A Mouthguard Fabrication Technique for Contemporary Sports Dentistry

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EXAM #16

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Since 1980, there have been more than 400 articles in the health science literature on topics relating to sports dentistry and athletics. These publications predominately have dealt with the fabrication, efficacy, and use of intraoral mouthguards. This manuscript focuses on reviewing current applications and standards for oral protectors and presenting a modern method of fabrication.

There is great correlation regarding the large percentage of children participating in organized sports and the prevalence of orofacial injuries.[1] Multiple survey data implies a significant reduction in the presence or severity of related injuries when a mouthguard is being worn by the participant.[2,3,4,5] The American Dental Association endorses the use of orofacial protectors by all participants in recreational sports activities with a significant risk of injury at all levels of competition, including practice sessions, physical education, and intramural programs.[6,7] Despite the overwhelming evidence of preventive benefits, few states officially mandate the use of mouthguards for sports other than football.[8]

According to the Academy of Sports Dentistry, an optimal athletic mouthguard should possess: 1) adequate thickness in all areas to provide for the reduction of impact forces; 2) a fit that is retentive and not dislodged on impact; 3) speech considerations equal to the demands of the playing status of the athlete; 4) a construction material that meets FDA approval and 5) useful wearing-time equal to one season of play.[9]

Not all mouthguards are created equal. Traditional sized stock guards or thermoplastic (self-adapting) guards, available commercially, do not have the mechanical or physical properties inherent to a custom-made device. Superior fit, adaptation and retention of a professionally provided custom guard, made from an accurate cast replica of the mouth, is well documented.[10,11] The most widely used and studied material for construction of a custom guard is ethylene vinyl acetate (EVA). Proprietary products vary in formulations, color and thickness. Research suggests an ideal Shore hardness of 80 and an ideal protective thickness, facially and occlusally, of 3-5 millimeters for an optimal EVA mouthguard.[12] Variations in mouthguard design have been suggested, depending on the nature and potential impact severity encountered in specific sports. Manipulation of the EVA material in the construction of custom-made mouthguards can produce such features.[13]

There are two types of thermoforming machines used in the construction of custom guards. The traditional apparatus employs the use of a vacuum table to adapt the heated EVA material to the cast. More recent formers apply the material to the cast by use of pressure and allows for multiple layer construction. This technology can create guards which are the most tailored and demonstrate significantly improved cast adaptation, resilience, and elastic proportional limits.[14] The following section describes a modern technique for

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

mouthguard construction demonstrating this technology.

A cast in low expansion stone (Resin Rock, Whipmix, USA) is derived from an accurate, fully-extended, alginate impression, set for 24 hours, and trimmed to a thickness representing the eventual extension of the mouthguard. (**Figure 1**.) The ideal cast height should be minimal for optimal adaptation of the EVA material. The cast is coated with silicone spray (Dentsply, USA) and allowed to dry. The pressure laminating machine (Biostar, Greatlakes Orthodontics LTD, USA) is set for the application of a 2 mm layer of EVA material and the cast is placed on the sample platform (**Figure 2**.) The heating cycle is reached and the pressure chamber attached to the platform (**Figure 3**.) Cooling ensues for 2 minutes prior to removal.

The applied EVA layer is separated from the cast and trimmed with surgical scissors to 1-2 mm from the border of the cast (**Figure 4**). The margins are refined and palatal thickness thinned using a small felt wheel (Komet, USA) at 2000-4000 rpm (**Figure 5**). The formed material is relocated to the cast and placed in a low heat oven at 250°F for 2-3 minutes, just until the surface becomes tacky. At this time a decal or logo can be placed on the initial layer (**Figure 6**). As an alternative to reheating, a solvent may be applied to help adhere the subsequent layer.

While still in the heated state, the assembly is placed again on the sample platform and another 2 mm layer adapted as before (**Figure 7**). The laminated form is removed and trimmed again, this time to the extent of the cast border. The edges are refined with the felt wheel and finished by applying burnished heat with a butane micro torch (Blazer, USA) (**Figure 8**). The finished mouthguard (**Figure 9**) can be tried in the mouth and adjusted for fit and occlusion.

There have been markedly demonstrated improvements in mouthguard construction in the last several years. Even so, the custom-fitted mouthguard represents only about 10 percent of all devices used in sports despite the documented incidence of athletic oral injuries. The cost of such a device is small compared to the expense, pain and suffering to resolve a significant oral injury. Compliance is also an issue with the young athlete and the importance of consistently wearing such oral protectors. There have been additional potential benefits of oral devices suggested which include enhancement of athletic performance and the avoidance of concussion and mandibular fracture, which may prove to encourage use. It is the dental profession's responsibility to educate and promote oral safety and the benefits of optimally constructed mouthguards in the prevention and reduction of sports injuries.

References:

1. Hayrien-Immonen, R, et.al., A Six Year Follow-Up Study of Sports Related Dental Injuries in Children and Adolescents. Endod Dent Tramatol 1990;6(5):208-12.
2. Johnsen DC, Winters JE. Prevention of Intraoral Trauma in Sports. Dent Clin North Amer 1991;35(4):657-66.
3. Kerr IL. Mouth Guards for the Prevention of Injuries in Contact Sports. Sports Med 1986;3(6);415-27.
4. Padilla R, Dorney B, Balikov S. Prevention of Oral Injuries. J Calif Dent Assoc 1996;24(3):30-6.
5. Woodmansey KF. Athletic Mouthguards Prevent Orofacial Injuries: A Review. Gen Dent 1999;47(1):64-9.
6. American Dental Association. Resolution 39-1960-H: Mouth Protectors. Transactions 1960:233-4.
7. American Dental Association. Amendment on Policy of Orofacial Protectors. Transactions 1995:613-4.
8. U.S. Department of Health and Human Services. Oral Health in America. A Report of the Surgeon General. National Institute of Dental and Craniofacial Research; 2000.
9. Academy for Sports Dentistry, Board of Directors' position statement. 1998.
10. Hoffman J, et.al., Experimental Comparative Study of Various Mouthguards. Endo Dent Tramatol 1999;15(4):157-63.
11. DeYoung AK, et.al., Comparing Comfort and Wearability: Custom-Made vs.Self-Adapted Mouthguards. JADA 1994;125(8): 1112-8.
12. Tran D, Cooke M, Newsome P. Laboratory Evaluation of Mouthguard Material. Dent Tramatol 2008;17(6): 260-5.
13. Duhaime C, et.al., Comparison of Forces Transmitted Through Different EVA Mouthguards. Dent Tramatol 2006; 22(4):186-192.
14. Miura J, et.al., Mouthguards: Difference in Longitudinal Dimensional Stability Between Single- and Double-Laminated Fabrication Techniques. Dent Tramatol 2006; 23(1): 9-13.

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Figure 7

Figure 8

Figure 9

Questions for Continuing Education Article - CE Exam #16

1. There have been more than 400 articles dealing with sports dentistry and athletics since:
   a. 1980
   b. 1985
   c. 1990
   d. 1995

2. Orofacial injuries sustained in athletic events correlates well with:
   a. football events only
   b. soccer and football
   c. adult males only
   d. the large percentage of children playing sports

3. The American Dental Association recommends the use of orofacial protectors:
   a. in all sports
   b. for sports with significant injury risks
   c. for all age groups
   d. in football and basketball

4. With the overwhelming evidence for preventive use of mouthguards:
   a. few states mandate their use
   b. all states mandate their use
   c. only colleges mandate their use
   d. only professional sports mandate their use

5. The most widely-used material for mouthguard construction is:
   a. EVA
   b. Alginate
   c. PCA
   d. THA

6. The ideal Shore hardness for a mouthguard is:
   a. 20
   b. 80
   c. 60
   d. 50

7. For optimum performance a mouthguard made of EVA should be:
   a. 1-2 mm thick
   b. 3-5 mm thick
   c. 6-8 mm thick
   d. <1mm thick

8. The edges of a mouthguard can be finished smoothly by:
   a. an acrylic lab bur
   b. a high-speed cross-cut fissure bur
   c. a felt wheel and butane torch
   d. a high-speed diamond

9. Custom-fitted mouthguards account for what percentage of all mouthguards:
   a. half
   b. 75%
   c. 10%
   d. 50%

10. Which of the following is not a proposed additional advantage to wearing a mouthguard:
    a. enhancement of athletic performance
    b. prevention of mandibular fracture
    c. prevention of zygomatic fracture
    d. prevention of concussion

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