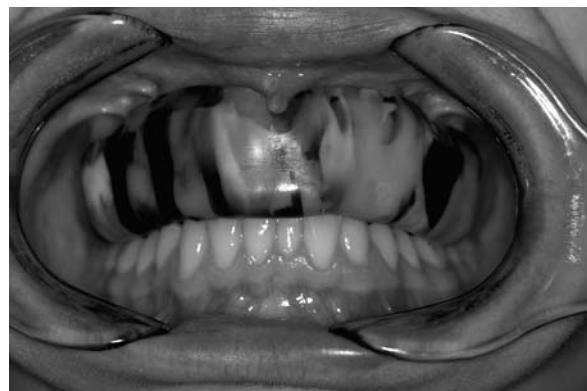
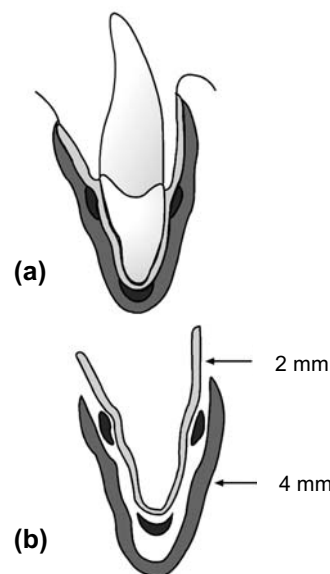


Figure 3. Custom-made mouthguard (two layers and three power distribution) Playsafe Heavy® (a) on the maxillary teeth (b).



Figure 4. Sport mouthguard with thickness of 4 mm made from SR-Ivocap Elastomer® in the mouth

cap Elastomer®; Figure 4) which is prepared after a prior wax moulding in a flask by the Ivocap procedure has proven to be effective in protecting the athlete. After polymerisation which lasts 45 minutes, the opening of the flask follows accompanied

by the finishing stage of processing the mouthguard (Žarković, Jerolimov, & Seifert, 2001).

Discussion and conclusion

Since participation in sports activities has demonstrated that it has a considerable potential to cause injuries, it is important to conduct studies on the aetiology, frequency and prevention against dental/orofacial traumas. Furthermore, the participants' awareness of the use of protective devices such as mouthguards during sports activities should be raised. As the number of individuals involved in sports activities increases, so do the number of athletes with dental/orofacial injuries. Consequently, the need for dental/orofacial protection should be pointed out to athletes by members of the dental profession. Mouthguard programmes can produce benefits for both the athletes and the dentists involved. Only a half of the Croatian basketball players interviewed, who are professionally involved in basketball, wear mouthguards. Also, the results of

a survey, in which a small but very specific population sample of professionally involved top handball players participated, reveal that only one player wore a mouthguard during matches but he was not satisfied with it.

In Israel only 27% of either professionally involved athletes or recreational athletes were aware of the need for appropriate protectors such as mouthguards but only 3% of the total number actually used mouthguards at the time when the survey was conducted (Kujala et al., 1995; Newsome et al., 2001; Ranalli, 2002; Kumamoto & Maeda, 2004).

The most important factors affecting the athletes' refusal to use mouthguards in sports are as follows: vomiting reflex, interference with speech and breathing, discomfort, bulkiness, decreased retention with stock and self-adapting mouthguards, fitting procedures are accomplished in a number of sittings with custom-made mouthguards, the possibility of distortion of the buccal flange over a period of time, hardening of the mouthguard from continued exposure to oral fluids, the need to remould mouthguards due to constant changes in growing children's dentition, cost, the non-existence of rules which would require participants in sports to use mouthguards, the unwillingness to adopt a mandatory mouthguard rule. Most often professionally involved athletes complain about discomfort, poor retention, inappropriate fit and cost (Deyoung et al., 1994; Dorney et al., 1994; Škrinjarić, 1995).

Since there is a number of currently available intraoral mouthguards differing in wearability, protective capacity and time needed for production, it is important to inform athletes of the best characteristics of a mouthguard such as retention, comfort, fit, ease of speech, resistance to tearing, ease of breathing as well as the good protection to the teeth, gingiva and lips. The chosen mouthguard should be recommended by the dental profession. Tooth loss is a permanent functional problem. In addition, edentulous dental arches are not aesthetically pleasing. These problems can be resolved by prosthodontic treatment and care but these require financial expenditure. Although custom-made mouthguards are the most expensive they are the most highly recommended protectors because the cost-benefit is well worth the expenditure if one considers the fees and discomfort associated with a traumatic dental injury and the subsequent time-consuming prosthodontic treatment and care.

More attention in terms of protection should be paid to athletes who are partial denture wearers as well to those who wear orthodontic appliances and other athletes with class II malocclusion (Newsome, Tran, & Cooke, 2001).

Several laboratory methods are available to produce custom-made mouthguards. These include the vacuum-forming technique, the pressure-lamination technique, the combined vacuum-pressure technique and the light-curing technique (Guevara & Ranalli, 1991; Ranalli & Guevara, 1992; Oikarinen et al., 1993; Oikarinen & Salonen, 1993; Dorney et al., 1994).

Although the Ivocap elastomer has proved to be an adequate material used in custom-made mouthguard production, it is not optimal because it requires the use of several more complex laboratory procedures. In other words, a custom-made mouthguard moulding material should be replaced by some construction material. The vacuum-forming method is the procedure of choice if the lamination technique is used. The essential difference between the seemingly identical custom-made mouthguards is in number of layers of thermoplastic sheets. They provide an effective protection against sports related dental injuries to the region at highest risk. Such a performance of mouthguards (Playsafe®, Erkodent), with regard to energy absorption and transmitted forces, has been shown to improve either with its thickness or the inclusion of air-cells which increase the energy absorption without increasing the thickness. However, mouthguards can be remoulded. This is particularly advantageous in refitting adolescents with mixed teeth because such dentitions undergo constant changes. 4mm seems to represent an ideal thickness that should be used at all points in the mouthguard which are likely to be impacted. It also represents a useful compromise with the thickness and wearer's comfort. Thicker mouthguards (about 6mm) are recommended for the more extreme sports. The thickness slightly improves the mouthguard's properties but decreases the athlete's comfort and acceptance (Westerman, Stringfellow, & Eccleston, 2002; Craig & Godwin, 2002).

There is no doubt that using a mouthguard while pursuing sports activities is beneficial. Apart from directly protecting the teeth, mouthguards also reduce the incidence and severity of sports-related injuries to dental and periodontal structures (Ferrari & Medeiros, 2002).

Despite the fact that all the necessary fitting procedures are accomplished in a few sittings and despite being expensive, custom-made mouthguards have a number of advantages over other types. They provide the best comfort during practice sessions and competitions thus offering athletes the best prevention against orofacial injuries (Deyoung, Robinson, & Godwin, 1994). Intraoral mouthguards are an indispensable part of dental care dedicated to both levels of sports involvement - the professional and the recreational alike.

References

- Berg, R., Berkey, D.B., Tang, J.M., Altman, D.S., & Londeree, K.A. (1998). Knowledge and attitudes of Arizona high-school coaches regarding oral-facial injuries and mouthguard use among athletes. *Journal of American Dental Association*, 129(10), 1425-1435.
- Blinkhorn, F.A. (2000). The aetiology of dento-alveolar injuries and factors influencing attendance for emergency care of adolescents in the north west of England. *Endodontology & Dental Traumatology*, 16(4), 162-165.
- Chapman, P.J. (1986). The bimaxillary mouthguard; a preliminary report of use in contact sports. *Australian Dental Journal*, 31(3), 200-206.
- Chapman, P. (1989). Mouthguards and the role of the sporting team dentists. *Australian Dental Journal*, 34(1), 36-42.
- Chapman, P.J., & Nasser, B.P. (1996). Prevalence of orofacial injuries and use of mouthguards in high school Rugby Union. *Australian Dental Journal*, 41(4), 252-255.
- Craig, R.G., & Godwin, W.C. (2002). Properties of athletic mouth protectors and materials. *Journal of Oral Rehabilitation*, 29(2), 146-150.
- Deyoung, A.K., Robinson, E., & Godwin, W.C. (1994). Comparing comfort and wearability: custom-made vs. self-adapted mouthguards. *Journal of American Dental Association*, 125(8), 1112-1118.
- Dorney, B., Dreve, V., & Rickert, T. (1994). Signature Mouthguards. Eine neue Produktlinie zur Anfertigung von individuellem Mundschutz. *Quintessenz Zahntechnik*, 20(3), 311-319.
- Emshoff, R., Schoning, H., Rothler, G., & Waldhart, E. (1997). Trends in the incidence and cause of sport-related mandibular fractures: A retrospective analysis. *Journal of Oral Maxillofacial Surgery*, 55(6), 585-592.
- Ferrari, C.H., & Medeiros, J.M.F. (2002). Dental trauma and level of information: Mouthguard use in different contact sports. *Dental Traumatology*, 18(3), 144-147.
- Garon, M.W., Merkle, A., & Wright, J.T. (1986). Mouth protectors and oral trauma: A study of adolescent football players. *Journal of American Dental Association*, 112(5), 663-665.
- Guevara, P.A., & Ranalli, D.N. (1991). Techniques for mouthguard fabrication. *Dental Clinical of North America*, 35(4), 667-682.
- Jerolimov, V., & Carek, V. (1997). Orofacijalne ozljede u sportu. [Orofacial injuries in sports.] *Medix*, 3(16), 111-113.
- Jerolimov, V., & Jagger, R.G. (1997). Orofacijalne ozljede u vaterpolu. [Orofacial injuries in water polo] *Kineziologija*, 29(1), 30-32.
- Jerolimov, V., Seifert, D., & Carek, V. (2000). Injuries to the orofacial structure in a selected sample of handball players. *Kinesiology*, 32(2), 93-98.
- Jerolimov, V., Seifert, D., & Carek, V. (2000). Ozljede orofacijalnog sustava u izabranom uzorku košarkaša. [Orofacial injureis in basketball players as a selected out sample.] *Hrvatski sportskomedicinski vjesnik*, 15(2), 81-84.
- Knapik, J.J., Marshall, S.W., Lee, R.B., Darakjy, D.D., Jones, S.B., Mitchener, T.A., delaCruz, G.G., & Jones, B.H. (2007). Mouthguards in sport activities: history, physical properties and injury prevention effectiveness. *Sports Medicine*, 37(2), 117-144.
- Kujala, U.M., Taimela, S., Antti-Poika, I., Orava, S., Tuominen, R., & Myllynen, P. (1995). Acute injuries in soccer, ice hockey, volleyball, basketball, judo, and karate: Analysis of national registry data. *British Medical Journal*, 311(7018), 1465-1468.
- Kumamoto, D.P., Winters, J., Novickas, D., & Mesa, K. (1997). Tooth avulsions resulting from basketball net entanglement. *Journal of American Dental Association*, 128(9), 1273-1275.
- Kumamoto, D.V., & Maeda, Y. (2004). A literature review of sport-related orofacial trauma. *General Dentistry*, 52(3), 270-281.
- Kvittem, B., & Roettger, M. (1998). Prospective epidemiological study of orofacial injuries in high school sports. *Journal of Public Health Dentistry*, 58(4), 288-293.
- Lee-Knight, C.T., Harisson, E.L., & Price, C.J. (1992). Dental injuries at the 1989 Canada games: An epidemiological study. *Journal of Canadian Dental Association*, 58(10), 810-815.
- Levin, L., Friedlander, L.D., & Geiger, S.B. (2003). Dental and oral trauma and mouthguard use during sports activities in Israel. *Dental Traumatology*, 19(5), 237-242.
- Mischkowski, R.A., & Zöller, J.E. (1999). Mundschutz zur Vorbeugung von sportbedingten Zahn-, Mund- und Kieferverletzungen. Retrieved July 11, 2007 from: <http://www.dgzmk.de/index.php?site=std84&backlink=m034>
- Mueller, F.O., Marshall, S.W., & Kirby, D.P. (2001). Injuries in Little League Baseball from 1987 through 1996. *Physician and Sports Medicine*, 29(7), 41-48.
- Newsome, P.R.H., Tran, D.C., & Cooke, M.S. (2001). The role of the mouthguard in the prevention of sports-related dental injuries: A review. *International Journal of Paediatric Dentistry*, 11(6), 396-404.
- Oikarinen, K.S., & Salonen, M.A.M. (1993). Introduction to four custom-made mouth protectors constructed of single and double layers for activists in contact sports. *Endodontology & Dental Traumatology*, 9(1), 19-24.
- Oikarinen, K.S., Salonen, M.A.M., & Korhonen, J. (1993). Comparison of the guarding capacities of mouth protectors. *Endodontology & Dental Traumatology*, 9(3), 115-119.

- Park, J.B., Shauli, K.L., Overton, B., & Donly, K.J. (1994). Improving mouth guards. *Journal Prosthetic Dentistry*, 72(4), 373-380.
- Ranalli, D.N., & Guevara, P.A. (1992). A new technique for the custom fabrication of mouthguards with photopolymerized urethane diacrylate. *Quintessence International*, 23(4), 253-255.
- Ranalli, D.N. (2002). Sports dentistry and dental traumatology. *Dental Traumatology*, 18(5), 231-236.
- Reed, R.V. Jr. (1994). Origin and early history of the dental mouthpiece. *British Dental Journal*, 176(12), 478-480.
- Sane, J., & Ylipaavalnime, P. (1988). Dental trauma in contact team sports. *Endodontology & Dental Traumatology*, 8(4), 164-169.
- Scott, J., & Burke FJT. (1994). A review of dental injuries and the use of mouthguards in contact team sports. *British Dental Journal*, 176(8), 310-314.
- Soporowski, N.J., Tesini, D.A., Weiss, A.I. (1994). Survey of orofacial sports-related injuries. *Journal of the Massachusetts Dental Society*, 43(4), 16-20.
- Škrinjarić, I. (1995). Orofacijalne ozljede u sportu i štitnici za usta: vrste štitnika, tehnika izradbe i zaštitno djelovanje. [Orofacial injuries in sports and mouthguard wear: types of mouth protectors, production techniques and modes of protection.] In M. Pećina & S. Heimer (Eds.), *Športska medicina: Odabrana poglavlja* (pp. 263-272). Zagreb: Naprijed.
- Tuli, T., Hachl, O., Hohlrieder, M., Grubweiser, G., & Gassner, R. (2002). Dentofacial trauma in sport accidents. *General Dentistry*, 50(3), 274-279.
- Yamada, T., Sawaki, Y., Tomida, S., Tohnai, I., & Ueda, M. (1998). Oral injury and mouthguard usage by athletes in Japan. *Endodontology & Dental Traumatology*, 14(2), 84-87.
- Waked, E.J., Lee, T.K., & Caputo, A.A. (2002). Effects of aging on the dimensional stability of custom-made mouthguards. *Quintessence International*, 9, 700-705.
- Westerman B., Stringfellow P.M., & Eccleston, J.A. (2002). EVA mouthguards: how thick should they be? *Dental Traumatology*, 18(1), 24-27.
- Žarković, D., Jerolimov, V., & Seifert, D. (2001). Prevencija orofacijalnih ozljeda u skijaša. [Prevention of orofacial injuries in alpine skiing.] *Medix*, 7(35), 153-155.

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DENTALNA/OROFACIJALNA TRAUMA U KONTAKTNIM SPORTOVIMA I VRSTE INTRAORALNIH ŠTITNIKA ZA ZUBE

Sažetak

Sportska aktivnost i dentalna/orofacijalna trauma

Prva saznanja o zdravstvenom problemu dentalnih/orofacijalnih trauma bila su povezana s aktivnošću bavljenja sportovima u kojima dolazi do sudara, kontakta (boks, američki nogomet), a kasnije i s atletskim aktivnostima te skupinama ekstremnih sportova. Svrha ovog pregleda je ukazati na potrebu korištenja sredstava prevencije sportom uvjetovanih dentalnih/orofacijalnih trauma na način koji će zadovoljiti sportaša i uspješno sačuvati njihovo orofacijalno zdravlje.

Sportska stomatologija

Kako su traume zuba i mekih tkiva orofacijalnog sustava prepoznate kao važan zdravstveni problem današnjice, od dječje fizičke aktivnosti pa sve do bavljenja tzv. vrhunskim sportom, 80-ih godina XX. stoljeća razvila se sportska stomatologija. Naglašavanje rizičnosti pojedinih sportova, kao i upoznavanje sportaša s razmjerima, privremenim i trajnim posljedicama ozljeđivanja tijekom sportskih aktivnosti trebalo bi potaknuti intenzivno korištenje primjerenih sredstava prevencije orofacijalnih i drugih sportom uvjetovanih ozljeda.

Epidemiologija dentalnih/orofacijalnih traumi uvjetovanih sportom

Najčešće ozljede zuba i usne šupljine (od 10 do 50%) povezane su sa sportskom aktivnošću: posjekotine mekih tkiva, gubitak jednog ili više zuba (najčešće gornjih sjekutića), a rjeđi su prijelomi donje čeljusti, alveolarne kosti i traume čeljusnog zgloba. Osim o pojedinim sportovima, učestalost dentalnih/orofacijalnih ozljeda bitno različito ovisi o geografskoj pripadnosti sportaša i dobi izabranog uzorka.

Preventivna uloga štitnika za zube

Primarna prevencija podrazumijeva sprečavanje nastanka ozljeda. Kao sredstva prevencije koriste se kacige, prsluci, maske i štitnici za lice te štitnici za zube. Za zaštitu i prevenciju orofacijalnih i, osobito, dentalnih trauma koriste se različite vrste i oblici intraoralnih štitnika za zube. Upotreba štitnika za zube dovela je do velikog smanjenja učestalosti i težine ozljeda zuba, dok su znatno smanjene ozljede usana, jezika i donje čeljusti.

Intraoralni štitnik za zube

Postoje tri vrste intraoralnih štitnika za zube, koji se razlikuju po stupnju individualne prilagodbe sportašu. Gotovi ili konfekcijski štitnici dostupni su bez posjeta stomatologu, loše su retencije i nisu udobni za korištenje. Polugotovi štitnici ("oblikovani u ustima") bolje su individualne prilagodljivosti. Stomatolog oblikuje ovu vrstu štitnika, najčešće prethodnim zagrijavanjem, i izravno ga aplicira u usta na zubne lukove ili na sadreni model. Individualni štitnik najbolja je vrsta štitnika, koji je u potpunosti prilagođen osobitostima svakog pojedinca za kojega se izrađuje. Na sadrenom modelu čeljusti izrađuje se štitnik po individualnim proporcijama, pa se postiže besprijekorna retencija i adaptacija na zube, zubno meso te nepce. Postupak izrade je najsloženiji, jer su neizbježni višestruki posjeti stomatologu.

Individualni štitnik za zube

Postupak kliničkog rada i laboratorijske izrade individualnog štitnika za zube čine sljedeće radne faze: anatomski otisak gornje i donje čeljusti u alginatu, prijenos gornjeg zubnog luka u artikator i centrični okluzijski registrat, laboratorijska izrada te predaja pacijentu, ubrušavanje, prilagodba i naknadna briga. Postoji više postupaka izrade s obzirom na upotrijebljeni materijal i razvijene tehnike izrade štitnika. Individualni štitnici za zube razlikuju se prema debljini, materijalu i građi. Autori se posebno osvrću na štitnike načinjene laminacijom u vakuumskom aparatu tvrtke Erkodent i štitnike iz akrilnih smola na bazi elastomera tvrtke Ivoclar.

Rasprava i zaključak

Troškovi stomatološke opskrbe gubitka ijednog zuba uvjetovanog sportskom aktivnošću višestruko su veći od troška izrade individualnog štitnika za zube. Budući da postoji više vrsta intraoralnih štitnika, potrebno je sportaše prosvjeđivati o pravilnom izboru štitnika koji podržava stomatološka struka. Neadekvatan i neudoban štitnik najčešće se ne nosi, što su potvrdili i profesionalni sportaši. Upotrebom adekvatnih štitnika za zube postiže se veliko smanjenje učestalosti i težine ozljeda dentalnih i parodontalnih struktura u sportu. Iako se gotovim i polugotovim štitnicima za zube izbjegava posjet stomatologu, samo korištenje individualnog štitnika pruža najveću udobnost tijekom treninga i natjecanja te optimalnu profilaksu dentalnih/orofacijalnih ozljeda.