

# Policy on Prevention of Sports-Related Orofacial Injuries

## Latest Revision

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## Purpose

The American Academy of Pediatric Dentistry (AAPD) recognizes the prevalence of sports-related orofacial injuries in our nation's youth and the need for prevention. This policy is intended to educate dental professionals, health care providers, and educational and athletic personnel on the prevention of sports-related orofacial injuries.

## Methods

This policy was developed by the Clinical Affairs Committee, adopted in 1991<sup>1</sup>, and last revised by the Council on Clinical Affairs in 2018<sup>2</sup>. The revision of this policy is based upon a review of current dental and medical literature related to orofacial injuries, including their prevention. Literature searches of PubMed®/MEDLINE and Google Scholar databases were performed using the terms: sports injuries, injury prevention, dental injuries, orofacial injuries. Eighty-six articles met these criteria. The articles were evaluated by title and/or abstract and relevance to the prevention of sports-related orofacial injuries. The policies, recommendations, and listed references of the Academy for Sports Dentistry (ASD) and the International Association of Dental Traumatology were consulted as valuable resources in preparation of this document.

## Background

The tremendous popularity of organized youth sports and the high level of competitiveness have resulted in a significant number of dental and orofacial injuries.<sup>3,4</sup> From 1990-2003, an average of 22,000 dental injuries occurred annually in children younger than 18 years, a rate of approximately 31.6 injuries per 100,000 children and adolescents.<sup>5</sup> According to a 2020 health survey, 54.1 percent of children ages six through 17 years participated in sports during the previous year.<sup>6</sup>

All sporting activities have an associated risk of orofacial injuries due to falls, collisions, contact with hard surfaces, and contact from sports-related equipment. A systematic review reported between 10-61 percent of athletes experienced dental trauma.<sup>7</sup> A 10-year study of 3,385 craniomaxillofacial trauma cases presenting to an oral and maxillofacial surgery department found 31.8 percent of injuries in children occurred during sports activities.<sup>8</sup> Children ages 17 years and younger represented 80.6 percent of the total (sport- and nonsport-

related) dental injuries that presented to United States (U.S.) emergency rooms from 1990-2003, with the majority presented in children younger than seven years of age.<sup>5</sup> In all age groups, males were more likely to sustain dental injuries than females.<sup>5</sup>

Introducing mandatory protective equipment significantly reduces dental and orofacial injuries.<sup>9,10</sup> Sports that require protective equipment in the U.S. include high school field hockey, football, ice hockey, and lacrosse, in addition to wrestling for athletes wearing braces.<sup>11</sup> Popular sports such as baseball, basketball, soccer, softball, volleyball, and gymnastics lag far behind in injury protection. Baseball accounts for most injuries in the seven- to 12-year-old age group<sup>4</sup>; basketball has the highest incidence of sports-related dental injuries (2.4 per 100,000 athletic exposures) for high school boys.<sup>12</sup> For girls' high school athletics, the highest rate of injuries (3.5 per 100,000 athletic exposures) occurs in field hockey.<sup>12</sup> Youth participating in other activities such as skateboarding, inline or roller skating, and bicycling also benefit from appropriate protective equipment.<sup>13-16</sup> A large national survey confirmed the bicycle as the most common consumer sports product related to dental injuries in children, followed by playground equipment, other riding equipment (skates, inline skates), and trampolines.<sup>5</sup>

The use of the trampoline provides specialized training for certain sports. With recreational use, a considerable number of head and neck injuries occurs, most often a result of falls from the trampoline.<sup>17</sup> As a result of injury rates and catastrophic injuries associated with home use of trampolines, the American Academy of Pediatrics strongly discourages recreational trampoline use and limits support to structured and supervised training programs having safety precautions in place.<sup>17</sup>

Reported rates of dental and orofacial athletic injuries vary greatly depending on the size of the sample, the sample's geographic location, the ages of the participants, and the specific sports involved in the study.<sup>18-22</sup> Rates of traumatic dental injuries also differ in regards to the athlete's level of

## ABBREVIATIONS

**AAPD:** American Academy of Pediatric Dentistry. **ASD:** Academy of Sports Dentistry. **ASTM:** American Society for Testing and Materials. **U.S.:** United States.

competition; amateur athletes exhibit a higher prevalence of sports-related injuries than do professionals.<sup>19</sup> The National High School Sports-Related Injury Surveillance Study captures information such as exposure (competition vs. practice), the injury, details of the event, and type of protective equipment used.<sup>23</sup> Data from this source found that in 2020-2021 school year, of the 619,714 injuries reported during competition, 117,820 (19 percent) occurred to the head/face; another 73,818 occurred during practice.<sup>23</sup> A similar study using this database followed athletes from 2008-2014 and found the rate of dental injuries in competition was three times higher than in practice.<sup>23</sup> For the majority of these reported injuries, the athlete was not wearing a mouthguard.<sup>12,18</sup> Review of this database found the highest rates of dental injuries in high school athletes occurred in girls' field hockey and boys' basketball.<sup>18</sup> Although the statistics vary, many studies reported that dental and orofacial injuries occurred regularly and concluded that participation in sports carries a considerable risk of injury.<sup>8,14,21,22</sup>

The consequences of orofacial trauma for children and their families are substantial because of potential for pain, psychological effects, and economic implications. Children with untreated trauma to permanent teeth exhibit greater impacts on their daily living than those without any traumatic injury.<sup>24,25</sup> The yearly costs of all injuries, including orofacial injuries, sustained by young athletes have been estimated to be 500 million dollars<sup>26</sup> and as high as 1.8 billion dollars<sup>27</sup>. Significant costs can accrue over a patient's lifetime for restorative, endodontic, prosthodontic, implant, or surgical treatment(s) resulting from dentoalveolar trauma. It has been suggested that the lifetime cost of an avulsed tooth in a teenage athlete can reach \$20,000, exceeding the maximum benefits for most insurance companies.<sup>28</sup> Traumatic dental injuries have additional indirect costs that include children's hours lost from school and parents' hours lost from work, consequences that disproportionately burden lower income, minority, and non-insured children.<sup>29-32</sup>

The majority of sport-related dental and orofacial injuries affect the upper lip, maxilla, and maxillary incisors, with 50 to 90 percent of dental injuries involving the maxillary incisors.<sup>21,22,28,33</sup> The most common injuries in order of incidence are lacerations, crown fractures, and avulsions.<sup>8</sup> Crown fractures are the most common injury to permanent teeth<sup>34</sup>, followed by subluxations and avulsions.<sup>35</sup> Even with a mouthguard in place, dentoalveolar injuries still can occur.<sup>36</sup>

Identifying patients who participate in sports and recreational activities allows the healthcare provider to recommend and implement preventive protocols for individuals at risk for orofacial injuries. For example, basketball is one of the sports with the highest incidence of dental injury, but these injuries usually involve player-player contact whereas greater than 87 percent of all dental injuries sustained by baseball, softball, and field hockey players are due to player-object contact.<sup>12</sup>

The frequency of dental trauma is significantly higher for children with increased overjet (greater than three millimeters

in the primary dentition and greater than five millimeters in the permanent dentition) and inadequate lip coverage.<sup>37-39</sup> A dental professional may be able to modify these risk factors. Initiating preventive orthodontic treatment in early- to middle-mixed dentition of patients with an overjet greater than three millimeters has the potential to reduce the severity of traumatic injuries to permanent incisors.<sup>38</sup>

Although some sports-related traumatic injuries are unavoidable, most can be prevented.<sup>40-42</sup> Helmets, facemasks, and mouthguards have been shown to reduce both the frequency and severity of dental and orofacial trauma.<sup>42</sup> While facemasks may not significantly reduce the risk of orofacial trauma due to player-player contact, they have shown a risk reduction with player-object contact.<sup>10</sup> The protective and positive results of wearing a mouthguard have been demonstrated in numerous epidemiological surveys and tests.<sup>19,43-46</sup> However, few sports have regulations that require their use. The National Federation of State High School Associations mandates mouthguards only for football, ice hockey, lacrosse, and field hockey and for wrestlers wearing braces.<sup>11</sup> Several states have attempted to increase the number of sports which mandate mouthguard use, with various degrees of success and acceptance. Three states (Maine, Massachusetts, and New Hampshire) have been successful in increasing the number of sports requiring mouthguard use to include sports such as soccer, wrestling, and basketball.<sup>47</sup> The mandated mouthguard rule likely has not expanded to other sports due to complaints by athletes, parents, and coaches that mouthguards interfere with how the game is played and the athletes' enjoyment.<sup>48,49</sup> Regardless of the relatively limited use of mouthguards in sports, the American Dental Associations and International Academy of Sports Dentistry currently recommend the use of mouthguards in 29 sports or activities.<sup>48,49</sup>

Initially used by professional boxers, the mouthguard has been used as a protective device since the early 1900s.<sup>7,21,50</sup> The mouthguard, also referred to as a gumshield or mouth protector, is defined as a "resilient device or appliance placed inside the mouth to reduce oral injuries, particularly to teeth and surrounding structures."<sup>51</sup> The mouthguard was constructed to "protect the lips and intraoral tissues from bruising and laceration, to protect the teeth from crown fractures, root fractures, luxations, and avulsions, to protect the jaw from fracture and dislocations, and to provide support for edentulous space."<sup>52</sup> The mouthguard helps to prevent fractures and dislocations of teeth by providing cushioning from the blow and redistributing shock during forceful impacts and decreases the likelihood of jaw fracture by a similar mechanism and also by stabilizing the mandible.<sup>53</sup> The mouthguard acts as a buffer between the soft and hard dento-oral structures to prevent soft tissue injuries by separating the teeth from the tissues.<sup>53</sup> Data suggest that a properly fitted mouthguard of 3.0 millimeter thickness might reduce the incidence of concussion injuries from a blow to the jaw by positioning the jaw to absorb the impact forces which, without it, would be transmitted through the skull base to the brain.<sup>54</sup>

The American Society for Testing and Materials (ASTM) classifies mouthguards by three categories<sup>55</sup>:

1. Type I – Custom-fabricated mouthguards are produced on a dental model of the patient's mouth by either the vacuum-forming or heat-pressure lamination technique.<sup>42</sup> The ASTM recommends that for maximum protection, cushioning, and retention, the mouthguard should cover all teeth in at least one arch, customarily the maxillary arch, less the third molar.<sup>55</sup> A mandibular mouthguard is recommended for individuals with a Class III malocclusion.<sup>56</sup>
2. Type II – Mouth-formed, also known as boil-and-bite, mouthguards are made from a thermoplastic material adapted to the mouth by finger, tongue, and biting pressure after immersing the appliance in hot water.<sup>51</sup> Available commercially at department and sporting-goods stores as well as online, these are the most used among athletes but vary greatly in protection, retention, comfort, and cost.<sup>42</sup>
3. Type III – Stock mouthguards are purchased over-the-counter. They are designed for use without any modification and must be held in place by clenching the teeth together to provide a protective benefit.<sup>43</sup> Clenching a stock mouthguard in place can interfere with breathing and speaking and, for this reason, stock mouthguards are considered by many to be less protective.<sup>57</sup> Despite these shortcomings, the stock mouthguard could be the only option possible for patients with particular clinical presentations (e.g., use of orthodontic brackets and appliances, periods of rapidly changing occlusion during mixed dentition).<sup>58,59</sup>

The custom-fabricated type is superior in retention, protection, and comfort.<sup>42,53,59-62</sup> When this type is not available, the mouth-formed mouthguard is preferable to the stock or preformed mouthguard.<sup>59,63-65</sup>

The ASD “recommends the use of a properly fitted mouthguard. It encourages the use of a custom fabricated mouthguard made over a dental cast and delivered under the supervision of a dentist. The ASD strongly supports and encourages a mandate for use of a properly-fitted mouthguard in all collision and contact sports.”<sup>56</sup> During fabrication of the mouthguard, establishing proper anterior occlusion of the maxillary and mandibular arches is recommended as this will prevent or reduce injury by better absorbing and distributing the force of impact.<sup>56</sup> Additional considerations include the patient's vertical dimension of occlusion, personal comfort, and breathing ability.<sup>64</sup> By providing cushioning between the maxilla and mandible, mouthguards also may reduce the incidence or severity of condylar displacement injuries as well as the potential for concussions.<sup>54,66</sup>

Due to the continual shifting of teeth in orthodontic therapy, the exfoliation of primary teeth, and the eruption of

permanent teeth, a custom-fabricated mouthguard may not fit the young athlete soon after the impression is obtained.<sup>67</sup> Several block-out methods used in both the dental operatory and laboratory may incorporate space to accommodate for future tooth movement and dental development.<sup>67</sup> By anticipating required space changes, a custom fabricated mouthguard may be made to endure several sports seasons.<sup>67</sup>

Parents play a vital role in the acquisition and use of a mouthguard for young athletes. In a 2004 national fee survey, custom mouthguards ranged from \$60 to \$285.54.<sup>68</sup> In a study to determine the acceptance of the three types of mouthguards by seven- and eight-year-old children playing soccer, only 24 percent of surveyed parents were willing to pay \$25 for a custom mouthguard.<sup>68</sup> Thus, cost may be a barrier.<sup>68</sup> However, a more likely barrier may be that children do not accept mouthguard use easily. In a study of children receiving mouthguards at no cost, 29 percent never wore the mouthguard, 32 percent wore it occasionally, 15.9 percent wore it initially but quit wearing it after one month, and only 23.2 percent wore the mouthguard when needed.<sup>69</sup>

Attitudes of officials, coaches, parents, and players about wearing mouthguards influence their usage.<sup>48</sup> Although coaches are perceived as the individuals with the greatest impact on whether or not players wear mouthguards, parents view themselves as equally responsible for maintaining mouthguard use.<sup>48,70</sup> However, surveys of parents regarding the indications for mouthguard usage reveal a lack of complete understanding of their benefits.<sup>70</sup> Compared to other forms of protective equipment, mouthguard use received only moderate parental support in youth soccer programs.<sup>71</sup> A 2009 survey commissioned by the American Association of Orthodontists reported that 67 percent of parents stated their children do not wear a mouthguard during organized sports.<sup>72</sup> The survey also found that 84 percent do not wear mouthguards while participating in organized sports because it is not required, even though other protective equipment (e.g., helmets, shoulder pads) is mandatory.<sup>72</sup> Players' perceptions of mouthguard use and comfort largely determine their compliance and enthusiasm.<sup>55,73-75</sup> Although a recent systematic review found athletic performance is neither impaired nor improved when wearing a custom-made mouthguard<sup>76</sup>, more research is needed to address gaps related to athletic performance and mouthguard use.<sup>77,78</sup>

Realizing athletes' speech as a potential hindrance to mouthguard compliance, the ASD recommends that a properly-fitted mouthguard should provide for adequate speech commiserate with the playing status of the athlete.<sup>56</sup> Given the multiple reasons for lack of compliance in wearing mouthguards, the dental profession needs to influence and educate all stakeholders about the risk of sports-related orofacial injuries and available preventive strategies.<sup>55,65,79</sup> Routine dental visits can be an opportunity to initiate patient/parent education and make appropriate recommendations for use of a properly-fitted athletic mouthguard.

## Policy statement

The AAPD encourages:

- dentists to play an active role in educating the public in the use of protective equipment for the prevention of orofacial injuries during sporting and recreational activities.
- continuation of preventive practices instituted in youth, high school, and college football, lacrosse, field hockey, ice hockey, and wrestling (for wrestlers wearing braces).
- an ASTM-certified face protector be required for youth participating in baseball and softball activities.
- mandating the use of properly-fitted mouthguards in other organized sporting activities that carry risk of orofacial injury.
- coaches/administrators of organized sports to consult a dentist with expertise in orofacial injuries prior to initiating practices for a sporting season regarding recommendations for immediate management of sports-related injuries (e.g., avulsed teeth).
- continuation of research in development of a comfortable, efficacious, and cost-effective sports mouthguard to facilitate more widespread use of this proven protective device.
- dentists to provide education to parents and patients regarding prevention of orofacial injuries as part of the anticipatory guidance discussed during dental visits.
- dentists to prescribe, fabricate, or provide referral for mouthguard protection for patients at increased risk for orofacial trauma.
- third-party payors to realize the benefits of mouthguards for the prevention and protection from orofacial sports-related injuries and, furthermore, to improve access to these services.
- pediatric dentists to partner with other dentists and child health professionals, school administrators, legislators, and community sports organizations to promote the broader use of mouthguards.
- pediatric dental departments to teach dental students to fabricate custom-fitted mouthguards.

## References

1. American Academy of Pediatric Dentistry. A position statement on the prevention of sports-related injuries. Reference Manual 1991-1992. Chicago, Ill.: American Academy of Pediatric Dentistry; 1991:38.
2. American Academy of Pediatric Dentistry. Policy on prevention of sports-related orofacial injuries. *Pediatr Dent* 2018;40(6):86-91.
3. Castaldi CR. Athletic mouthguards: History and present status. *Sports Med Digest* 1988;10:1-2.
4. Castaldi CR. Sports-related oral and facial injuries in the young athlete: A new challenge for the pediatric dentist. *Pediatr Dent* 1986;8(4):311-6.
5. Stewart GB, Shields BJ, Fields S, Comstock RD, Smith GA. Consumer products and activities associated with dental injuries to children treated in United States emergency departments 1990-2003. *Dent Traumatol* 2009;25(4):399-405.
6. Black LI, Terlizzi EP, Vahratian A. Organized Sports Participation Among Children Aged 6-17 Years: United States, 2020. NCHS Data Brief, Number 441. August 2022. Available at: "<https://www.cdc.gov/nchs/products/databriefs/db441.htm#:~:text=In%202020%2C%2054.1%25%20of%20children%20aged%206%2D17%20years,in%20the%20past%2012%20months>". Accessed February 6, 2023.
7. Knapik JJ, Marshall SW, Lee RB, et al. Mouthguards in sport activities: History, physical properties and injury prevention effectiveness. *Sports Med* 2007;37(2):117-44.
8. Gassner R, Tuli T, Hächl O, Moreira R, Ulmer H. Craniomaxillofacial trauma in children: A review of 3,385 cases with 6,060 injuries in 10 years. *J Oral Maxillofac Surg* 2004;62(4):399-407.
9. Black AM, Patton DA, Eliason PH, Emery CA. Prevention of sport-related facial injuries. *Clin Sports Med* 2017;36(2):257-78.
10. Carniol ET, Shaigany K, Svider PF, et al. "Beaned": A 5-year analysis of baseball-related injuries of the face. *Otolaryn Head Neck Surg* 2015;153(6):957-61.
11. National Federation of State High School Associations, Sports Medicine Advisory Committee. Position statement and recommendations for mouthguard use in sports. 2022. Available at: "<https://www.nfhs.org/media/6553348/position-statement-and-recommendations-for-mouth-guard-use-in-sports-october-2022-final.pdf>". Accessed February 6, 2023.
12. Azadani EN, Peng J, Townsend JA, Collins CL. Traumatic dental injuries in high school athletes in the United States of America from 2005 to 2020. *Dent Traumatol* 2023;39(2):109-18. Available at: "<https://onlinelibrary.wiley.com/doi/full/10.1111/edt.12800>". Accessed March 13, 2023.
13. Fasciglione D, Persic R, Pohl Y, Fillippi A. Dental injuries in inline skating – Level of information and prevention. *Dent Traumatol* 2007;23(3):143-8.
14. Finnoff JT, Laskowski ER, Altman KC, Diehl NW. Barriers to bicycle helmet use. *Pediatrics* 2001;108(1):4-10.
15. Ranalli DN. Prevention of sports-related dental traumatic injuries. *Dent Clin North Am* 2000;44(1):35-51.
16. Tesini DA, Soporowski NJ. Epidemiology of orofacial sports-related injuries. *Dent Clin North Am* 2000;44(1):1-18.
17. American Academy of Pediatrics, Briskin S, LaBotz M, Council on Sports Medicine and Fitness. Policy statement on trampoline safety in childhood and adolescence. *Pediatrics* 2012;130(4):774-9. Reaffirmed August 2021.
18. Collins CL, McKenzie LB, Ferketich AK, Andridge R, Xiang H, Comstock RD. Dental injuries sustained by high school athletes in the United States, from 2008/2009 through 2013/2014 academic years. *Dent Traumatol* 2016;32(2):121-7.

*References continued on the next page.*



19. Glendor U. Aetiology and risk factors related to traumatic dental injuries: A review of the literature. *Dent Traumatol* 2009;25(1):19-31.
20. Huang B, Wagner M, Croucher R, Hector M. Activities related to the occurrence of traumatic dental injuries in 15- to 18-year-olds. *Dent Traumatol* 2009;25(1):64-8.
21. Kumamoto D, Maeda Y. A literature review of sports-related orofacial trauma. *Gen Dent* 2004;52(3):270-80.
22. Kumamoto D, Maeda Y. Global trends and epidemiology of sports injuries. *J Pediatr Dent Care* 2005;11(2):15-25.
23. Datalys Center for Sports Injury Prevention. National High School Sports-Related Injury Surveillance Study 2021-22 School Year. Available at: "<http://datalyscenter.org/wpcontent/uploads/2023/01/2021-22-High-School-RIO-ORIGINAL-Summary-Report.pdf>". Accessed February 6, 2023.
24. Berger TD, Kenny DJ, Casas MJ, Barrett EJ, Lawrence HP. Effects of severe dentoalveolar trauma on the quality-of-life of children and parents. *Dent Traumatol* 2009; 25(5):462-9.
25. Cortes M, Marcenes W, Sheiham A. Impact of traumatic injuries to the permanent teeth on the oral health-related quality of life in 12-14-year-old children. *Community Dent Oral Epidemiol* 2002;30(3):193-8.
26. Welch CI, Thomson WM, Kenned R. ACC claims for sports-related dental trauma from 1999-2008: A retrospective analysis. *N Z Dent J* 2010;106(2):137-42.
27. Adirim T, Cheng T. Overview of injuries in the young athlete. *Sports Med* 2003;33(1):75-81.
28. Piccininni P, Clough A, Padilla R, Piccininni G. Dental and orofacial injuries. *Clin Sports Med* 2017;36(2): 369-405.
29. Gift HC, Reisine ST, Larach DC. The social impact of dental problems and visits. *Am J Public Health* 1992;82 (12):1663-8.
30. McIntyre JD, Lee JY, Trope M, Vann WF. Elementary school staff knowledge about dental injuries. *Dent Traumatol* 2008;24(3):289-98.
31. Nguyen PM, Kenny DJ, Barret EJ. Socio-economic burden of permanent incisor replantation on children and parents. *Dent Traumatol* 2004;20(3):123-33.
32. Sane J, Ylipaavalniemi P, Turtola L, Niemi T, Laaka V. Traumatic injuries among university students in Finland. *J Am Coll Health* 1997;46(1):21-4.
33. Takeda T, Ishigami K, Nakajima K, et al. Are all mouthguards the same and safe to use? Part 2. The influence of anterior occlusion against a direct impact on maxillary incisors. *Dent Traumatol* 2008;24(3):360-5.
34. Ranalli DN. Dental injuries in sports. *Curr Sports Med Rep* 2005;4(1):12-7.
35. Cohenca N, Roges RA, Roges R. The incidence and severity of dental trauma in intercollegiate athletes. *J Am Dent Assoc* 2007;138(8):1121-6.
36. Labella CR, Smith BW, Sigurdsson A. Effect of mouthguards on dental injuries and concussion in college basketball. *Med Sci Sports Exerc* 2002;34(1):41-4.
37. Arraj GP, Rossi-Fedele G, Doğramacı EJ. The association of overjet size and traumatic dental injuries-A systematic review and meta-analysis. *Dent Traumatol* 2019;35(4-5): 217-32.
38. Bauss O, Rohling J, Schweska-Polly R. Prevalence of traumatic injuries to the permanent incisors in candidates for orthodontic treatment. *Dent Traumatol* 2004;20(2): 61-6.
39. Forsberg C, Tedestam G. Etiological and predisposing factors related to traumatic injuries to permanent teeth. *Swed Dent J* 1993;17(5):183-90.
40. BMJ Journals. 1st World Congress of Sports Injury Prevention. Abstracts. *Br J Sports Med* 2005;39(6):373-408.
41. Mills S. Can we mandate prevention? *J Pediatr Dent Care* 2005;11(2):7-8.
42. Ranalli DN. Sports dentistry in general practice. *Gen Dent* 2000;48(2):158-64.
43. Maeda Y, Kumamoto D, Yagi K, Ikebe K. Effectiveness and fabrication of mouthguards. *Dent Traumatol* 2009; 25(6):556-64.
44. Ozawa T, Tomotaka T, Ishigami K, et al. Shock absorption ability of mouthguard against forceful, traumatic mandibular closure. *Dent Traumatol* 2014;30(3):204-10.
45. Ranalli DN. Sports dentistry and dental traumatology. *Dent Traumatol* 2002;18(5):231-6.
46. Takeda T, Ishigami K, Mishima O, et al. Easy fabrication of a new type of mouthguard incorporating a hard insert and space and offering improved shock absorption ability. *Dent Traumatol* 2011;27(6):489-95.
47. Academy for Sports Dentistry. What states mandate mouthguards? Available at: "[https://www.academyforsportsdentistry.org/faq-s#What\\_states\\_mandate\\_mouthguards](https://www.academyforsportsdentistry.org/faq-s#What_states_mandate_mouthguards)". Accessed March 13, 2023.
48. Gardiner D, Ranalli DN. Attitudinal factors influencing mouthguard utilization. *Dent Clin North Am* 2000;44 (1):53-65.
49. Mills SC. Mandatory mouthguard rules for high school athletes in the United States. *Gen Dent* 2015;63(6): 35-40.
50. Mayer C. Tooth protectors for boxers. *Oral Hyg* 1930; 20:298-9.
51. Newsome P, Tran D, Cooke M. The role of the mouthguard in the prevention of sports-related dental injuries: A review. *Int J Paediatr Dent* 2001;11(6):396-404.
52. Biasca N, Wirth S, Tegner Y. The avoidability of head and neck injuries in ice hockey: A historical review. *Br J Sports Med* 2002;36(6):410-27.
53. Deogade SC, Dube G, Sumathi K, Dube P, Katare U, Katare D. Sports dentistry and mouthguards. *Brit J Med Med Res* 2016;11(6):1-10.

54. Winters J, DeMont R. Role of mouthguards in reducing mild traumatic brain injury/concussion incidence in high school athletes. *Gen Dent* 2014;62(3):34-8.
55. American Society for Testing and Materials. ASTM F697-16. Standard practice for care and use of athletic mouth protectors. West Conshohocken, Pa.: 2016. Available at: "<https://www.astm.org/Standards/F697.htm>". Accessed February 6, 2023.
56. Academy for Sports Dentistry. Position statement. 2019 Available at: "<https://www.academyforsportsdentistry.org/position-statement>". Accessed February 6, 2023.
57. American Dental Association. The importance of using mouthguards: Tips for keeping your smile safe. *J Am Dent Assoc* 2004;135(7):1061.
58. Ranalli DN. Prevention of craniofacial injuries in football. *Dent Clin North Am* 1991;35(4):627-45.
59. Duddy FA, Weissman J, Lee RA Sr, Paranipe A, Johnson JD, Cohenca N. Influence of different types of mouthguards on strength and performance of collegiate athletes: A controlled-randomized trial. *Dent Traumatol* 2012;28(4):263-7.
60. Greasley A, Imlach G, Karet B. Application of a standard test to the in vitro performance of mouthguards. *Br J Sports Med* 1998;32(1):17-9.
61. McClelland C, Kinirons M, Geary L. A preliminary study of patient comfort associated with customised mouthguards. *Br J Sports Med* 1999;33(3):186-9.
62. Warner L, Greasley A. Transient forces generated by projectiles on variable quality mouthguards monitored by instrumented impact testing. *Br J Sports Med* 2001;35(4):257-62.
63. Bureau of Dental Health Education and Bureau of Economic Research and Statistics. Evaluation of mouth protectors used by high school football players. *J Am Dent Assoc* 1964;68(3):430-42.
64. DeYoung AK, Robinson E, Godwin WC. Comparing comfort and wearability: Custom-made vs. self-adapted mouthguards. *J Am Dent Assoc* 1994;125(8):1112-8.
65. Patrick DG, van Noort R, Found MS. Scale of protection and the various types of sports mouthguard. *Br J Sports Med* 2005;39(5):278-81. Available at: "<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1725211/pdf/v039p00278.pdf>". Accessed May 29, 2023.
66. Waliko T, Bir C, Godwin W, King A. Relationship between temporomandibular joint dynamics and mouthguards: Feasibility of a test method. *Dent Traumatol* 2004;20(5):255-60.
67. Croll T, Castaldi CR. Custom sports mouthguard modified for orthodontic patients and children in the transitional dentition. *Pediatr Dent* 2004;26(5):417-20.
68. Walker J. Parents plus: Getting mouthguards into kids' mouths. *J Pediatr Dent Care* 2005;11(2):39-40.
69. Matalon V, Brin I, Moskovitz M, Ram D. Compliance of children and youngsters in the use of mouthguards. *Dental Traumatol* 2008;24(4):462-7.
70. Diab N, Mourino A. Parental attitudes toward mouthguards. *Pediatr Dent* 1997;19(8):455-60.
71. Khodae M, Fettes MD, Gorenflo DW. Football (soccer) safety equipment use and parental attitudes toward safety equipment in a community youth sports program. *Res Sports Med* 2011;19(2):129-43.
72. American Association of Orthodontists. Play it Safe: Prevent Childhood Injuries on the Field with Simple Sports Safety Precautions. Press Release April 2, 2012. Available at: "<https://www.prnewswire.com/news-releases/play-it-safe-prevent-childhood-injuries-on-the-field-with-simple-sports-safety-precautions-145788985.html>". Accessed May 1, 2023.
73. Gawlak D, Mańka-Malara K, Kamiński T, Łuniewska M, Mierzwinska-Nastalska E. Comparative evaluation of custom and standard boil and bite (self-adapted) mouthguards and their effect on the functioning of the oral cavity. *Dent Traumatol* 2016;32(5):416-20.
74. Raaij F, Vaidya N, Vaidya K, et al. Patterns of mouthguard utilization among atom and pee wee minor ice hockey players: A pilot study. *Clin J Sport Med* 2011;21(4):320-4.
75. Walker J, Jakobsen J, Brown S. Attitudes concerning mouthguard use in 7- to 8-year-old children. *J Dent Child* 2002;69(2):207-11.
76. Ferreira GB, Guimarães LS, Fernandes CP, et al. Is there enough evidence that mouthguards do not affect athletic performance? A systematic literature review. *Int Dent J* 2019;69(1):25-34. Available at: "<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9379066/pdf/main.pdf>". Accessed March 17, 2023.
77. Gallagher J, Fine P, Ashley P, Needleman I. Developing the role of the sports dentist. *Br Dent J* 2021;231(9):544-6. Available at: "<https://pubmed.ncbi.nlm.nih.gov/34773016/>". Accessed March 15, 2023.
78. Parrini S, Rossini G, Nebiolo B, et al. Variations in athletic performance with occlusal splint in track and field athletes: A randomized clinical trial. *J Med Phys Fitness* 2022;62(3):375-81.
79. Woodmansey K. Athletic mouth guards prevent orofacial injuries: A review. *Gen Dent* 1999;47(1):64-9.