

The Orthodontic Sports Protection Appliance

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Mouthguards greatly reduce the frequency and severity of traumatic dental injuries during contact sports.¹ For an athlete wearing fixed orthodontic appliances, a properly fitted, individualized mouthguard that adapts intimately to the teeth can prevent intraoral laceration and bruising.²

The most common custom mouthguard material is a thermoplastic copolymer, ethylene vinyl acetate (EVA).³ EVA mouthguards such as Proform* have high energy absorption and distribute the impact force over a wider area, thus reducing the transmitted stress.⁴ These mouthguards can be difficult to fabricate over fixed appliances,^{5,6} however, because they are designed to fit over the occlusal surfaces of the maxillary teeth and gingivae.⁷ They may also hinder planned orthodontic tooth movements.

This article presents a new technique for constructing an individualized orthodontic sports protection appliance (OSPA) for athletes. The

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OSPA is designed to prevent orofacial injuries and damage to fixed appliances while still allowing orthodontic tooth movement.

Fabrication

1. Take an impression of the upper arch with a light-body polyvinyl siloxane (PVS), gingival to the brackets up to the level of the attached gingiva (Fig. 1).



Fig. 1 PVS impression of area gingival to orthodontic appliances.



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2. Take an alginate impression on top of the PVS impression.
3. Take an alginate impression of the lower arch if the casts are to be articulated.
4. Attach the PVS impression to the upper alginate impression with a cyanoacrylate adhesive (Fig. 2). Pour a working cast using Type IV plaster.
5. Apply a 1.5mm layer of light-cured acrylic over the brackets and the areas where individual teeth

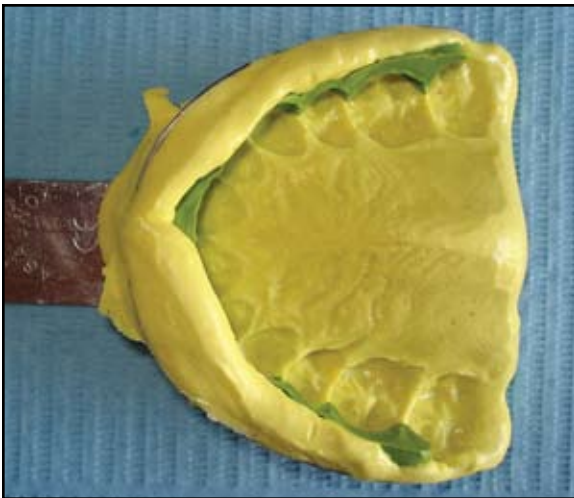


Fig. 2 Alginate and PVS impressions attached using cyanoacrylate adhesive.



Fig. 3 Light-cured acrylic applied to plaster cast, covering brackets and buccal surfaces of posterior teeth in anticipation of arch expansion.

6. Adapt a 1mm, 9% EVA sheet over the cast with a Proform Vacuum Former* (Fig. 4). After trimming the sheet, apply a thin layer of petroleum

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Fig. 4 First sheet of EVA (1mm, 9%) vacuum-formed over plaster cast.



Fig. 5 First EVA sheet trimmed and coated with petroleum jelly.

jelly to allow later separation (Fig. 5).

7. Vacuum-form and trim a second sheet of 1.5mm, 28% EVA (Fig. 6).

8. Vacuum-form a final sheet of 3mm Proform over the cast. Ideally, the upper plaster cast with the finished mouthguard is then mounted on a semi-adjustable articulator using the opposing cast and a centric-relation bite registration.

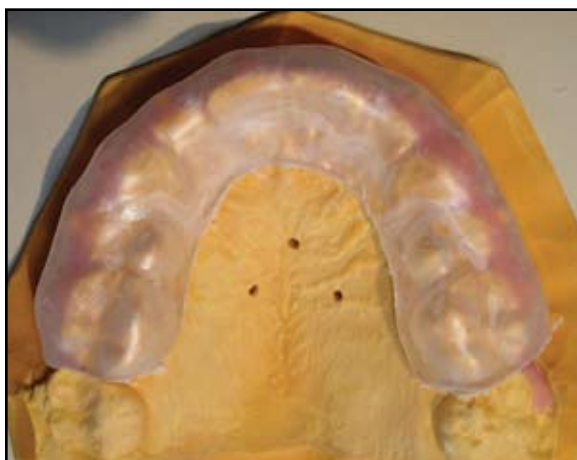


Fig. 6 Second sheet of EVA (1.5mm, 28%) vacuum-formed over plaster cast and trimmed.



Fig. 7 After vacuum-forming of 3mm Proform sheet, finished mouthguard removed from plaster cast, and innermost EVA layer carefully peeled away, leaving relief area for tooth movement.

9. Remove the mouthguard from the plaster cast. Carefully peel away the innermost EVA layer with a tweezer (Fig. 7). The resulting space allows for planned orthodontic tooth movement.

10. Insert the mouthguard to confirm retention and patient comfort (Fig. 8).

Discussion

The OSPA provides a higher level of protection than stock or boil-and-bite mouthguards,⁸⁻¹⁰ as well as greater comfort and retention, better occlusion, improved neck muscle function due to cranial support, and improved ability to communicate and breathe. Several mechanical studies are planned to test the impact resistance of different OSPA materials and thicknesses.

The relative elasticity of the OSPA allows some compensation for distention due to a pressure point. Pressure points can be detected with pressure-revealing spray and then cut out with a tungsten drill. Generally, however, the mouthguard is not worn long enough that a pressure point would interfere with orthodontic tooth movement.

Orthodontic brackets should be low-profile to minimize the possibility of detachment during sports activity. The most distal bonded or banded molars should be included in the mouthguard. Especially in contact sports, the lower teeth should

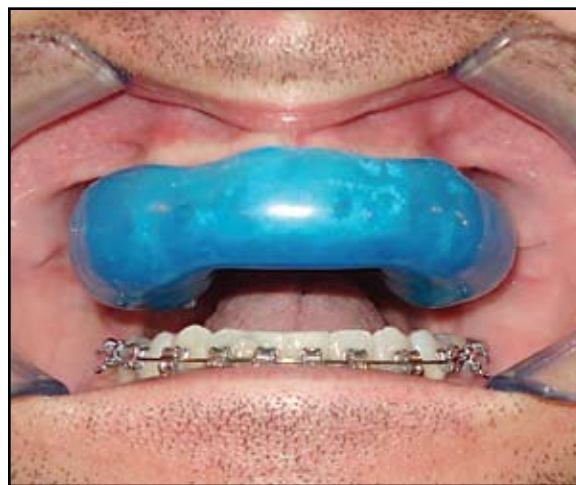


Fig. 8 Finished mouthguard in place.

also be protected (by a one-layer mouthguard, for example) to prevent soft-tissue laceration. In Invisalign** patients, mouthguards can be constructed from duplicate aligners.

Leveling and alignment prior to construction of the mouthguard could improve mechanical retention and adaptation, especially in a case of severe crowding. The appliance can be adapted or refabricated as required to accommodate further tooth movements or improve protection. In a patient with anterior crossbite, it may be necessary to place the OSPA in the mandibular arch.¹¹

We recommend mounting the casts on an articulator to ensure uniform contact points for proper force distribution, taking into account the positions of the condyles. In an open-bite patient, the mouthguard should promote anterior contact with the lower teeth.

The appliance allows for translation of the condyles out of the glenoid fossae into an alert position, providing ultimate safety when the jaw is struck.

The disadvantages of the OSPA compared to standard mouthguards are its relatively high cost and bulky appearance. These factors should be weighed against the cost of the loss or destruction of an anterior tooth or periodontal tissue, which would have significant physical, psychological, and social repercussions. The rehabilitation of such a patient could be expensive, time-consuming, and

ultimately unsuccessful. With this in mind, the cost of a customized mouthguard could be considered minimal.

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REFERENCES

1. Yamada, T.; Sawaki, Y.; and Ueda, M.: Mouth guards for athletes during orthodontic treatment, *Endod. Dent. Traumatol.* 13:40-41, 1997.
2. Bishop, B.M.; Davies, E.H.; and von Fraunhofer, J.A.: Materials for mouth protectors, *J. Prosth. Dent.* 53:256-261, 1985.
3. Josell, S.D. and Abrams, R.G.: Traumatic injuries to the dentition and its supporting structures, *Pediat. Clin. N. Am.* 29:717-741, 1982.
4. Park, J.; Shaull, K.; Overton, B.; and Donly, K.: Improving mouthguards, *J. Prosth. Dent.* 72:373-380, 1994.
5. Croll, T.P. and Castaldi, C.R.: Customized protective mouthguards for orthodontic patients, *J. Clin. Orthod.* 30:15-19, 1996.
6. Croll, T.P. and Castaldi, C.R.: The custom-fitted athletic mouthguard for the orthodontic patient and for the child with a mixed dentition, *Quintess. Int.* 20:571-575, 1989.
7. Westerman, B.; Stringfellow, P.M.; and Eccleston, J.A.: The beneficial effects of air-inclusions on the performance of ethylene vinyl acetate (EVA) mouthguard material, *Br. J. Sports Med.* 36:51-53, 2002.
8. Newsome, P.R.; Tran, D.C.; and Cooke, M.S.: The role of the mouthguard in the prevention of sports-related dental injuries: A review, *Int. J. Paediat. Dent.* 11:396-404, 2001.
9. DeYoung, A.K.; Robinson, E.; and Godwin, W.C.: Comparing comfort and wearability: Custom-made vs. self-adapted mouthguards, *J. Am. Dent. Assoc.* 125:1112-1118, 1994.
10. De Wet, F.A. and de Muelenaere, J.J.: Mouthguards for orthodontic patients, *J. Dent. Assoc. S. Afr.* 39:339-340, 1984.
11. Standard practice for care and use of mouthguards, ASTM F 697-80, in *Annual Book of ASTM Standards*, American Society for Testing and Materials, Philadelphia, 1986, p. 323.

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