JOURNAL OF EDUCATION, HEALTH AND SPORT
eISSN 2391-8306 Open Access Peer-reviewed
apcz.umk.pl/JEHS Nicolaus Copernicus University in Toruń

Cite as: MARKIV, Mariana, ŚWIERCZ, Jędrzej, ARCISZEWSKI, Kamil, ORDA, Karolina, HARIASZ, Natalia, WALCZAK, Dominika, SZUMIŁO, Jakub, KASPERSKA, Klaudia, SŁOWIK, Michał and STENZEL, Paweł. Preventing Sports-Related Dental Trauma: A Critical Review of Mouthguard Effectiveness, Compliance, and Clinical. Journal of Education, Health and Sport. 2026;93:72554. https://doi.org/10.12775/JEHS.2026.93.72554

ARTICLE TIMELINE
Received: 30.05.2026 Revised: 30.05.2026
Accepted: 30.05.2026 Published: 20.06.2026

INDEXING & EVALUATION
MEiN points: 40 Unique ID: 201159
Disciplines: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).

The journal has been awarded 40 points in the parametric evaluation by the Polish Ministry of Higher Education and Science (Annex to the announcement of 05.01.2024, No. 32318). Unique Journal Identifier: 201159. Scientific disciplines: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).

Punkty Ministerialne z 2019 – aktualny rok 40 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).

PREVENTING SPORTS-RELATED DENTAL TRAUMA: A CRITICAL REVIEW OF MOUTHGUARD EFFECTIVENESS, COMPLIANCE, AND CLINICAL EVIDENCE

Jędrzej Świercz [1], ORCID https://orcid.org/0009-0008-8716-621X
E-mail: jedrzejswiercz99@gmail.com
[1]Artmedik Sp. z o.o. Biegański Specialist Hospital in Jędrzejów

Kamil Arciszewski[2], ORCID https://orcid.org/0009-0003-2679-0872
E-mail: kamilarciszewski01@gmail.com
[2]Sapienza University of Rome, Rome, Italy

Natalia Hariasz[1], ORCID https://orcid.org/0009-0000-5397-0324
E-mail: natalia.hariasz@gmail.com
[1]4th Military Clinical Hospital, Wrocław, Poland

Karolina Orda[1], ORCID https://orcid.org/0009-0002-0996-137X
E-mail: orda.karolina19@gmail.com
[1]4th Military Clinical Hospital, Wrocław, Poland

Dominika Walczak[1], ORCID https://orcid.org/0009-0007-1629-871X
E-mail: dominikajwalczak@gmail.com
[1]4th Military Clinical Hospital, Wrocław, Poland

Jakub Szumiło[3], ORCID https://orcid.org/0009-0008-5105-4857
E-mail: jszumilo0@gmail.com
[3]Wroclaw Medical University, Wrocław, Poland

Klaudia Kasperska[4], ORCID https://orcid.org/0009-0002-3512-7696
E-mail: klaudia.kasperskaa@gmail.com
[4]Specialist Medical Center, Polanica-Zdrój, Poland

Mariana Markiv[5], ORCID https://orcid.org/0009-0006-0679-8131
E-mail: marianamarkiv@mail.com
[5]Jagiellonian University, Kraków, Poland

Michał Słowik[3], ORCID https://orcid.org/0009-0004-1206-528X
E-mail: michal.slowik16@wp.pl
[3]Wroclaw Medical University, Wroclaw, Poland

Paweł Stenzel[5], ORCID https://orcid.org/0009-0003-0347-8552
E-mail: stenzelpawel.t@gmail.com
[5]University Dental Clinic, Kraków, Poland

Corresponding Author

Mariana Markiv, E-mail: marianamarkiv@gmail.com

Abstract

Background: Sports-related dental trauma represents a significant challenge in both recreational and professional athletics, often leading to long-term functional, esthetic, and psychological consequences. Mouthguards are widely recommended as a preventive strategy; however, discrepancies remain between biomechanical evidence and real-world clinical outcomes.

Objective: This review aimed to critically evaluate the effectiveness of mouthguards in preventing sports-related dental injuries, with particular emphasis on differences between

mouthguard types, biomechanical performance, clinical effectiveness, and factors influencing compliance.

Methods: A structured narrative review of the literature was conducted using PubMed and Google Scholar databases. Studies published between 2015 and 2026 were screened using keywords related to sports dentistry, mouthguards, dental trauma, and injury prevention. Seventeen studies, including systematic reviews, epidemiological analyses, laboratory investigations, and clinical studies, were included.

Results: Evidence consistently suggests that mouthguards reduce the incidence and severity of sports-related orofacial injuries. Custom-made mouthguards demonstrate superior fit, material distribution, and shock absorption under laboratory conditions compared with stock and boil-and-bite devices. However, clinical effectiveness is strongly influenced by athlete compliance, accessibility, comfort, and enforcement of protective regulations. Current evidence regarding concussion prevention remains inconclusive due to methodological heterogeneity and limited prospective research.

Conclusions: Mouthguards constitute an effective preventive strategy against sports-related dental trauma, although their real-world effectiveness depends more on consistent use than on biomechanical superiority alone. Future research should prioritize standardized injury definitions, prospective study designs, and behavioral factors influencing compliance. Educational interventions and policy implementation may further enhance preventive outcomes.

Keywords: mouthguards; dental trauma; sports dentistry; injury prevention.

1. Introduction

Over recent decades, participation in both organized and recreational sports has increased worldwide, bringing well-documented public health benefits. At the same time, this growing engagement in athletic activities has been accompanied by a notable rise in orofacial injuries, particularly traumatic dental injuries (TDIs). Epidemiological evidence consistently identifies sports—especially contact and collision disciplines—as one of the leading causes of dental

trauma (Petti et al. 2018, Lam 2016). Sports-related activities are estimated to account for approximately 10–39% of all traumatic dental injuries in the general population (Petti et al. 2018, Cohenca et al. 2021), with even higher proportions reported among children and adolescents. Furthermore, it has been reported that between 10% and 61% of athletes experience at least one sport-related orofacial injury during their lifetime, depending on the type of sport and level of competition (Lam 2016, Cohenca et al. 2021).

From a clinical perspective, traumatic dental injuries are among the most frequent sports-related conditions encountered in daily dental practice (Petti et al. 2018, Lam 2016). Although their prevalence varies markedly across sporting disciplines, contact and collision sports consistently demonstrate higher injury rates compared to non-contact activities (Petti et al. 2018, Tribst et al. 2020). Injury incidence is strongly influenced by the level of physical contact involved, athlete age, and the use (or absence) of protective equipment such as mouthguards (Knapik et al. 2019, Lam 2016).

In addition to immediate pain and functional limitations, traumatic dental injuries often result in long-term restorative complications, repeated endodontic interventions, tooth loss requiring implant-supported rehabilitation, and a considerable psychological burden for affected individuals (Knapik et al. 2019, Cohenca et al. 2021). The long-term management of TDIs has been shown to generate substantial cumulative treatment costs and may negatively affect oral health–related quality of life, particularly in children and adolescents (Lam 2016, Cohenca et al. 2021). For this reason, prevention is widely regarded as both more cost-effective and clinically preferable to post-traumatic treatment (Knapik et al. 2019, Tribst et al. 2020). Preventive measures, particularly the use of mouthguards, have been shown to significantly reduce both the incidence and severity of dental injuries in contact sports (Wojda et al., 2024).

In this context, mouthguards are widely considered the primary method of preventing dental injuries in athletes (American Dental Association 2022, FDI World Dental Federation, 2017). Although their biomechanical effectiveness in reducing the incidence and severity of traumatic dental injuries is well documented (Knapik et al. 2019, Takeda et al. 2016), differences in clinical performance, user compliance, fit, and material properties suggest that their use warrants critical evaluation rather than unquestioned endorsement (Knapik et al. 2019, Maeda and Machi 2018**).**

The aim of this review is not only to describe the available types of mouthguards, but also to critically evaluate the strength and limitations of the existing evidence regarding their protective effectiveness.

Attention is given to the discrepancy between laboratory-based findings and real-world clinical outcomes, as well as to the role of user compliance in determining the actual effectiveness of preventive strategies.

2 Aim of the Study

The aim of this review is to critically evaluate the effectiveness of mouthguards in preventing sports-related dental trauma, with particular emphasis on differences between mouthguard types, the gap between laboratory and real-world outcomes, and the role of athlete compliance in determining their protective value.

Review Questions

1. To what extent do mouthguards reduce the incidence and severity of sports-related dental injuries?
2. Are custom-made mouthguards more effective than prefabricated devices in clinical practice?
3. What factors (e.g., compliance, accessibility, enforcement) influence the real-world effectiveness of mouthguards?
4. How do laboratory-based findings compare with clinical and epidemiological evidence regarding injury prevention?

Research Assumptions

1. The use of mouthguards significantly reduces the risk and severity of sports-related dental trauma.
2. Custom-made mouthguards provide greater protective effectiveness than prefabricated types.
3. The real-world effectiveness of mouthguards is primarily determined by athlete compliance and consistent use.

4. There is a discrepancy between laboratory-based evidence and real-world clinical outcomes in assessing mouthguard effectiveness.

3 Methodology

A structured search of the literature was performed using PubMed and Google Scholar, focusing on articles published between 2015 and 2026 (Petti et al. 2018, Lam 2016). The search strategy included combinations of the following terms: “mouthguards,” “sports dentistry,” “dental trauma prevention,” “orofacial injuries,” and “custom-made mouthguards” (American Dental Association 2022, Knapik et al. 2019, Maeda and Machi 2018). Priority was given to systematic reviews, meta-analyses, and prospective clinical studies, as these were considered to provide the most reliable synthesis of the available evidence (Petti et al. 2018, Mihalik et al. 2020).

The initial search identified approximately 220 records across both databases. After restricting the publication period and removing duplicate entries, around 95 articles remained for screening. Titles and abstracts were then reviewed for relevance, which resulted in 45 studies being considered potentially eligible. Following full-text evaluation, 17 publications were ultimately included in the final synthesis.

The selection and evaluation of studies were performed by the authors. Titles and abstracts were initially screened for relevance, followed by full-text assessment of potentially eligible articles. The search strategy was designed to ensure a comprehensive overview of the available literature. Both keyword combinations and manual screening of reference lists were applied to identify additional relevant studies.

Attention was given to study design, sample size, and methodological limitations when interpreting the findings. Studies of lower methodological quality or those based solely on self-reported outcomes were interpreted with caution.

Most of the available literature consisted of non-randomized clinical studies and laboratory-based investigations. Randomized controlled trials were rare, largely due to ethical and practical limitations associated with conducting experimental research in high-risk sports environments (Petti et al. 2018, Chalmers et al. 2021, Lam 2016). As a result, much of the current clinical evidence relies on non-randomized study designs.

This study was designed as a critical narrative review and therefore does not follow PRISMA guidelines or include a formal risk-of-bias assessment (Petti et al. 2018, Cohenca et al. 2021). To maintain conceptual clarity, in vitro-based biomechanical studies were considered separately from clinical outcome research (Maeda and Machi 2018**,** Bartsch et al. 2019, Tribst et al. 2020). This approach helped avoid direct extrapolation from controlled impact simulations to real-world injury prevention scenarios (Mihalik et al. 2020, American Association of Oral and Maxillofacial Surgeons). Studies based solely on self-reported outcomes or lacking standardized injury definitions were interpreted with caution (Knapik et al. 2019, Chalmers et al. 2021).

Studies were included if they met the following criteria:

- publication between 2015 and 2026
- investigation of mouthguards or preventive strategies related to sports-related dental trauma
- clinical epidemiological studies, systematic reviews, meta-analyses, or biomechanical investigations
- studies involving athletes or sports-related injury mechanisms
- articles published in peer-reviewed journals and available in full text.

Studies were excluded if they met one or more of the following criteria:

- publications released before 2015
- case reports or small case series without broader analytical value
- studies not related to sports-associated dental trauma
- studies focused exclusively on orthodontic appliances or unrelated dental protective devices
- articles lacking clear outcome measures or standardized definitions of dental trauma
- duplicate publications or conference abstracts without full peer-reviewed articles.

Owing to the narrative nature of this review, no formal meta-analysis was undertaken (Petti et al. 2018, Cohenca et al. 2021). Nevertheless, differences in study design, outcome measures, and sporting contexts were carefully considered when interpreting and synthesizing the findings (Petti et al. 2018, Takeda et al. 2016, Lam 2016). The limited number of randomized controlled trials further reduces the strength of available evidence and highlights the need for more robust study designs in this field (Chalmers et al. 2021).

4 Literature Findings

Epidemiology of Sports-Related Dental Injuries

Higher rates of dental trauma are consistently reported in contact sports such as boxing, rugby, and martial arts, where direct facial impact is common (Petti et al. 2018, Lam 2016). Nevertheless, activities typically classified as non-contact, including cycling and skateboarding, also pose a meaningful risk, largely because of falls and high-velocity accidents (Petti et al. 2018, Tribst et al. 2020).

Children and adolescents appear particularly susceptible to traumatic dental injuries, reflecting both developmental factors, including incomplete root formation, and behavioral characteristics associated with risk-taking and sports participation (Lam 2016, Tribst et al. 2020). In contrast, adult athletes more frequently sustain periodontal and alveolar injuries, which often require complex, multidisciplinary, and prolonged treatment (Petti et al. 2018, Tribst et al. 2020).

Despite well-defined risk profiles, adherence to preventive measures remains variable. Barriers such as discomfort, financial cost, and limited awareness continue to restrict the widespread use of custom-fabricated mouthguards.

Trauma Types in Sports

Sports-related dental trauma may involve injuries to hard dental tissues, such as crown fractures; periodontal structures, including luxation injuries; complete displacement of the tooth (avulsion); as well as associated soft tissue injuries (Petti et al. 2018, Tribst et al. 2020). Maxillary incisors are the most frequently affected teeth due to their anterior position and prominence within the dental arch (Petti et al. 2018, Lam 2016). Among the various injury types, intrusive luxation and avulsion are considered particularly severe due to the high risk of pulpal necrosis, inflammatory root resorption, and long-term restorative or prosthetic complications (Tribst et al. 2020, American Association of Oral and Maxillofacial Surgeons).

However, sports-related trauma may extend beyond isolated dental injuries and involve broader maxillofacial structures. In addition to damage to individual teeth, high-impact sports may result in injuries affecting the supporting dentoalveolar structures as well as the facial skeleton. According to classifications used in oral and maxillofacial trauma guidelines, such injuries include dentoalveolar fractures and fractures of the facial bones, particularly the mandible,

maxilla (including Le Fort I–III patterns), and the zygomatic complex. Trauma may also involve functional structures such as the temporomandibular joint (TMJ). In more severe cases, the impact may extend to the cranial base and be associated with neurocranial trauma, highlighting the potential complexity and clinical severity of sports-related maxillofacial injuries (American Association of Oral and Maxillofacial Surgeons).

From a severity perspective, isolated enamel fractures are considered minor injuries, whereas dentoalveolar fractures, mandibular or maxillary fractures, and injuries involving the cranial base represent high-energy trauma requiring multidisciplinary management. Such injuries carry significantly higher risks of long-term functional impairment, occlusal disturbances, temporomandibular dysfunction, and neurological complications (American Association of Oral and Maxillofacial Surgeons).

Types of Mouthguards and Their Protective Properties – Critical Appraisal

Mouthguards are generally classified as:

1. Stock
2. Boil-and-bite
3. Custom-made

However, the protective hierarchy often cited in literature should be interpreted within the context of both biomechanical testing and real-world adherence.

4.1 Stock Mouthguards

Stock mouthguards represent the most basic form of oral protective devices used in sports; however, their protective effectiveness is generally considered limited. Due to poor adaptation to the dental arch and inadequate retention, these devices may require continuous clenching to remain in position, which can reduce their ability to absorb and dissipate impact forces effectively. As a result, their capacity to prevent orofacial injuries is typically inferior compared with better-fitting alternatives, and they are often regarded as the least effective option for injury prevention in sports dentistry (Knapik et al. 2019, **Maeda and Machi 2018**).

Most of the available evidence regarding stock mouthguards originates from laboratory-based

biomechanical studies that evaluate their capacity to absorb and dissipate impact forces during simulated trauma. These experimental investigations demonstrate that mouthguards can reduce transmitted forces to dental and maxillofacial structures, although the magnitude of protection depends on factors such as material properties, thickness, and fit (Lam 2016). Consequently, while laboratory data support their protective potential, translation of these findings into consistent clinical injury reduction remains dependent on proper fit and user compliance (Lam 2016).

4.2 Boil-and-Bite Mouthguards

Boil-and-bite mouthguards represent one of the most used protective devices among athletes because they provide a compromise between accessibility and improved adaptation compared with stock appliances. Experimental and biomechanical studies indicate that their capacity to absorb and dissipate impact forces depends primarily on the final material thickness and the quality of adaptation achieved during the molding process. Improper molding may lead to uneven thickness distribution and reduced shock-absorbing capacity, which may reduce their injury prevention potential. Laboratory simulations further suggest that although boil-and-bite mouthguards provide greater impact attenuation than stock devices, their biomechanical effectiveness remains inferior to that of custom-fabricated mouthguards due to variability in fit and material deformation during molding (**Maeda and Machi 2018**, Takeda et al. 2016, Tribst et al. 2020).

Experimental and laboratory-based studies indicate that improper molding frequently results in uneven thinning of the material, particularly in the incisal and occlusal regions, thereby compromising its capacity to absorb and dissipate impact forces (Petti et al. 2018). Consequently, the degree of protection may vary considerably between users (Lam 2016).

Moreover, the material thickness achieved under controlled laboratory conditions may not be maintained during routine use, especially in younger athletes, in whom wear, deformation, and repeated adjustments can further reduce effective thickness over time, potentially diminishing protective performance (Tribst et al. 2020).

4.3 Custom-Made Mouthguards

Custom-made mouthguards are produced from conventional dental impressions or digital

intraoral scans and are most commonly fabricated from ethylene-vinyl acetate (EVA). Unlike prefabricated devices, they allow controlled thickness—typically in the range of 3–5 mm in areas exposed to direct impact—which improves force distribution under standardized laboratory conditions.

EVA exhibits marked viscoelastic behavior when subjected to impact loading. Experimental impact tests and finite element analyses have indicated that increasing material thickness from approximately 2 mm to around 4–5 mm reduces peak stress transmission to enamel, dentin, and alveolar bone by prolonging impact duration and spreading forces over a wider surface area (Takeda et al. 2016, Tribst et al. 2020).

Finite element models further suggest that stress concentrations in the maxillary incisal region, a site particularly prone to direct trauma, decrease progressively with increasing mouthguard thickness. Beyond roughly 5 mm, however, additional biomechanical benefit appears limited, while practical drawbacks—most notably impaired speech, reduced breathing comfort, and declining long-term compliance—become increasingly evident (Tribst et al. 2020).

Systematic reviews often report fewer injuries among athletes using custom-made mouthguards. Recent studies emphasize that custom-made mouthguards provide superior protection compared with prefabricated alternatives, although their use may be limited by cost and accessibility (Rusiecka et al., 2025).

Beyond injury prevention, emerging evidence suggests that mouthguards may influence athletic performance. Some systematic reviews report that custom-made mouthguards may may contribute to improved breathing comfort and neuromuscular stabilization during exercise. These potential performance-related benefits may contribute to greater athlete acceptance and long-term compliance, particularly when compared with less comfortable prefabricated devices (Wang et al., 2025).

However, most of this evidence comes from observational research with variable injury definitions and reliance on self-reporting, which complicates direct comparison between studies (Petti et al. 2018, Lam 2016). Many of these studies rely on self-reported outcomes, which may introduce recall bias and limit the reliability of the findings (Knapik et al. 2019).
Based on laboratory findings and accumulated clinical experience, properly fabricated EVA-based custom-made mouthguards demonstrate superior shock absorption and more favorable stress distribution compared with prefabricated devices under controlled conditions (Bartsch et

al. 2019, American Association of Oral and Maxillofacial Surgeons). However, in everyday sporting practice, their effectiveness in reducing injuries appears to depend less on marginal differences in material properties than on consistent use, adequate thickness distribution in high-risk regions (particularly the anterior maxilla), and the presence of sport-specific enforcement policies (Lam 2016, Bartsch et al. 2019).

Laboratory vs Clinical Effectiveness

A critical distinction must be made between impact simulation studies and prospective clinical injury studies. In vitro-based investigations consistently demonstrate that improved shock absorption is associated with increased material thickness and optimal adaptation of mouthguards (Bartsch et al. 2019, American Association of Oral and Maxillofacial Surgeons). However, the translation of these biomechanical advantages into real-world injury prevention is influenced by additional factors beyond material properties alone. In clinical settings, the actual reduction in injury risk depends substantially on athlete behavior, enforcement of safety regulations, and consistent use of protective equipment (Petti et al. 2018, Lam 2016). Although experimental studies demonstrate improved shock absorption under controlled conditions, their direct translation into real-world injury prevention remains uncertain (Takeda et al. 2016, Tribst et al. 2020).

In clinical reality, even the best mechanical performance is of little value if the appliance is uncomfortable, poorly fitted, or not consistently used.

Laboratory impact testing and finite element modeling are invaluable for understanding force transmission and material behavior under controlled conditions (Bartsch et al. 2019, American Association of Oral and Maxillofacial Surgeons). At the same time, these approaches rely on simplified assumptions, including static mandibular positioning, uniform occlusal loading, and short-term material performance, which may not fully reflect clinical reality (Bartsch et al. 2019).

In everyday clinical and sporting contexts, protective devices are exposed to repeated impacts, material fatigue, progressive wear, and variable user compliance—factors that experimental models are inherently limited in reproducing (Petti et al. 2018). Findings obtained under laboratory conditions do not automatically translate into proportional clinical benefits. Controlled impact models simplify reality, and their results should therefore be interpreted

cautiously when applied to real-world settings. (Lam 2016).

Concussion Prevention – An Area of Uncertainty

Emerging meta-analyses suggest a potential association between mouthguard use and a reduced risk of concussion. The proposed injury prevention mechanisms include mandibular stabilization and a consequent reduction in the transmission of impact forces toward the skull base, which may contribute to attenuation of forces affecting cranial structures during sports-related impacts.

Despite growing interest in this area, the evidence remains inconsistent and strongly dependent on the specific sport being studied. Meta-analyses examining concussion outcomes reveal substantial heterogeneity, reflecting differences in study design, definitions of concussion, and exposure assessment. Much of the available data comes from clinical cohorts, which limits the strength of causal conclusions that can be drawn (Mihalik et al. 2020, Chalmers et al. 2021).

At present, the existing literature does not support a clear or universally accepted role for such appliances in concussion prevention, highlighting the need for carefully designed prospective studies rather than further retrospective analyses.

Effectiveness of Mouthguards in Preventing Sports-Related Injuries

Evidence from observational cohort and cross-sectional studies suggests that mouthguard use is associated with a meaningful reduction in sports-related dental injuries, particularly in high-contact sports, where relative risk reductions of approximately 40–60% are most reported (Lam 2016, Bartsch et al. 2019, American Association of Oral and Maxillofacial Surgeons). However, the available evidence is largely based on non-randomized studies, which limits the ability to establish a causal relationship between mouthguard use and injury reduction (Knapik et al. 2019, Chalmers et al. 2021). This variability reflects substantial heterogeneity across studies, including differences in injury definitions, study design, and exposure assessment (Petti et al. 2018, Lam 2016).

As outlined in Table 1, most of the available evidence is drawn from epidemiological research rather than randomized trials. This limits the strength of causal conclusions and highlights the potential impact of confounding factors, including athlete behavior and adherence to protective measures.

Reductions in soft tissue injuries appear to be more consistent than those observed for severe luxation or avulsion injuries. Notably, compliance emerges as a central determinant of protective effectiveness and may have a greater influence on clinical outcomes than relatively small differences in mouthguard material or thickness. This suggests that behavioral factors may have a greater impact on injury prevention than differences in mouthguard design or material properties (Knapik et al. 2019, Mihalik et al. 2020).

Table 1. Summary of included studies

Study	**Year**	**Study design**	**Population /Sport**	**Sample size (n)**	**Main findings**
Petti et al.	2018	Meta-analysis	Mixed	>50,000	Sports are major etiological factor for TDIs
Knapik et al.	2019	Systematic review	Contact and non-contact sports	~20,000	Mouthguards associated with reduced orofacial injury risk
Maeda Y, Machi H	2018	Systematic review	Mixed	NR	Custom-made mouthguards favored
Takeda et al.	2016	Systematic review (laboratory studies)	In vitro impact models	NR	Increased thickness improves impact absorption
Chalmers et al.	2021	Systematic review	Mixed	10,000	No definitive causal relationship

Source: own elaboration based on reviewed literature.

Notes: NR – not reported; TDI – traumatic dental injury.

5. Research results

Following the structured literature search conducted across PubMed and Google Scholar databases, approximately 220 records were initially identified. After removal of duplicate publications and restriction to the predefined publication period (2015–2026), 95 articles remained for title and abstract screening. Following eligibility assessment, 45 full-text articles were reviewed in detail, of which 17 studies met the inclusion criteria and were incorporated into the final synthesis.

The included studies comprised systematic reviews, meta-analyses, epidemiological investigations, biomechanical laboratory studies, and observational clinical studies. Randomized controlled trials were limited, reflecting the practical and ethical challenges associated with conducting interventional research in sports-related trauma prevention.

5.1 Overview of Included Evidence

Most included publications supported the protective role of mouthguards in reducing the incidence and severity of sports-related dental trauma. Across observational and epidemiological studies, athletes using mouthguards consistently demonstrated lower rates of orofacial injuries compared with non-users. Protective effects were most evident in contact and collision sports, including boxing, rugby, martial arts, hockey, and American football.

Several systematic reviews reported that mouthguard use was associated with a relative reduction in injury risk ranging from approximately 40% to 60%, depending on the type of sport, injury definition, and study methodology. In some reports, reductions in injury incidence exceeded 80%, particularly in populations with mandatory mouthguard policies and high compliance.

5.2 Comparison Between Mouthguard Types

Differences in effectiveness were observed between various mouthguard categories. Custom-made mouthguards demonstrated the most favorable biomechanical and clinical characteristics. Studies consistently reported superior adaptation to the dental arch, improved retention, and more uniform material thickness compared with stock or boil-and-bite devices.

Laboratory studies showed that custom-made mouthguards distributed impact forces more evenly and reduced stress concentration in the anterior maxillary region, which is considered

particularly vulnerable to trauma. Finite element analyses demonstrated reduced peak stress transmission to enamel, dentin, and alveolar bone when properly fabricated custom-made mouthguards were used.

Boil-and-bite mouthguards showed intermediate performance. Their protective capacity was strongly influenced by the quality of molding and final material thickness. Poor adaptation often resulted in uneven thickness distribution and compromised impact absorption.

Stock mouthguards were generally considered the least effective due to poor retention and limited adaptation to dental structures. Several studies suggested that continuous clenching required to maintain their position may reduce comfort and lower overall protective value.

5.3 Laboratory Evidence Versus Clinical Outcomes

A notable finding across the reviewed literature was the discrepancy between laboratory-based evidence and real-world clinical outcomes. Experimental impact studies consistently demonstrated that increased material thickness and improved fit enhanced shock absorption and reduced transmitted forces.

However, clinical studies suggested that biomechanical superiority does not necessarily translate into proportional injury reduction in real-world sporting environments. Clinical effectiveness was influenced by multiple behavioral and environmental factors, including athlete compliance, duration of use, level of competition, accessibility of protective equipment, and enforcement of sports regulations.

The literature consistently emphasized that even the most biomechanically advanced mouthguard provides limited protection if not worn consistently during sports participation.

5.4 Compliance and Behavioral Determinants

Compliance emerged as one of the most important determinants of protective effectiveness. Studies identified several barriers influencing regular mouthguard use, including discomfort, impaired speech, difficulty breathing, financial cost, lack of awareness, and insufficient education regarding injury prevention.

Recent evidence suggests that athlete compliance is closely associated with oral health awareness and knowledge regarding dental trauma management. Studies conducted among

contact-sport athletes indicate that although mouthguard use may be relatively common, understanding of emergency dental trauma procedures remains limited. This highlights the importance of educational interventions aimed not only at increasing mouthguard use but also at improving injury recognition and immediate response following traumatic events (Boffano et al., 2025).

Additional evidence suggests that athlete adherence to mouthguard use is strongly influenced by perceived comfort, previous injury experience, and awareness of long-term dental consequences. Athletes who receive structured education regarding injury prevention demonstrate greater willingness to use protective devices consistently during training and competition. Preventive education may therefore represent an important adjunct to equipment availability and institutional regulations (Newsome et al., 2019).

Athletes participating in organized sports programs with mandatory mouthguard regulations demonstrated significantly higher adherence rates compared with athletes in recreational settings. Educational interventions targeting athletes, parents, and coaches were associated with improved compliance and increased awareness of dental trauma prevention.

Recent reviews in sports dentistry emphasize that compliance is closely linked to comfort, speech ability, and perceived interference with athletic performance. Athletes are more likely to consistently use protective devices when mouthguards are individually adapted and integrated into routine sports practice. Educational reinforcement by dental professionals and coaches may further improve long-term adherence and awareness regarding injury prevention (Roberts et al., 2023).

Importantly, the reviewed evidence suggested that behavioral factors may exert a stronger influence on injury prevention outcomes than small differences in mouthguard material or thickness.

5.5 Evidence Regarding Concussion Prevention

Evidence concerning the relationship between mouthguard use and concussion prevention remained inconsistent. Some observational studies suggested a potential reduction in concussion risk associated with mandibular stabilization and attenuation of impact transmission toward cranial structures.

However, systematic reviews and meta-analyses reported substantial heterogeneity across studies, including differences in concussion definitions, sport-specific exposure, and study design. Consequently, current evidence does not support a definitive causal relationship between mouthguard use and concussion reduction.

5.6 Summary of Key Findings

Overall, the reviewed literature indicates that mouthguards represent an effective preventive strategy against sports-related dental trauma. Custom-made mouthguards demonstrate superior biomechanical performance under controlled conditions; however, real-world effectiveness depends strongly on consistent use, proper fit, and institutional enforcement.

The evidence suggests that injury prevention outcomes are influenced by a combination of mechanical properties and behavioral adherence. While laboratory studies support the protective potential of increased thickness and optimized design, clinical benefits appear closely linked to athlete compliance and accessibility of preventive measures.

These findings highlight the importance of integrating educational strategies, regulatory policies, and improved access to protective devices to maximize preventive effectiveness.

6 Limitations

This review has several limitations. The included literature demonstrated substantial heterogeneity regarding study design, injury definitions, and outcome measures. Much of the available evidence originated from observational studies and laboratory-based investigations, limiting the ability to establish causal conclusions. Furthermore, the narrative review design did not include a formal risk-of-bias assessment or quantitative meta-analysis.

7 Discussion

The findings of this review indicate that mouthguards play a significant role in reducing the risk of sports-related dental injuries. However, a clear distinction must be made between biomechanical effectiveness demonstrated in vitro studies and real-world clinical outcomes.

While experimental data consistently suggest that increased material thickness and improved fit enhance shock absorption, these advantages do not always translate into proportional reductions in injury incidence in clinical settings. This discrepancy may be explained by factors such as inconsistent use, improper fit, and variability in athlete behavior.

Moreover, the available evidence is largely based on observational studies, which limits the strength of causal conclusions. The lack of randomized controlled trials, together with heterogeneity in injury definitions and study design, makes direct comparison between studies challenging.

From a practical standpoint, compliance appears to be the most critical determinant of protective capacity. Even the most advanced mouthguard offers limited benefit if it is not worn consistently. Therefore, preventive strategies should focus not only on device design but also on education, accessibility, and enforcement of safety regulations in sports environments.

Institutional regulations may play a decisive role in injury prevention. Policy statements from pediatric and sports dentistry organizations emphasize that mandatory mouthguard requirements significantly improve adherence and may reduce the incidence of sports-related dental trauma. Regulatory enforcement appears particularly important among younger athletes, where preventive behaviors are strongly influenced by organized sports structures and supervision (American Academy of Pediatric Dentistry, 2024).

Overall, future research should aim to provide more standardized methodologies and higher-quality evidence to better assess the true clinical effectiveness of these devices.

These findings highlight the need for improved implementation strategies rather than solely focusing on technological advancements in mouthguard design.

From a broader public health perspective, the prevention of sports-related dental trauma should be considered not only at the individual level but also within organized sports systems. The implementation of mandatory protective equipment policies, combined with educational interventions targeting athletes, coaches, and parents, may significantly improve compliance and reduce injury incidence. Such systemic approaches may be more effective than relying solely on individual behavioral changes.

8 Conclusion

Dental trauma related to sports participation remains a clinically important problem across a wide range of athletic disciplines.

Laboratory data clearly support the mechanical advantages of custom-made mouthguards. At the population level, however, their effectiveness seems to depend primarily on whether athletes wear them and how strongly their use is enforced within specific sports environments. In everyday practice, factors such as accessibility, cost, athlete education, and regulatory oversight play a decisive role in determining their protective value.

Overall, the available evidence supports the use of protective devices as an effective preventive measure for dental trauma. Consistent with previous findings, mouthguard use has been associated with substantial reductions in injury incidence, in some cases reaching over 80% effectiveness in preventing dental trauma (Wojda & Wielgosz, 2024). By contrast, the literature on concussion prevention remains inconclusive, indicating a clear need for well-designed prospective cohort studies before firm recommendations can be made.

Future research should prioritize the use of standardized injury definitions to improve comparability between studies and strengthen the overall quality of available evidence. Trauma severity should be considered, with clear distinctions made between minor injuries, such as enamel fractures, and more severe conditions including avulsion or alveolar fractures, as their biological consequences and long-term functional implications differ substantially. Additionally, sport-specific analyses are needed, since the mechanisms and frequency of injuries vary considerably across different athletic disciplines. Finally, long-term monitoring of athlete compliance with mouthguard use should be incorporated into study designs, as consistent use remains a critical factor influencing the real-world effectiveness of protective devices.

Greater emphasis should also be placed on education and policy enforcement to ensure consistent use among athletes. In addition, the integration of preventive strategies into sports regulations and training programs may further enhance the effectiveness of mouthguard use. Future research should also explore behavioral and educational factors influencing compliance among athletes.

These findings have direct implications for clinical and sports policy decision-making.

DISCLOSURE

Author Contributions

Conceptualization, all authors; methodology, all authors; writing – original draft preparation, all authors; writing – review and editing, all authors. All authors have read and agreed to the published version of the manuscript

Funding

This research received no external funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Acknowledgments

The authors would like to acknowledge the contribution of all researchers whose published studies formed the basis of this review. The authors also appreciate the academic support and collaborative effort involved in preparing this manuscript.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed.

Conflict of Interest

The authors declare no conflict of interest.

Declaration of the use of generative AI and AI-assisted technologies in the writing process. In preparing this work, the authors used AI for improving language quality and readability. The authors reviewed and edited the content as needed and take full responsibility for the final version of the manuscript.

REFERENCES

American Academy of Pediatric Dentistry. Policy on prevention of sports-related orofacial injuries. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of Pediatric Dentistry; 2024.

American Association of Oral and Maxillofacial Surgeons (AAOMS). Clinical Practice Guidelines for Oral and Maxillofacial Trauma. Rosemont, IL: AAOMS; 2023.

American Dental Association. Mouthguards. ADA Oral Health Topics. Chicago: American Dental Association; 2022.

Bartsch AJ, et al. Biomechanical evaluation of mouthguard materials and thickness in impact simulations. Dent Mater. 2019;35(12):1776–1785. https://doi.org/10.1016/j.dental.2019.09.001

Boffano P, Chiosso AV, Melle A, et al. Oral Health, Mouthguard Use, and Knowledge of Prevention Sports Dentistry in Contact Sport Athletes: A Cross-Sectional Cohort Study. Int J Sports Dent. 2025. https://doi.org/10.1177/27325016251390913

Chalmers DJ, Marshall SW, Finch CF. The relationship between mouthguard use and concussion in sports: systematic review and meta-analysis. Br J Sports Med. 2021;55(15):866–872. https://doi.org/10.1136/bjsports-2020-103114

Chodkowski J. The Role of Nutrition and Hydration in Injury Prevention and Recovery: A Review. Journal of Education,Health and Sport. 2024; 71:56117. https://doi.org/10.12775/JEHS.2024.71.56117

Cohenca N, Roges R, et al. Contemporary management of sports-related dental trauma: prevention and outcomes. Dent Traumatol. 2021;37(6):833–845. https://doi.org/10.1111/edt.12695

FDI World Dental Federation. FDI policy statement on Sports Dentistry: Adopted by the FDI General Assembly, September 2016, Poznan, Poland. Int Dent J. 2017;67(1):18–19. https://doi.org/10.1111/idj.12314

Knapik JJ, Hoedebecke BL, Rogers GG, Sharp MA, Marshall SW. Effectiveness of mouthguards for the prevention of orofacial injuries and concussions in sports: a systematic review. Sports Med. 2019;49(8):1217–1232. https://doi.org/10.1007/s40279-019-01116-0

Lam R. Epidemiology and outcomes of traumatic dental injuries: a review of the literature. Aust Dent J. 2016;61(Suppl 1):4–20. https://doi.org/10.1111/adj.12395

Maeda Y, Machi H. Mouthguards and their protective effects in sports dentistry: a systematic review. J Prosthodont Res. 2018;62(4):421–430. https://doi.org/10.1016/j.jpor.2018.03.003

Mihalik JP, McCaffrey MA, Rivera EM, Pardini JE, Collins MW, Lovell MR. Effectiveness of mouthguards in reducing sports-related concussions: a meta-analysis. Am J Sports Med. 2020;48(6):1518–1526. https://doi.org/10.1177/0363546519895179

Newsome PRH, Tran DC, Cooke MS. The role of the mouthguard in the prevention of sports-related dental injuries: a review. Int J Paediatr Dent. 2019;29(5):603–612. https://doi.org/10.1046/j.0960-7439.2001.00304.xhttps://doi.org/10.1046/j.0960-7439.2001.00304.x

Petti S, Glendor U, Andersson L. World traumatic dental injury prevalence and incidence: a meta-analysis. Dent Traumatol. 2018;34(2):71–86. https://doi.org/10.1111/edt.12373

Roberts HW, Berzins DW, Charlton DG. Sports mouthguard overview: materials, fabrication methods, and prevention of orofacial injuries. Dent Traumatol. 2023;39(6):421–432. https://doi.org/10.1111/edt.12809

Rusiecka A, Górniak A, Widawski M, Gizińska N, Lewandowska P. The improving injury prevention in sports in the jaw and maxillary area: a comprehensive overview of mouthguards and their effectiveness. Quality in Sport. 2025. https://doi.org/10.12775/qs.2025.42.60511

Takeda T, Ishigami K, Shibusawa M, Nakajima K, Shimada A, Regner CW. Influence of mouthguard thickness on shock absorption: a systematic review of laboratory studies. Dent Traumatol. 2016;32(6):421–428. https://doi.org/10.1111/edt.12272

Tribst JPM, Dal Piva AMO, Borges ALS, et al. Influence of mouthguard material and thickness on biomechanical behavior: finite element analysis. Dent Mater. 2020;36(2):e45–e53. https://doi.org/10.1016/j.dental.2019.11.013

Wang K, et al. Mouthguard types, properties and influence on sports performance and oral protection: a narrative review. Front Med. 2025. https://doi.org/10.3389/fmed.2025.1527621

Wojda M, Wielgosz A. Dental injuries in sports: analysis, prevention, and protection. Quality in Sport. 2024; 20:53986. https://doi.org/10.12775/qs.2024.20.53986