

## The Use of Mouth Protectors in Sports

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### Summary

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Some sports are correlated with a high risk of dental injuries. The damage or loss of a tooth causes high expenses in the following lifetime. Front-tooth damage or loss may cause additional aesthetic problems. Especially children and young people have a 50% risk for dental injury while growing up, 39% of all dental injuries in adolescents happen in public sports facilities. The damage of teeth and ambient tissues due to sports accidents can be reduced by use of a gum shield. Gum shields are an important preventive aid which works best when produced individually in accordance with specific sports requirements. Custom-made mouth protectors offer the greatest comfort, fit and durability.

**Key words:** gum shield, dental injuries in sports, high risk sports for dental injuries, custom-made mouth protectors, prevention of dental injuries and surrounded tissues in sports.

### Dental Sports Trauma

Sports participants are at risk for unique and distinct kinds of dental injuries. Direct trauma from a high-velocity object, such as a baseball or hockey ball that strikes the front teeth, is likely to cause a fracture. Alternatively, good lip coverage will diffuse the force of the blow, lower the velocity of the ball, and distribute the energy of impact over a wider area, causing greater surrounding

hard- and soft-tissue damage. Low-velocity trauma causes greatest damage to the hard and soft tissues that surround the teeth, whereas high-velocity trauma is more likely to fracture the teeth. Any traumatic dental injury has the potential to challenge pulp vitality even if not apparent initially. Table 1 shows numerous sports with high risk for dental and mouth injuries.

Dental injury-related sports			
Baseball	Basketball	Boxing	BMX
Hockey	Soccer	Football	Handball
Inlineskating	Karate	Motocross	Polo
Mountainbike	Horse-riding	Wrestling	Rugby
Ski	Snowboarding	Squash	Tennis
Gymnastics	Waterball	Contact sports	

Table 1: hazardous sports with high risk for dental and mouth injuries

### Statistical analysis of dental injuries in Germany

- Up to 50% of all adolescents
- 35% concerning permanent teeth
- Up to 39% in public schools and sports facilities
- Each fifth 6-years-old and tenth 18 years-old youth is affected
- Each third child in school or sports facilities
- Each contact sports athlete has a chance of 10% in each season to experience tooth damage

The tendency is increasing because of venturesome leisure behaviour and trend sports (skateboarding, mountainbiking, rollerblading etc.)

## Dental Injuries

The maxillary central incisors are the most frequently traumatized teeth (Table 2), and consequently, a mouth-guard is usually constructed for the maxillary arch.

Exceptionally in cases of mandibular prognathism, it may be desirable to reverse this or construct a bimaxillary appliance.

77% maxillary central incisor	6% maxillary lateral incisor
3% mandibular lateral incisor	8% mandibular central incisor

Table 2: Statistics by Schützmannsky (1963): Most frequently traumatized teeth

The maxillary central incisors are the most frequently avulsed teeth. In 1% of all dental injuries a complete displacement of the tooth from its socket (avulsion) is occurred. The sooner an avulsed tooth is replanted, the better its chances of survival. Immature teeth with incomplete root formation have a potential to revitalize and survive. In a sports setting, immediate replantation by a dentist is necessary. Maintenance of periodontal ligament integrity is critical, therefore no attempt to clean, treat chemically, or disinfect the tooth should be made. In situations where replantation is delayed more than 20 minutes, the type of storage media and the method of

handling become important issues. The tooth should be handled by its crown rather than by its root and stored in cold homogenized milk, normal saline solution, or dentosafe box on the way to a dentist. A tooth allowed to air dry will lead to periodontal ligament necrosis with replacement resorption (ankylosis) or inflammatory resorption (external root resorption). Revascularization is a possibility in replanted immature teeth with open apices. Conversely, untreated avulsed teeth with mature roots always develop pulpal necrosis and external root resorption. Replanted teeth undergo gradual ankylosis but are capable of functioning for many years.

## Mouth protectors – Prevention of sports-related dental and mouth injuries

In professional sports mouthguards have been established, but in general the acceptance and use of mouthguards in amateur and recreational sports is low (max. 6%), whereas 25% of all dental injuries occurred in

the last-mentioned. Most think about mouth protectors only then a dental injury has happened. But the following should be taken into consideration:

**The damage or loss of a tooth leads to lifetime consequential costs and also to aesthetic losses.**

## Mouth Protector Construction and Designs

The first historic use of gum shields was found 1913 in the British boxing sport. This historic gum shield was made from natural rubber, which was held in position by keeping the teeth together. An efficient, comfortable, and properly-fitted mouthguard can reduce the sports-related dental injuries up to 60%. It protects tongue, lips and cheeks against bite-lesions. The mouthguard absorbs

blows and shocks due to its elasticity and is on the other hand rigid enough to spread the energy away from the teeth to at most large surfaces. In consequence of shock absorbency and force distribution alveolar and dental fractures are minimized, and concussions occur up to 16 fold more rare. An absolute indication for a mouthguard is an overjet greater than 3 mm or an insufficient lip-closing.

## Construction requirements

- Covering teeth and alveolar bone
- Construction for the maxillary arch (exception: prognathism)
- Mandibular impressions for support
- No interference with occlusion and arch position
- No interference with breathing and speech
- No influence on sports performance
- Durable and stable
- Well fitting
- Hygiene request (cleaning and disinfection (0,2% CHX))

## 1. Stock mouthguards

Stock mouthguards are inexpensive, can be purchased over-the-counter, and are ready for immediate use. They are often ill-fitting and many interfere with breathing and speech because they must be held in position by keeping the teeth together.

Further disadvantages:

- Thin occlusal layer
- Fast bite-through
- No impressions for opposite arch
- Worse-fitting, few sizes
- Interference with breathing and speech

## 2. Mouth-formed mouthguards (Boil and Bite)

They are a compromise between stock and custom-made, and inexpensive. The most popular is the "boil and bite". Often it is made of a thermoplastic material, usually EVA copolymer. It is softened by boiling water and adapted intraorally while warm by biting into the material. Another variety comes with a shell, usually of ethylene vinyl chloride. Mouth-formed mouthguards fit better than

the stock mouthguards, but do not provide the optimal level of care and protection: The occlusal layer is not thick enough (bite-through), has no opposite impressions for support and unsatisfying fit may leave sports participants at risk unexpectedly. However, the best mouthguard is the one that is worn at the time trauma is encountered.

## 3. Custom-made mouthguards

Custom-made mouthguards are fabricated indirectly on a stone model from a dental impression, usually alginate. These mouthguards are the most expensive but are superior in many aspects. The majority of custom mouthguards are vacuum custom-made. They are fashioned by first heating a 3 to 5 mm thick sheet of EVA held in frame on a vacuum-forming machine until it exhibits a specific amount of drag or sag. The sheet is then vacuum-formed over a stone model or cast that has been prepared from the dental impression. After the mouthguard is separated from the model it is trimmed and polished. Gentle heating of the occlusal surface of the mouthguard immediately followed by having the patient bite down with it in place will equilibrate the occlusion. Heated EVA can be formed in other ways. One method uses positive pressure rather than a vacuum to adapt the same EVA sheet material. Positive pressure yields a much more accurately adapted mouthguard than the vacuum fabricated custom method. Heat laminating thinner 2 mm sheets of EVA rather than thicker 3 to 5 mm sheets yields improved adaptation and conformity to

the model. A hybrid of the vacuum-made and pressure-laminating techniques is the Erkoform-RVE with a self-contained thermoforming system that does not require compressed air. Boxing and martial arts mouthguards need to provide an extra degree of protection to both dental arches, especially against TMJ injuries and cerebral concussions. These mouthguards need to be made of a firmer material to resist bite-through and change in "power bite" position that heavy clenching might produce. Boxing and martial arts mouthguards need to ensure maximum oxygen exchange. Maintaining an adequate airway in the event of nasal obstruction from a blow is an important consideration. A custom-made mouthguard has the superior comfort, breathing, fit, speech, protection, and performance. The consequential costs after sports-related alveolar and dental injuries in mixed dentition are much higher than the repeated mouthguards fabrication costs due to growing jawbones in children. To make mouthguards more attractive for children, they can choose between different colours and additional sparkling particles.

## The construction of the custom-made mouthguards depending on sports

The mouthguard can be strengthened by nylon-net layers. The thickness of the laminated sheets varies in dependence on risk of sports-related injuries. In Sports where helmets are required, 2 sheets of 2mm thickness should be laminated, in soccer, wrestling, horse-riding,

handball, motocross 2mm and 4mm sheets should be chosen. Sports with high speed and high impact (boxing, baseball, American football, carate, rugby etc.) two 2mm and 4mm sheets should be laminated together.

## Cleaning and Desinfection

Mouthguards need to be cleaned regularly, stored in a box and desinfected (0,1% /0,2% chlorhexidine solution, 65% alcohol)

**The use of mouthguards can reduce sports-related dental and alveolar injuries and is an important preventive tool.**

### Additional recommended literature:

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