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A modified method of mouthguard fabrication for orthodontic patients

Yoshinobu Maeda[1], Shisuke Matsuda[1], Tsuyoshi Tsugawa[1], Sachiko Maeda[2]

[1]Department of Prosthodontics and Oral Rehabilitation, Osaka University School of Dentistry; [2]Orthodontist, Private Practice, Osaka, Japan

Correspondence to: Yoshinobu Maeda DDS, PhD, Department of Prosthodontics and Oral Rehabilitation, Osaka University Faculty of Dentistry, 1-8 Yamadaoka Suita, Osaka 565-0871, Japan
Tel.: +81 6 6879 2954
Fax: +81 6 6879 2957
e-mail: ymaeda@dent.osaka-u.ac.jp

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Abstract – Orthodontic appliances are one of the major risk factors for traumatic injuries during sports events. As it is difficult to take precise impressions with orthodontic appliances, fabricated custom-made mouthguards (MGs) often have poor retention or are too tight causing the disturbance of orthodontic treatments. The purpose of this article is to describe a method for custom-made MG fabrication using sheet and tube materials, with which better MG retention and rigidity as well as pressure control to the orthodontic appliances can be easily achieved.

Newsome et al. (1) suggested that orthodontic appliances are one of the major risk factors for traumatic injuries in the maxillofacial region during sports events. Although properly fitted custom-made mouthguards (MGs) are quite effective in reducing these risks (2), MGs for orthodontic patients should have special considerations; namely, minimized bulk, maximized retention as well as space and anchor control for orthodontic tooth movements.

Croll and Castaldi (3) introduced a method for fabricating MGs using the vacuum-forming technique and block out with putty material for appliances and tooth movements. Yamada et al. (4) suggested the use of coating material such as a tissue conditioner to compensate for the relieved space around the appliances. However, this may not be easy to clean off after use.

The purpose of this article is to describe a method for custom-made MG fabrication using sheet and tube materials, with which better MG retention and rigidity as well as pressure control to the orthodontic appliances can be easily achieved.

Fabrication procedure

1. Take impressions of both the maxillary and mandibular arches with the alginate impression material (Vericol Aroma, GC, Tokyo, Japan) and stock trays during the visit for appliance adjustment when arch wires are removed (Fig. 1).
2. Pour the hand-mixed die stone (New Plastone, GC, Tokyo, Japan) and trim the model to reduce the height from the base (Fig. 2).
3. After at least a 3-h dehydration period, a catheter tube (silicone feeding tube) material (Terumo, Tokyo, Japan) is applied to the surface of the brackets by making a cut and fix it with a ciano-acrylate adhesive (Fig. 3). Brackets on the anchor teeth should be covered with a piece of tube and isolated from the other part (Fig. 4).
4. Place the working model with the tube on the stage of the vacuum forming machine (Erkoform, Erkodent, Pfalzgrafenweiler, Germany) or the pressure forming machine (Erkopress, Erkodent, Germany).
5. A 3-mm thickness sheet of soft material (Erkosoft, Erkodent, Germany) is heated and placed onto the working model on the stage.

Fig. 1. Twenty seven year old male patient needing a mouthguard who has fixed orthodontic appliances.

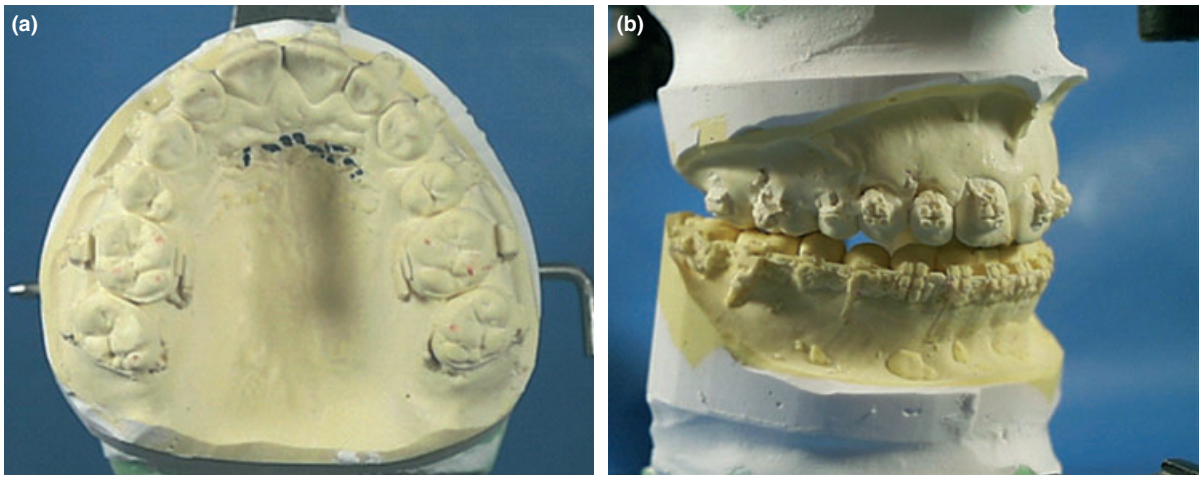

Fig. 2. (a) Occlusal view of the working model obtained from the impression at the adjustment of the arch wire. Out line of the mouthguard is indicated by the superimposed dotted line. (b) Lateral view of the mounted maxillary and mandibular working models.

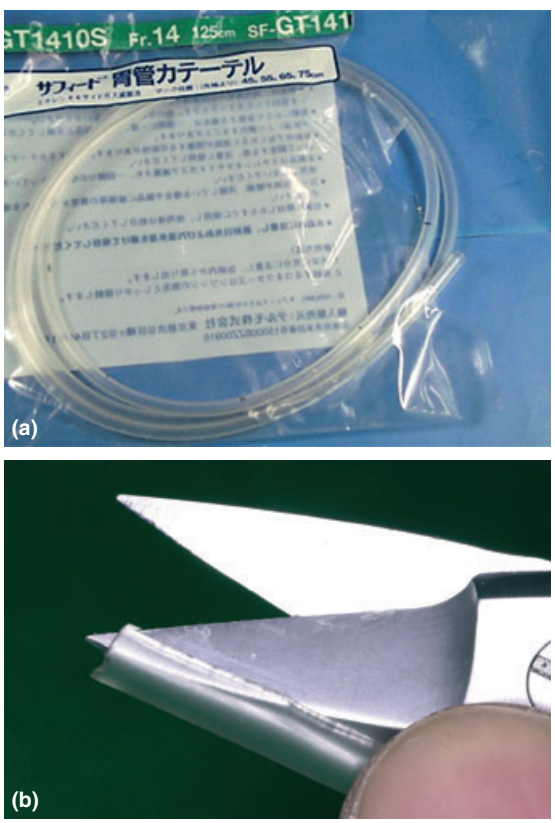

Fig. 3. (a) Catheter tube that has proven biocompatibility. (b) Tube with the cut.

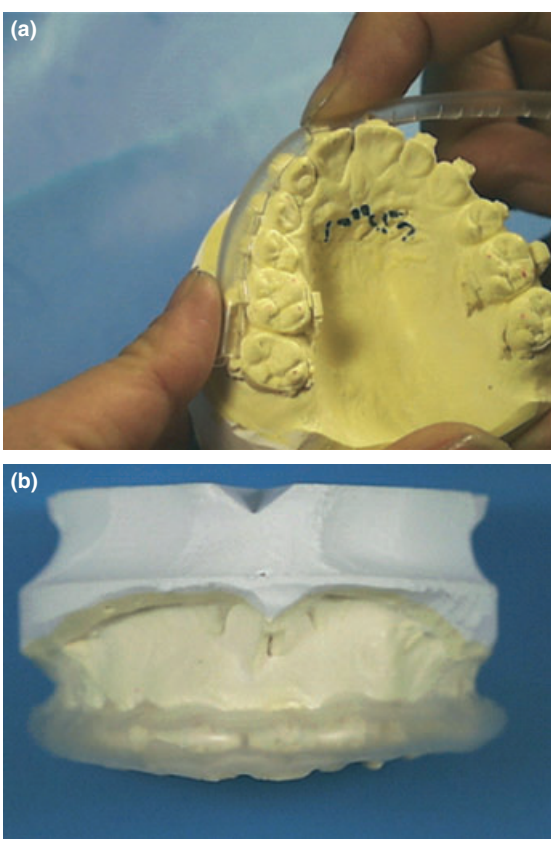

Fig. 4. (a) Application of cut tube to the bracket and arch wire space. Fixation was achieved with the ciano-acrylate adhesive. (b) Brackets on the anchor teeth are also blocked out but isolated from the tube.

6. Commence the vacuum or pressure forming.
7. After cooling down to room temperature, the formed sheet is removed from the model with careful handling of sheet so as not to distort the MG. Remove the tube from the inside of the MG (Fig. 5).
8. Polish and finish the outline area of the MG with a disk (Risko-S, Erkodent, Germany).
9. Occlusal adjustments should be performed in the oral cavity as well as on the articulator with articulating papers to provide contacts on both sides of the arch in the closing position (Fig. 6).

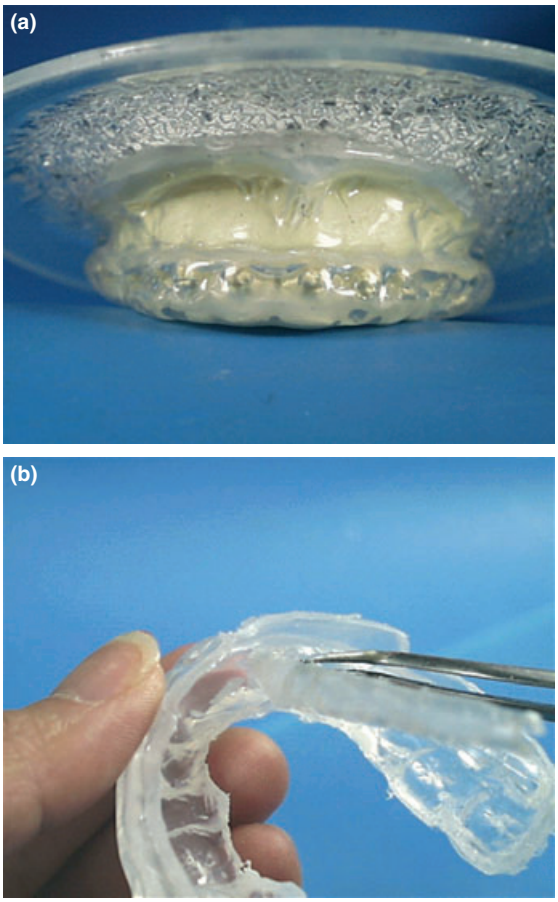

Fig. 5. (a) Formed sheet with the maxillary working model. (b) Removal of the tube is easily achieved because the sheet and tube materials do not stick together without surface treatments.

Fig. 6. Trimmed and finished mouthguard on the articulator. Occlusal adjustments are followed.

10. Adjustments of the MG for the bracket and teeth cusp areas where interference is expected due to the orthodontic teeth movements should be performed as frequently as possible (Fig. 7).

Fig. 7. Finished MG in the patient's mouth.

Discussion

In fabricating MGs for athletes suitable for use during sports activities, the following three things should be carefully achieved: accuracy of fit, comfortable outline design, and an acceptable maxillomandibular relationship. To achieve the precise accuracy of fit, the dryness of the working model is critical (5).

Mouthguards for orthodontic patients should also have special considerations; namely, a minimized bulk, maximized retention, space available for teeth movements, and retention of the anchor teeth positions. To achieve these prerequisites, we developed a method using a tube as the block-out material for maintaining the space for the brackets and arch wire. To decrease bulk and increase MG rigidity, partial lamination can be applied in the anterior region or the block-out area (6, 7). With these laminations, MGs have better force distribution capabilities even with the same buccopalatal thickness (8).

Summary

The purpose of this article is to describe a method for custom-made MG fabrication with sheet and tube materials, through which better MG retention and rigidity as well as pressure control to the orthodontic appliances can be easily achieved.

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