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Sports-related dental injuries and their prevention: mouthguards, materials, perfomance, and hygiene- a narrative review

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Abstract

Background. Dental injuries are common in contact and combat sports, with maxillary central incisors most frequently affected. Custom-made mouthguards reduce injury risk, and ethylene-vinyl acetate (EVA) remains the most widely used material. Proper cleaning and maintenance help reduce microbial contamination and biofilm formation.

Aim. To assess the current evidence on sports-related dental injuries and the role of mouthguards in their prevention, with particular emphasis on mouthguard types, materials, manufacturing methods, impact on athletic performance, and hygiene.

Material and methods. A narrative literature review was conducted using the PubMed database. Studies relevant to sports-related dental injuries, mouthguard types, materials, manufacturing, performance effects, and hygiene were selected and synthesized narratively.

Results. Dental injuries are prevalent in contact sports. Custom-made mouthguards provide superior protection, fit, and comfort compared to stock or mouth-formed devices. EVA is the primary material due to its balance of flexibility and impact resistance. Evidence does not support a general negative effect of mouthguards on athletic performance; some studies suggest potential benefits. Inadequate hygiene leads to biofilm formation, but regular cleaning with appropriate agents reduces microbial load.
Conclusions. Mouthguards are essential for preventing sports-related dental injuries, particularly in contact and high-risk sports. Custom-made devices offer the best protection without adversely affecting performance. Regular hygiene and maintenance are crucial for oral health. Further research is needed to standardize cleaning protocols and optimize materials for digitally manufactured mouthguards.
Key words: mouthguards, dental injury, dental trauma prevention, sports injury, athletic performance

1. Introduction

Sports-related dental injuries represent an important public health concern due to their frequency, potential long-term consequences, and impact on athletes' quality of life. Traumatic dental injuries are particularly common in contact sports, where collisions and direct impacts increase the risk of damage to the teeth and surrounding oral tissues (de Lima et al., 2024; Tysiąc-Miśta et al., 2025; Wojda & Wielgosz, 2024). Such injuries may result in tooth fractures, luxations, or avulsions, potentially leading to functional impairment, aesthetic problems, and the need for complex dental treatment (Tysiąc-Miśta et al., 2025; Wojda & Wielgosz, 2024). Consequently, effective preventive strategies are essential to reduce the incidence of sports-related dental trauma (Abbott et al., 2024; Agarwal et al., 2025).
Mouthguards are among the most important protective devices used to prevent dental and orofacial injuries during sports participation (Agarwal et al., 2025; Roberts, 2023). Their effectiveness depends on several factors, including design, material properties, thickness, adaptation to the dental arch, and consistent use during both training and competition (Abbott et al., 2024; de Lima et al., 2024; Roberts, 2023). Although different types of mouthguards are available, custom-made devices are generally preferred because of their improved fit, retention, comfort, and protective potential (Abbott et al., 2024; Roberts, 2023; Wang et al., 2025). Nevertheless, barriers such as discomfort, difficulties with communication, and limited awareness of the benefits of mouthguard use may affect athletes' adherence to preventive recommendations (de Lima et al., 2024; Wang et al., 2025; Wojda & Wielgosz, 2024).
Recent advances in dental materials and digital technologies have expanded the possibilities for mouthguard fabrication, including three-dimensional scanning and additive manufacturing (Abbott et al., 2024; Dias Gonçalves et al., 2024). These developments offer opportunities to improve personalization, manufacturing precision, and control over material properties. In addition to their protective function, mouthguards have also been investigated for their potential effects on athletic performance (Dias Gonçalves et al., 2024; Ferreira et al., 2020). Furthermore, appropriate cleaning, hygiene, and maintenance are essential aspects of their use, as microbial accumulation and biofilm formation may compromise oral health and appliance hygiene (Badari et al., 2025; Hayashi et al., 2022).
Considering these developments, a comprehensive understanding of mouthguard design, materials, protective effectiveness, performance-related effects, and hygiene is necessary to support their appropriate use in sports. This article reviews current evidence on sports-related

dental injuries and their prevention, with particular emphasis on mouthguard types, conventional and emerging manufacturing methods, athletic performance, and hygiene practices.

Research Objective. The objective of this review was to assess the current evidence on sports-related dental injuries and the role of mouthguards in their prevention, with particular emphasis on mouthguard types, materials, manufacturing methods, impact on athletic performance, and hygiene.

Research Problems.

1. What is the role of mouthguards in preventing sports-related dental and orofacial injuries?
2. Which types, materials, and manufacturing methods provide the most favorable combination of protection, comfort, and functionality?
3. Does the use of mouthguards negatively affect athletic performance?
4. What hygiene and maintenance practices are recommended to ensure the safe and effective use of mouthguards?

Research Hypotheses.

1. The use of properly fitted mouthguards reduces the risk and severity of sports-related dental injuries.
2. Custom-made mouthguards provide better protection, fit, and comfort than stock and mouth-formed mouthguards.
3. The use of custom-made mouthguards does not negatively affect athletic performance.
4. Appropriate cleaning and maintenance of mouthguards reduce microbial accumulation and biofilm formation.

2. Research materials and methods

2.1. Review design

This article was designed as a narrative literature review focusing on sports-related dental injuries and their prevention. The review examined the role of mouthguards in reducing the risk of dental and orofacial injuries, with particular emphasis on their types, materials, manufacturing methods, effects on athletic performance, and hygiene and maintenance.

2.2. Evidence identification

The literature search was conducted using the PubMed database and publications from the *Quality in Sport* journal. The search focused on the following keywords and terms: “mouthguard”, “dental trauma”, “dental injury”, “contact sport”, and “non-contact sport”. The identified literature was used to address the main aspects of sports-related dental injuries and mouthguard use discussed in this review.

2.3. Study selection

Studies and publications relevant to the objectives of the review were selected based on their relevance to sports-related dental injuries, their prevention, and the use of mouthguards. Particular attention was given to publications addressing the types of mouthguards, materials used in their fabrication, manufacturing methods, protective effectiveness, influence on athletic

performance, and hygiene and cleaning procedures. Publications that provided information relevant to these topics were included in the narrative synthesis.

2.4. Evidence synthesis

The evidence was synthesized narratively and organized according to the main topics addressed in the review. The analysis included the prevalence and causes of sports-related dental injuries, the preventive role and types of mouthguards, materials and manufacturing technologies, their potential effects on athletic performance, and hygiene and maintenance. Particular emphasis was placed on the protective properties of mouthguards, the advantages and limitations of different designs and materials, and the importance of appropriate use and maintenance.

3. Research results

3.1. Sports-related dental injuries and risk factors

Sports-related dental and orofacial injuries represent an important health problem among physically active individuals, particularly those participating in contact and high-risk sports. Traumatic dental injuries are also an important reason for emergency dental consultations, highlighting the need for effective preventive strategies and timely clinical management (Lima et al., 2023).

Dental injuries may include crown fractures, root fractures, luxations, intrusions, extrusions, and avulsions, with the upper central incisors being particularly susceptible to trauma. The risk of injury is influenced by the type of sport, the degree of physical contact, and individual anatomical characteristics. Contact sports are associated with a higher prevalence of dental trauma than non-contact activities, with reported injury rates of 11.38% and 5.24%, respectively (de Lima et al., 2024; Mordini et al., 2021; Roberts, 2023). A systematic review and meta-analysis of 17 studies estimated the overall prevalence of dentofacial injuries among contact-sport participants at 27.57%, with dental injuries accounting for the most common injury category (Oliveira Werlich et al., 2020).

Several individual factors may further increase the susceptibility to dental trauma. Malocclusions, particularly Angle Class II relationships, increased overjet, and incomplete lip closure, have been identified as potential risk factors. Sports-related injuries may have consequences extending beyond the immediate physical damage and can affect aesthetics, oral function, psychological well-being, and quality of life. Complications may include pulp necrosis, caries, tooth loss, and long-term aesthetic problems (de Lima et al., 2024; Tysiąc-Miśta et al., 2025; Wang et al., 2025; Wojda & Wielgosz, 2024).

The prognosis of traumatic dental injuries depends on the type and severity of the injury, the developmental stage of the tooth, the time elapsed since trauma, and the presence of root resorption. Clinical assessment should include evaluation of tooth vitality, mobility, photographic documentation, and radiographic examination (Krastl et al., 2021). Treatment should be customized based on the patient's age and the specific injury (Contemporary Approach for Traumatic Dental Injuries in the Primary Dentition - O'Connell - 2025 - Dental Traumatology - Wiley Online Library, n.d.).

However, diagnostic tests performed immediately after trauma may be unreliable because of temporary pulpal shock and stress-related changes. More advanced diagnostic methods, including Doppler techniques, laser Doppler flowmetry, ultrasound Doppler, pulse oximetry, and magnetic resonance imaging, have therefore been investigated to improve the assessment

of pulpal status (Present Status and Future Directions: Endodontic Management of Traumatic Injuries to Permanent Teeth - Krastl - 2022 - International Endodontic Journal - Wiley Online Library, n.d.).

3.2. Mouthguards in the prevention of dental injuries

Mouthguards are one of the most essential preventive measures for reducing sports-related dental and orofacial injuries. Their use has been associated with a reduction in the risk and severity of dental trauma, particularly fractures and avulsions. Using them can reduce the risk of fractures and knocked-out teeth by about 1.6–1.9 times (Agarwal et al., 2025). Properly fitted mouthguards covering the dentition can provide substantial protection against direct and indirect forces generated during sports activities.

Despite their protective potential, mouthguard use remains inconsistent among athletes. In some sports, even when mouthguards are formally recommended or required, athletes may fail to wear them during training sessions, which can expose them to preventable injuries (de Lima et al., 2024). A cross-sectional study of young basketball players in Turkey found that 16.8% had experienced a dental injury during basketball, whereas only 7.2% reported using mouthguards, indicating a substantial gap between injury risk and preventive practice (Comert et al., 2026).

Limited awareness of the benefits of mouthguards and concerns regarding comfort, speech, breathing, and concentration may contribute to low compliance. Therefore, education of athletes, coaches, and sports staff represents an important component of dental injury prevention (Agarwal et al., 2025; de Lima et al., 2024).

The maxillary dentition is generally the primary target of mouthguard protection because the upper teeth are more prominent and consequently more exposed to direct trauma. In individuals with an Angle Class III relationship, protection of the mandibular dentition may also be particularly important. A properly designed mouthguard should extend approximately 2 mm beyond the vestibular fold and should cover all teeth adequately to provide effective protection (Roberts, 2023).

3.3. Types of mouthguards and their characteristics

Three main types of mouthguards can be distinguished according to their method of fabrication: stock mouthguards, mouth-formed mouthguards, and custom-made mouthguards (Abbott et al., 2024). These types differ considerably in terms of adaptation, retention, comfort, cost, and protective potential.

Stock mouthguards are commercially available in predefined shapes and sizes and represent the least expensive and most readily accessible option. However, because they are not individually adapted to the athlete, they may have poor retention and stability. Their loose fit can interfere with breathing, speech, concentration, and overall comfort and may reduce their protective effectiveness (Abbott et al., 2024; Roberts, 2023; Wang et al., 2025).

Mouth-formed mouthguards provide a better adaptation than stock devices and are widely used because they offer a relatively good balance between cost and protection. They are generally produced from thermoplastic or chemically processed materials and are adapted to the dentition after heating, for example in hot water. Although they provide greater stability than stock mouthguards, their adaptation and precision remain inferior to those of individually fabricated devices (de Lima et al., 2024; Wang et al., 2025).

Custom-made mouthguards are fabricated on the basis of an individual dental impression or digital scan. This allows precise adaptation to the patient's dentition and provides improved retention, comfort, and protection. Recent recommendations from the European Association for Sports Dentistry identify custom-made mouthguards as the preferred preventive option and emphasize appropriate material selection, individual fit, regular maintenance, and athlete education (Avgerinos et al., 2025).

Their design can be modified according to the type of sport and the required thickness. Custom-made devices are also suitable for athletes undergoing orthodontic treatment and can be produced in different colours and designs (Abbott et al., 2024; Roberts, 2023). However, the use of darker colours may increase heat absorption, and prolonged exposure to heat may contribute to material deformation or shrinkage (Roberts, 2023).

3.4. Mouthguard materials and thickness

Ethylene-vinyl acetate (EVA) is the most commonly used material for mouthguard fabrication. Its popularity is related to its combination of flexibility, impact resistance, softness, and sufficient hardness to absorb and distribute forces generated during trauma. EVA is also considered non-toxic, relatively inexpensive, and widely available (Rusiecka et al., 2025).

Other materials used or investigated for mouthguard fabrication include acrylic materials, polyurethane, and silicone. The mechanical properties of the material are important because the mouthguard must absorb and distribute impact forces while maintaining sufficient flexibility and structural integrity (Rusiecka et al., 2025). Material selection therefore directly influences both protective performance and user comfort.

Mouthguard thickness is another important factor affecting impact absorption and force distribution. Increasing thickness may improve protective properties; however, excessive thickness can negatively affect comfort and may interfere with speech or breathing. In particular, EVA mouthguards exceeding approximately 4 mm in thickness may be perceived as noticeably less comfortable by athletes (Roberts, 2023). Therefore, the optimal design should provide an appropriate balance between mechanical protection and intraoral comfort.

Mouthguard materials may also be modified to provide additional biological functions. Experimental approaches have included the incorporation of casein, silver nanoparticles, fluoride, and chlorhexidine. Chlorhexidine-containing materials may contribute to the control of oral microorganisms, including *Candida* species and *Streptococcus mutans*, whereas EVA containing casein has been investigated for its ability to reduce plaque adhesion and susceptibility to caries. The addition of silver nanoparticles to EVA has also demonstrated antibacterial activity against microorganisms including *Streptococcus sorbinus*, *Porphyromonas gingivalis*, and *Escherichia coli* (Wojda & Wielgosz, 2024).

3.5. Manufacturing methods and additive manufacturing

Recent developments in digital dentistry and additive manufacturing have created new possibilities for the production of individualized mouthguards. Digital scanning and computer-aided design may facilitate precise reproduction of the patient's oral anatomy and allow improved control of mouthguard geometry and material thickness. Additive manufacturing may therefore provide greater consistency and reproducibility during fabrication.

Several flexible polymeric materials have been investigated as potential alternatives to conventional EVA in digitally fabricated mouthguards. Computational analysis of PLA+ and polycarbonate has explored their potential to reduce stress and absorb impact energy,

supporting further investigation of alternative materials for digitally manufactured sports mouthguards (Kumar et al., 2024).

Their properties have been evaluated using parameters such as tensile strength, flexural strength, hardness, notch toughness, and deformation. Some flexible polymeric resins have demonstrated promising mechanical characteristics, including high tensile strength and notch toughness combined with relatively low Shore hardness.

Multilayer structures have also been investigated, including combinations of acrylonitrile butadiene styrene (ABS) and thermoplastic polyurethane (TPU). In such constructions, the TPU layer may contribute to flexibility, energy dissipation, and stabilization of deformation within the oral environment. Other investigated materials, including acrylic ester and orthodontic resins, have demonstrated impact absorption comparable to EVA, although limitations such as insufficient damping properties and cohesive fracture have also been reported.

Despite the potential advantages of additive manufacturing, conventional EVA remains an important reference material because of its favorable deformation and mechanical damping properties. The development of digitally fabricated mouthguards is therefore still limited by the need for materials that can reproduce the protective and mechanical characteristics of conventionally fabricated EVA (Abbott et al., 2024).

3.6. Influence of mouthguards on athletic performance

The potential influence of mouthguards on athletic performance is an important consideration because concerns regarding breathing, communication, and physical performance may affect athletes' willingness to use them. Evidence from a systematic review including 12 studies comparing custom-made mouthguards with conditions without mouthguards showed that seven studies reported no significant effects on performance, three reported improvements, and two reported deterioration. Overall, the available evidence did not demonstrate a general negative effect of mouthguard use on athletic performance. A systematic review of 41 studies involving 852 athletes found that mouthguard use was associated with improvements in some performance outcomes, with custom-made devices showing more favorable results than other mouthguard types (Cao et al., 2023).

Mouthguard use has not been associated with significant changes in several commonly assessed performance parameters, including 20-m sprint performance, jumping ability, handgrip strength, or isometric strength of the lower limbs and back. In some studies, mouthguard use was associated with increased peak and mean power during the Wingate test and increased peak hamstring torque.

Cardiorespiratory performance also appears to be largely preserved during mouthguard use. Studies have reported no significant deterioration in minute ventilation, oxygen consumption, VO_2max, or heart rate. In football players, mouthguard use did not negatively influence aerobic performance, total distance covered, or VO_2max. In cyclists, the use of a neuromuscular mouthguard was associated with an approximately 4% increase in maximal power and a 7% increase in power at the respiratory compensation point, without deterioration in cardiorespiratory responses. These findings suggest that appropriately designed mouthguards do not generally impair physical performance and may potentially provide additional neuromuscular or respiratory benefits (Wojda & Wielgosz, 2024).

3.7. Mouthguard hygiene and maintenance

Because mouthguards are repeatedly placed in and removed from the oral cavity, they are exposed to saliva, oral microorganisms, the hands, and the external environment. Their surfaces may therefore provide suitable conditions for microbial adhesion and biofilm formation if adequate cleaning is not performed. This makes good hygiene and regular maintenance a vital part of using a mouthguard (Badari et al., 2025).

Experimental investigations using EVA mouthguards exposed to microorganisms including *Streptococcus oralis*, *Streptococcus mutans*, and *Staphylococcus aureus* demonstrated the development of biofilm on the material when adequate cleaning was not performed. Different cleaning procedures were evaluated, including sterile distilled water, ultrasonic washing, and a mouthwash-containing cleaning method. The mouthwash-containing method produced a significantly greater reduction in viable microorganisms compared with the other tested approaches. Electron microscopy also demonstrated the presence of biofilm before cleaning and a reduction in microbial accumulation after the cleaning procedure (Hayashi et al., 2022).

These findings indicate that inadequate cleaning may allow persistent microbial biofilms to remain on the mouthguard surface. Regular cleaning, appropriate drying, and hygienic storage should therefore be considered essential elements of mouthguard maintenance. At the same time, cleaning procedures should be selected carefully to preserve the physical properties, fit, and protective performance of the material. Based on the evidence presented in this review, mouthguards should at least be rinsed with cold water after use, while cleaning methods containing mouthwash may provide greater antimicrobial effectiveness. Exposure to direct sunlight and high temperatures should also be avoided because these conditions may contribute to material deformation.

4. Discussion

4.1. Sports-related dental injuries and the importance of prevention

The findings presented in this review confirm that sports-related dental and orofacial injuries remain an important problem, particularly among athletes participating in contact and high-risk sports. The higher frequency of dental trauma observed in contact sports compared with non-contact activities indicates that the level of physical interaction during sport is an important determinant of injury risk (de Lima et al., 2024; Mordini et al., 2021; Roberts, 2023). The maxillary anterior teeth, especially the upper central incisors, are particularly vulnerable because of their anatomical position. Individual factors, including increased overjet, Angle Class II malocclusion, and incomplete lip closure, may further increase susceptibility to trauma (de Lima et al., 2024; Tysiąc-Miśta et al., 2025; Wang et al., 2025; Wojda & Wielgosz, 2024).

The consequences of sports-related dental trauma extend beyond the immediate injury. Fractures, luxations, intrusions, extrusions, and avulsions may result in aesthetic and functional impairment and may require long-term dental treatment. Pulpal complications, caries, tooth loss, and psychological consequences may further affect the patient's quality of life (de Lima et al., 2024; Tysiąc-Miśta et al., 2025; Wojda & Wielgosz, 2024). These findings emphasize that prevention should be considered an essential component of sports participation rather than only a response to an already sustained injury. A recent review also pointed out that sports

dentistry needs to focus on preventive measures, regular oral checkups, and mouthguard use to keep athletes safe (Nosowicz et al., 2026).

4.2. Mouthguards as an effective preventive measure

Mouthguards represent one of the most important preventive measures against sports-related dental injuries. The evidence summarized in this review indicates that their use can substantially reduce the risk of dental trauma, particularly fractures and avulsions. However, the protective effect depends not only on wearing a mouthguard but also on its design, adaptation, material, thickness, and stability (Agarwal et al., 2025).

Despite their preventive potential, mouthguards are not consistently used by all athletes. Lack of awareness, concerns regarding comfort, breathing, speech, and concentration, as well as failure to wear mouthguards during training, may limit their effectiveness (Agarwal et al., 2025; de Lima et al., 2024). This is particularly important because training sessions may expose athletes to the same mechanisms of injury as competitive events. Consequently, prevention programs should emphasize the use of mouthguards during both training and competition and should involve athletes, coaches, and other sports personnel. Ahmed and Fine also suggested that making mouthguards mandatory could help build a culture of safety in contact sports, especially for younger athletes (Ahmed & Fine, 2021).

4.3. Custom-made mouthguards and individual adaptation

The comparison of different mouthguard types suggests that custom-made devices provide the most favorable combination of adaptation, retention, comfort, and protection. Stock mouthguards are easily accessible and inexpensive, but their universal shape may result in poor retention and reduced comfort. Mouth-formed devices offer better adaptation than stock mouthguards but remain less precise than individually fabricated appliances (Abbott et al., 2024; de Lima et al., 2024; Roberts, 2023; Wang et al., 2025).

Custom-made mouthguards are individually fabricated using dental impressions or digital scans, allowing their shape and thickness to be adapted to the athlete’s dentition and the requirements of the specific sport (Abbott et al., 2024; Roberts, 2023). This individualization may improve stability and comfort and reduce problems associated with speech and breathing. The possibility of modifying the design is also particularly relevant for athletes undergoing orthodontic treatment.

At the same time, increased thickness does not necessarily provide an optimal solution. Although greater thickness can improve impact absorption and force distribution, excessive thickness may reduce comfort. In EVA mouthguards, thickness greater than approximately 4 mm may be perceived as uncomfortable (Roberts, 2023). Therefore, mouthguard design should aim to achieve an appropriate balance between protection and functional comfort.

4.4. Materials and technological development

EVA remains the principal material used in mouthguard fabrication because of its favorable combination of flexibility, impact resistance, softness, mechanical strength, availability, and relatively low cost (Rusiecka et al., 2025). The mechanical properties of the material are important because an effective mouthguard must absorb and distribute impact forces while maintaining its structural integrity.

The development of alternative materials and the incorporation of biologically active substances indicate that mouthguards may potentially serve functions beyond mechanical protection. Materials containing casein, chlorhexidine, fluoride, or silver nanoparticles have been investigated for their potential antimicrobial or anti-caries properties (Wojda & Wielgosz, 2024). However, these approaches represent additional material modifications, and the primary function of the mouthguard remains the protection of oral structures against trauma.

Digital technologies and additive manufacturing provide further possibilities for individualization and precise control of mouthguard geometry and thickness. Digitally designed devices may improve reproducibility and consistency of fabrication. However, the evidence summarized in this review also indicates that conventional EVA continues to have important advantages in terms of deformation and mechanical damping. The development of additive-manufactured mouthguards therefore requires materials capable of reproducing these favorable characteristics while maintaining adequate flexibility and energy absorption.

4.5. Mouthguards and athletic performance

A relevant concern among athletes is whether wearing a mouthguard may interfere with physical performance. The evidence summarized in this review does not support a general negative effect of mouthguard use on athletic performance. A systematic review of 12 studies found no significant performance effect in the majority of studies, while some reported improvements and only a smaller number reported deterioration.

The use of mouthguards has not been associated with significant reductions in sprint performance, jumping ability, handgrip strength, or isometric strength. Similarly, cardiorespiratory parameters, including minute ventilation, oxygen consumption, VO_2max, and heart rate, were generally not negatively affected. In some studies, improvements in power-related parameters were observed, including peak and mean Wingate power and hamstring peak torque. Findings in cyclists also suggested increases in maximal power and power at the respiratory compensation point without deterioration of cardiorespiratory performance.

These observations are relevant because concerns about impaired breathing or athletic performance may discourage mouthguard use. The available evidence presented in this review suggests that appropriately designed mouthguards can provide protection without compromising overall physical performance. Some potential additional respiratory, neuromuscular, or oxidative-stress-related benefits have also been suggested (Wojda & Wielgosz, 2024).

4.6. Hygiene and maintenance of mouthguards

Protection against dental trauma should be considered together with appropriate mouthguard hygiene. Because mouthguards are repeatedly exposed to saliva, oral microorganisms, the hands, and the external environment, inadequate cleaning may facilitate microbial adhesion and biofilm formation.

The reviewed experimental evidence demonstrates that microorganisms such as *Streptococcus oralis*, *Streptococcus mutans*, and *Staphylococcus aureus* can form biofilms on EVA mouthguards when adequate cleaning is not performed. Different cleaning procedures showed different levels of effectiveness, with a mouthwash-containing cleaning method producing a greater reduction in viable microorganisms than sterile distilled water or ultrasonic washing.

These findings indicate that regular cleaning should be regarded as an integral part of mouthguard use. Cleaning, drying, and appropriate storage may help reduce microbial

accumulation and maintain the hygienic condition of the appliance. At the same time, cleaning procedures should not adversely affect the material, fit, or protective properties of the mouthguard. Avoiding high temperatures and direct sunlight is also important because these conditions may contribute to deformation of the material.

4.7. Implications for sports dentistry

The findings of this review highlight the important role of dentists in the prevention of sports-related dental injuries. Dental professionals can contribute not only by treating traumatic injuries but also by educating athletes about the benefits of mouthguards and helping them select an appropriate device.

Particular attention should be given to custom-made mouthguards because their individual adaptation provides advantages in terms of retention, comfort, and protection. Education should also extend to coaches and sports staff, as their involvement may improve compliance with mouthguard use during both training and competition (Agarwal et al., 2025; de Lima et al., 2024).

Overall, effective prevention requires a combination of athlete education, appropriate mouthguard selection, individual adaptation, adequate material and thickness, consistent use, and proper hygiene. Further development of manufacturing technologies and materials may improve the protective and functional properties of mouthguards in the future.

5. Conclusions

Sports-related dental and orofacial injuries are an important problem, particularly in contact and high-risk sports, and may result in significant functional, aesthetic, and psychological consequences. The findings presented in this review indicate that many of these injuries can be prevented through appropriate use of mouthguards.

Among the available types, custom-made mouthguards provide the most favorable combination of fit, retention, comfort, and protection. Their effectiveness depends on appropriate design, material selection, thickness, and individual adaptation. EVA remains the most commonly used material, while additive manufacturing and alternative flexible materials provide promising possibilities for further development of individualized mouthguards.

Current evidence does not indicate that appropriately designed mouthguards generally impair athletic performance. In addition, some studies suggest potential improvements in selected strength, power, respiratory, and neuromuscular parameters. Therefore, concerns that mouthguards necessarily reduce athletic performance should not discourage their use.

Mouthguard hygiene is also an essential aspect of preventive care. Regular cleaning, drying, and appropriate storage may reduce microbial accumulation and biofilm formation and help maintain the condition of the appliance. Athletes should be encouraged to use mouthguards consistently during both training and competition and to follow appropriate hygiene procedures.

Education of athletes, coaches, sports staff, and dental professionals is essential for improving compliance with mouthguard use. Further research is needed to optimize materials, manufacturing techniques, thickness, and hygiene protocols in order to achieve the best possible balance between protection, comfort, performance, and long-term durability.

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Supplementary Materials Not applicable

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