A Technique For Fabricating Modern Athletic Mouthguards

BY RAY R. PADILLA, DDS

ABSTRACT

The prevention and treatment of orofacial trauma is now a very important part of the general practice.1,2 Children as well as adults are participating more in events where the probability of trauma is apparent. Attendance at health clubs and gymnasiums is on the rise. With the increase in sports participation comes an increase in orofacial injuries.3 The general population is taking its health more seriously. Athletic participation is on the rise, and Title IX has introduced increased female participation at all levels. This only increases the possibility that our patients will present themselves in our offices with the need for trauma treatment and also our opinions on the methods of preventing such traumatic experiences.4

The field of sports and trauma dentistry has come a long way in recent years. Dentistry is now represented on various medical commissions and organizations as a viable component of the total package of prevention and treatment of orofacial injuries. Internationally, dentistry is represented on the International Olympic Committee’s Medical Commission and the International Ice Hockey Federation Medical Commission. In 1998, the International Society for Dentistry, Sport and Trauma was introduced as the need for international trauma dentists increased. In the United States, the Academy for Sports Dentistry was continuing to grow and provide insight on trauma treatment and prevention.

The general dentist is now being asked by their patients for their opinions on prevention of athletic injuries. In the past, patients would feel comfortable going to the local sporting goods stores to obtain mouth/dental guard protection. This is no longer the case. As the population becomes more and more educated on injury prevention and the availability of proven methods of prevention, the general dentist will be called on to provide a more viable responsible solution for orofacial trauma prevention. The medical/dental literature now provides many references for the probability and treatment of trauma.5-12

The numbers, incidences and severity of trauma leads us to contemplate ways of preventing such injuries. Presently, the use and acceptance of preventive mouthguards is gaining on the general dentist’s list of priorities. More general dentists are now providing custom-made mouthguards to their patients. However, there are still a significant number of dentists who do not provide this service to their regular patients. Dentist’s knowledge and attitudes toward providing protective mouthguards is well documented. Parental perceptions of mouthguards is an important issue that dentists needs to identify and manage.13,14 Overcoming objections of cost, custom-made vs. store-bought, vacuum vs. pressure, and availability is critical to the education of dentists, staff and patients.15 Patient education is essential to the success of trauma prevention. The dental hygienist here may play a critical role in this education during routine periodontal treatment.16

There are basically three types of athletic mouthguards presently available, all significantly different in fit, comfort and acceptance. Type I is the stock mouthguard available at sporting goods stores. These are the least desirable and acceptable. There is no attempt at fit. Remove from package and place in mouth. Type II refers to the common boil and bite mouthguard. These are also mostly of the store-bought variety and some attempt at fit is made by boiling the mouthguard and trying to mold it to the teeth. The instability and uneven distribution of material does not lend themselves to proper fit and protection. In a study by Dr. Andrew Greasley on the difference between various types of mouthguards, the custommade mouthguards all performed better than the “boil and bite type which afforded only slightly more protection than no mouthguard at all.”17

Chapman and McNutt reported many occurrences of injuries while wearing the over the counter Types I and II variety of mouthguards.18,19 In literature reviews by the author, there were no published data and support found for stock and boil and bite mouthguards after 1980. The literature makes it very clear that only custom-made mouthguards should be offered to patients.

The literature cites occurrences of injuries while wearing noncustom-made mouthguards.

Chapman in 1991 reported as high as 36 percent of the athletes who wore mouthguards while playing at the Second Rugby World Cup, sustained some type of orofacial injury.20 McNutt in 1989 reported that of the 1,470 surveyed American Football players, 52 athletes were injured wearing mouthguards, and 53 were injured without a mouthguard. The injury rate is the same for those wearing mouthguards and those who were not wearing mouthguards. They were the same as wearing nothing.21

There are two types of Type III custom-made mouthguards presently available, those made with vacuum machines and those made by pressure machines. The difference between the old conventional vacuum machines and the new vacuum and pressure machines are significant and should be addressed. The internal adaptation difference is noteworthy due to the amount of heat and pressure/suction variances in each machine. While contemplating purchasing these machines, the internal adaptation for fit should be the prime focus of attention. A mouthguard will not be as protective if it does not fit properly. The better the fit, the better the protection, acceptance, and compliance.

Figures 1a-f. Note the difference in internal adaptation when compar-
ing the old conventional vacuum
machine to the newer pressure or vac-
umum machines. One can easily see the
adaptation from their machine by
making a mold from a 3 mm sheet of
ethylene vinyl acetate material. Take
out the original model and pour stone
into the ethylene vinyl acetate materi-
al. The result will show you the adap-
tation of your machine. From there,
decisions can be made on purchasing
the newer varieties of vacuum
machines or investing in the state of
the art pressure machines.

The role of the dentist in trauma
prevention is patient education, diag-
nosis and designing custom-made
mouthguards, then choosing whether
to fabricate them in office or send
them to qualified laboratories.
Minimum thicknesses and extensions
are critical for trauma prevention. The
suggested minimal thicknesses are
labially 3 mm, palatal 2 mm, and
occlusally 3 mm.2 The mouthguards
are designed according to the sport
played, age of the athlete, and past
history of trauma. The material of
choice is ethylene vinyl acetate with a
shore hardness of 80.

There are four parts to the fabrica-
tion of custom made mouthguards.
• Impression
• Fabrication
• Trimming and polishing
• Placement and occlusal equili-

bration

Figures 2a-c. The impression is
critical to the end result. Similar to
any restorative procedure requiring an
impression; the better the impression,
the better the appliance. It has been
the author's experience that an excel-


Figure 2b. Light body application to
tooths.

Figure 2c. Light body application to
vestibular areas.

Figure 2d. Heavy body seat with tray.

a more efficient and profitable man-
ner. The impression gels are formu-
lated in two viscosities, a light-bodied
syringe gel that captures soft tissues
and a heavy body tray gel for hard tis-
sue. Ideal for athletic custom-made
mouthguards, the Accu-Dent System II
can also be used for partials, immedi-
ate dentures, orthodontics, and splints.
The light-bodied syringe gel is applied
with a special tip to capture detail
while eliminating air bubbles.
Figure 3. Once the impression has been taken, immediate pour-up with a hard die stone is recommended. Care is taken to capture all vestibular borders. A large base is not necessary as it will be taken off while trimming the model.

Soak the model in the soap for approximately one hour, then dry and polish with a dry towel. The model is now lubricated for the life of the model.

The model is now ready for the fabrication of the mouthguard. This method of bilamination by thermopressure was previously described in 1999. There have been a few changes and additions to the fabrication process.

Figures 4a-e. After the model has become hard and set, usually about 45 minutes, mark the highest margins of the vestibular border with a pencil for reference during trimming. At the model trimmer, remove the excess stone carefully to these borders. By including these vestibular borders, the mouthguard will have more retention due to increased surface adaptation and will also help protect the alveolar bone for further protection from trauma.

Figure 5a. Once the model has been properly trimmed and dry, it must be lubricated to allow easy separation after fabrication. The author’s lubricant of choice is orthodontic model soap.

A 3 mm to 4 mm mouthguard will be made. Two layers of 3 mm ethylene vinyl acetate will be laminated together. It is important that this process be done in two separate steps to allow for proper thickness in the incisal and occlusal surfaces. If done in only one step, the thickness in these critical incisal and occlusal areas will be compromised. There is approximately 30 percent to 40 percent shrinkage of ethylene vinyl acetate material during fabrication, so two 3 mm sheets laminated together will form a 3 mm to 4 mm mouthguard.

Figures 7a-b. After the heater switch and machine power is turned on, a 3 mm sheet of ethylene vinyl acetate is placed in the disc positioning ring. The trimmed model with marked extensions is placed on the tray table slightly off center toward the lingual.

Figure 8a. The clamping ring is placed over the ethylene vinyl acetate sheet to lock it into position.

Figures 9a-b. The heater is placed into position over the model allowing the ethylene vinyl acetate
material to heat and soften to formable consistency.

**Figure 10.** As the ethylene vinyl acetate material softens, it will begin to slump until it is touching the model. At this stage, the first layer is ready to be thermoformed by pressure.

**Figure 11.** On the upper left side of the Druomat is a white button that activates the pressure. This button must be pressed at the same time the heater is removed from the ethylene vinyl acetate material. The pressure chamber will drop over the model and thermoform and pressurize the ethylene vinyl acetate to the model. A light will illuminate signaling the thermo-process has begun and the hands can be removed from the machine. If the hands are removed prior to the light activation, the pressure will not be maintained.

**Figure 12.** The ethylene vinyl acetate material must now cool for a minimum of 10 to 15 minutes. The ethylene vinyl acetate material should not be manipulated and removed from the pressure chamber until it has completely cooled to prevent any distortion.

**Figures 13a-b.** Once the time has elapsed, the white button is depressed until the pressure indicator light shuts off releasing the pressure in the chamber. The heater lever is slowly pushed toward the cylinder. The pressure cylinder will rise.
Figure 14. First layer is complete. It may be removed from the disc positioning ring and allowed to cool to room temperature before trimming to prevent distortion.

Figures 15a-c. Once the ethylene vinyl acetate material has cooled, excess material may be trimmed off using a hot knife. Care should be taken not to trim excessively. The lingual borders are trimmed 1 mm from the teeth, and the labial borders follow the penciled mucosal borders. The distal of the first molar is the minimal extension.

Figures 16a-d. The first layer is now ready for identification labels and logos. Any label machine may be used as long as it provides a small font (10 point maximum).

Figures 17a-c. The mouthguard is now ready for the second layer which will be laminated. A clear sheet of ethylene vinyl acetate of desired thickness (in this case, 3 mm) is placed in the disc positioning ring. The model with the first trimmed and labeled layer is placed on the positioning tray slightly off center toward the lingual. At this point, steps 8 through 13 (Figures 8a-13) are repeated. The clear second layer begins to melt to the desired formable consistency. It is very critical the second layer be allowed to become hot enough to predictably laminate to the first layer. It must heavily droop over the first layer. If
Figure 17a. Figures 17a-17c. The mouthguard is ready for a second layer.

Figure 18. With the clamping ring removed, the laminated mouthguard is cooled to room temperature.

Figure 19a. Trimming the excess from the second layer.

Figure 19b. Trimming the excess from the second layer.

not allowed to heat sufficiently, complete lamination will not occur and separation will take place in time. The pressure chamber is activated as in step 11 (Figure 11), and the model allowed to cool under pressure for 15 minutes. Steps 12-16 (Figures 12-16) are repeated.

Figure 18. The clamping ring is removed and the laminated mouthguard is allowed to cool to room temperature to eliminate any chance of distortion, thereby ensuring a perfect tight fit.

Figures 19a-b. The second layer excess ethylene vinyl acetate material is trimmed to proper extensions as in steps 15-16 (Figures 15-16).

Figure 20. The internal lingual extensions should be checked and marked with a pen to 1 mm from the teeth.

Figures 21a-b. With a Dedico stone acrylic bur, the excess material is trimmed lingually to the marked extensions. The mouthguard is then placed back on the model and the margins are feather finished for comfort lingually, buccally, and labially. Any interferences with muscle attachments should be removed. It is key to finish and thin the lingual extensions to provide comfort and ease in speaking. The lingual area should not remain bulky.

Figures 22a-c. With Essix Scotch wheels, the mouthguard is further trimmed and smoothed to desired thickness. All frenum attachments are relieved with a lisco disc.

Figure 23. Final finish and polish is placed with wax remover.

Figures 24a-d. The 4 mm custommade pressure laminated mouthguard is now completed.

Figures 25a-d. It is now important to try the mouthguard in the patient’s mouth and check for fit and comfort. Minimal adjusting may be necessary just as any other dental appliance insertion appointment. It is extremely important that a balanced occlusion be present. This is done by slightly warming the posterior occlusal surface of the mouthguard, taking extreme care not to overheat and distort, and placing the mouthguard in the patient’s mouth and asking them to bite down very lightly and carefully until all posterior teeth occlude. Care should be taken not to bite down excessively as the occlusal separation of 3 mm to 4 mm must be maintained to ensure proper absorption of impact energy.
Figure 22a and 22b. Final trimming with a Scotch wheel.

Figure 23. Finish and polish is placed with wax remover.

Figure 24a.

Figure 24b. Trimming frenum muscle attachments.

Figure 24c. Finish and polish is placed

Figures 24a-24d. Completion of the custom-made, pressued-laminated mouthguard.

Figure 24d.

CONCLUSION

The pressure-laminated mouthguard continues to be the mouthguard of choice and acceptance for athletes of all levels. The precise fit lends to an increased compliance and reduction of injuries. Athletes who have not been able to wear over-the-counter mouthguards in the past due to poor fit, bulkiness, and lack of retention are more prone to wear a mouthguard that is comfortable, nonbulky, and tight fitting.

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REFERENCES


4. Title IX of the Educational Amendments of 1972 is the landmark legislation that bans sex discrimination in schools, whether it be in academics or athletics. Title IX states: “No

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To Document or Not to Document, That is the Question

BY TDIC RISK MANAGEMENT

Risk management presenters repeatedly instruct dentists on the importance of proper documentation. At the end of most seminars, the final words of wisdom are typically: document, document, document. There are some things, however, that do not belong in a patient’s chart. So how does a dentist know what details are essential and what could be damaging?

Appropriate documentation provides treatment continuity. Any health care provider should be able to pick up a patient’s chart and know what dental treatment the patient has undergone and be able to continue with remaining treatment. However, not all information obtained from the patient is treatment related and if documented in the patient’s chart could pose a problem. Patients and their attorneys can obtain a patient’s record; therefore, all information in the chart is discoverable and not privileged. Some of those items that do not belong in the patient’s chart include:

- Financial information. The cost of treatment and the patient’s payment history can influence how care is perceived. References to cost may have the appearance that the dentist is more concerned with finances than treatment. Dollar figures can encourage a plaintiff’s counsel to focus on cost instead of care. Therefore, financial records should be kept in a file separate from the treatment record.

- Documentation regarding any discussion with your attorney or liability carrier regarding a particular situation. These discussions may be interpreted as defensive rather than a desire to do the right thing for the patient. Plaintiff’s attorneys could use such entries to suggest that dentists knew they had done something wrong and contacted their malpractice carrier for protection. While these types of conversations are important and should be documented, keep them in a separate file. They are privileged and confidential unless they are put in the treatment records.

- Critical or subjective comments about the patient. The chart should only include relevant, factual comments regarding the patient’s health and treatment. When documenting a negative conversation or comment from the patient, be sure to directly quote the patient.

The information in a patient’s chart is the first line of defense when facing allegations of negligence. However, you do not want to keep information that distracts from clinical decision-making in the treatment record. Ask yourself, “would I be comfortable with this entry being enlarged and projected on the screen in front of a jury?” While it may be important, it is best to keep it separate from the record maintained for your attorney or insurance carrier.

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person in the U.S. shall, on the basis of sex be excluded from participation in, or denied the benefits of, or be subject to discrimination under any educational program or activity receiving federal aid.