

**DENTAL TECHNIQUE**

## Fabrication technique for a custom face mask for the treatment of obstructive sleep apnea

Ronald S. Prehn, DDS<sup>a</sup> and Tom Colquitt, DDS<sup>b</sup>

The positive airway pressure custom mask (TAP-PAP CM) is a treatment option for severe presentations of obstructive sleep apnea (OSA). This custom mask (CM) is fabricated from an impression of the face and is screwed onto the mechanism of the TAP3 (Thornton Anterior Positioner) oral appliance. This continuous positive airway pressure (CPAP) therapy involves a CPAP machine and a hose and face mask for the delivery of positive pressure to stabilize the airway. The mask features a stable and efficient CPAP interface, providing stabilization of the mandible and the airway. The CM has no straps to cause mask dislodgment during sleep movements. In addition, the CM is firmly attached to the cranium through the fit of the TAP element to the maxillary teeth. These design features ensure better compliance and comfort than a stock CPAP mask.<sup>1-3</sup> This is the basis for the combination of oral appliance therapy and CPAP therapy (combination therapy).

The TAP-PAP CM was invented<sup>4</sup> and developed in 1993 to address the challenges of treating OSA for patients with postpolio complications. These patients have a paralyzed diaphragm or compromised neuromuscular drive, which requires ventilation. Constant volume ventilation is required to adequately maintain the airway and blood oxygen saturation. Average ventilation pressure requires a minimum of 32 cm H<sub>2</sub>O with pressures reaching well over 45 cm H<sub>2</sub>O (Fig. 1). Standard CPAP

### ABSTRACT

The development of the positive airway pressure custom mask (TAP-PAP CM) has changed the treatment of obstructive sleep apnea. The TAP-PAP CM is used in continuous positive airway pressure therapy (CPAP) and is fabricated from the impression of the face. This mask is then connected to a post screwed into the mechanism of the TAP3 (Thornton Anterior Positioner) oral appliance. This strapless CPAP face mask features an efficient and stable CPAP interface with mandibular stabilization (Hybrid Therapy). A technique with a 2-stage polyvinyl siloxane face impression is described that offers improvements over the established single-stage face impression. This 2-stage impression technique eliminates problems inherent in the single-stage face impression, including voids, compressed tissue, inadequate borders, and a rushed experience due to the setting time of the single stage. The result is a custom mask with an improved seal to the CPAP device. (J Prosthet Dent 2015;■:■-■)

mask were not adequate to deal with those pressures (a standard CPAP machine delivers between 5 and 30 cm H<sub>2</sub>O pressure). A post was added to the TAP oral appliance (used for the treatment of OSA) in order to anchor a custom-made face mask. A universal joint from facebow technology was used to attach the mask to the post. The result was a perfectly fitting face mask attached to the skull base through the dentition that had no straps and no shifting of the mask. The mandible and airway were stabilized with the TAP aspect of the mask device.<sup>5,6</sup> The clinical application for the TAP-PAP CM is for patients on the more severe end of the range of OSA.<sup>7-9</sup> The development of the CM for noninvasive ventilation led to its use in combination therapy. Most patients discontinue CPAP therapy because of mask leakage,<sup>10</sup> a problem solved by stabilization with an oral appliance.

Since that time, advances in both the technique and materials used for the CM have been made. The earliest technique involved using irreversible hydrocolloid on the face as the first layer, then plaster over the irreversible hydrocolloid as the second layer (Fig. 2). Later a single

<sup>a</sup>Director, Restore TMJ & Sleep Therapy, The Woodlands, Texas; and Director, Inspire Research and Education, Houston, Texas.

<sup>b</sup>Owner, Airway-Centered Dentistry, Shreveport, La; and Adjunct Professor, Sleep Fellowship Program, University Health, Shreveport, La.



**Figure 1.** CM on patient with postpolio complications on ventilator with pressure of 35 to 45 cm H<sub>2</sub>O.



**Figure 2.** Plaster over irreversible hydrocolloid face impression on patient with whole body paralysis.



**Figure 3.** Single-stage PVS impression made on patient with postpolio complications in iron lung.



**Figure 4.** Maxillary and mandibular TAP3 luted together in 3 mm protrusion with post protruding from mouth ready for face impression.

polyvinyl siloxane (PVS) impression technique was developed (Fig. 3). The face impression is critical in the fabrication of this CM, as the seal of this mask is dependent on its accuracy. Presented here is an improved technique for making an accurate face impression.

### TECHNIQUE

1. With the patient in the supine position, comfortably fit the maxillary and mandibular dual laminate shells (TAP3) onto the patient's teeth. With the maxillary shell having a post screwed onto the TAP3 mechanism that protrudes anteriorly through the lips, lute the shells together with thermoplastic material (ThermAcryl) with the mandible set at 3 mm in protrusion (protrusion optional) (Fig. 4).
2. Attach the breathing tube to the post to allow breathing during the impression (Fig. 5).
3. Cut about 10 to 15 mm from a cotton roll, wet it, and insert it into the nose, making sure the nares are well exposed (Fig. 6). Reassure patients at this point that airflow is adequate and encourage them to relax.
4. After rubbing petroleum jelly (Vaseline; Unilever) onto the skin of the face, apply a light-body PVS (3M Paradigm Light Body) with a syringe. Two operators syringing at the same time is preferred (Fig. 7). Cover the bridge of the nose, cheeks, and chin. Cover the lips up to the breathing tubes. Allow the material to polymerize.
5. Take a perforated thermoplastic disk (Airway Management Inc), heat it in a water bath to over 160 degrees, and mold it to the patient's face (Fig. 8). Cut air holes to allow the breathing tubes to protrude through the disk.
6. Load the disk with a heavy-body PVS (3M Paradigm Heavy Body) from an automatic PVS mixing machine



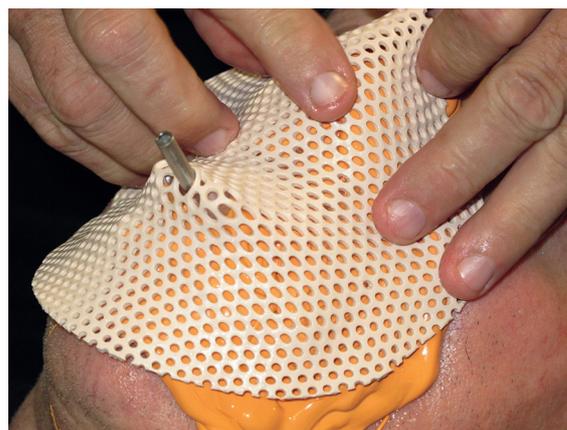
**Figure 5.** Preformed breathing tube slid onto post coming from luted TAP (in mouth) and extruding through lips. Base is put under lips. It features 2 breathing holes, each 6 mm in diameter.



**Figure 6.** Wetted cotton roll inserted into nostrils leaving nares fully exposed. Notice breathing tube in proper position.



**Figure 7.** Light-body PVS extruded onto lubricated face with TAP, post, and breathing tubes in place.



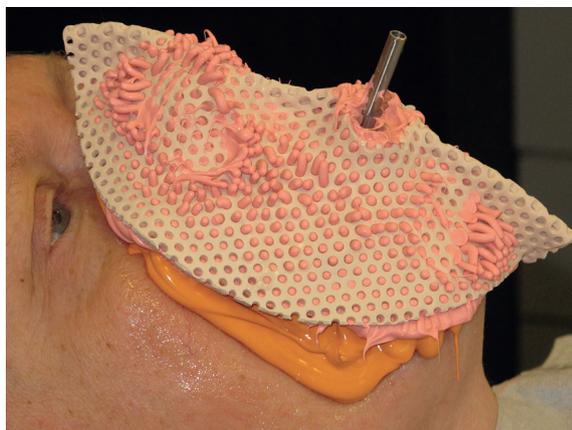
**Figure 8.** Perforated thermoplastic disk heated to soften and molded to fit face. Air hole will be expanded by cutting after it hardens.

(3M Penta), starting expressing the material at the breathing holes of the disk and moving disk in a circular pattern to the borders of the disk (Fig. 9).

7. Move to place the impression disk onto the face while taking caution to insert the breathing tube into the breathing holes of the disk. Then press until the impression squeezes through the perforations on the disk (Fig. 10).
8. After the material has polymerized, remove the impression from the face and the breathing tube from the post. Reinsert the breathing tube into the impression and inspect for any voids (Fig. 11).
9. Remove the cotton and inspect for detail. Look for adequate extension to the bridge of the nose, to the chin, and bilaterally beyond the nasolabial folds. Check for well-defined nasolabial folds and visible border of the nares (Fig. 12).



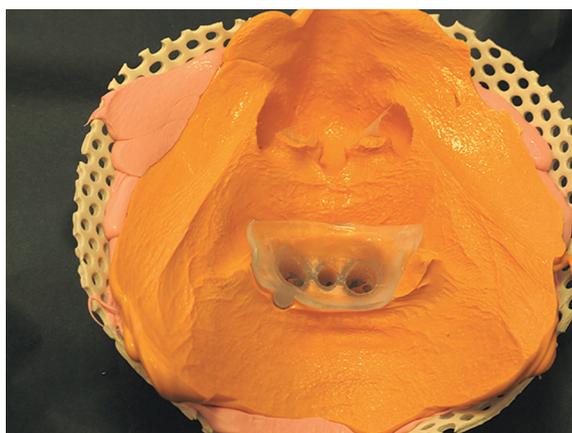
**Figure 9.** Heavy-body PVS applied to impression disk by PVS mixer in circular pattern, starting at air hole and expanding out to outer borders of disk.



**Figure 10.** Disk with heavy-body PVS material applied to face with air hole protruding and open for breathing.



**Figure 11.** Polymerized impression removed showing face side of impression. Cotton roll usually adheres to impression. Breathing tube often remains, but if not is reinserted into impression.



**Figure 12.** Cotton rolls removed and impression inspected. Note detail of skin and nasolabial folds.



**Figure 13.** TAP-PAP CM delivered and screwed securely to post.

- Send the impression to the dental laboratory for the fabrication of the TAP-PAP CM, and on return, insert it onto the post of the luted TAP3 device (Fig. 13).

## DISCUSSION

In our experience, these impressions are better than the previous single-stage irreversible hydrocolloid or PVS impressions. Frequent problems with single-stage impressions included voids, compressed tissue, inadequate borders, and a rushed experience due to setting time. On the basis of our extensive experience, irreversible hydrocolloid and PVS face impressions account for about 20% of remakes. These issues are eliminated with this 2-stage technique. Syringing the first stage directly to the face provides control of all these issues.

The efficacy of the CM depends on getting an impression of the face in a relaxed state because this relaxed state best represents the face during sleep. If the muscles are tense during the face impression, then the

CM will leak when the patient falls asleep. This technique allows time to apply the material calmly. The patients' facial muscles remain relaxed, and they tolerate the procedure well. This 2-stage face impression technique produces an accurate impression of the face with 1 attempt, resulting in a CM that fits accurately on the first insertion.

## SUMMARY

The clinical application for the TAP-PAP CM is for patients on the more severe end of the range of OSA who require combination therapy.<sup>7-9</sup> The 2-stage face impression technique for the fabrication of the CM is an improvement on previous techniques. It eliminates the issues of obtaining accurate face impressions that are inherent in the 1-stage impression technique. This 2-stage impression technique not only reduces the time required for the impression and the delivery of the CM but also provides a superior CPAP interface.

**REFERENCES**

1. Thornton WK. Case report: combined CPAP-oral appliance therapy. *Sleep Rev* 2002;1:1-5.
2. Prehn RS. The new TAP-PAP custom face mask for CPAP compliance and satisfaction (abstract). *Sleep Breath* 2010;14:283.
3. Prehn RS. The new TAP-PAP custom face mask for CPAP satisfaction (abstract). *Sleep* 2010;33:A156.
4. Thornton WK. Combination face mask and dental device for improved breathing during sleep. US Patent 5 537 994, Appln. No. 253 949, July 23, 1996.
5. Dieltjens M, Vanderveken OM, Heyning PH, Braem MJ. Current opinions and clinical practice in the titration of oral appliances in the treatment of sleep-disordered breathing. *Sleep Med Rev* 2012;16:177-85.
6. Cistulli PA, Gotsopoulos H, Marklund M, Lowe AA. Treatment of snoring and obstructive sleep apnea with the mandibular repositioning appliance. *Sleep Med Rev* 2001;8:443-57.
7. Sanders AE, Denbar MA, White J, Prehn RS, Rogers RR, Pardue T, et al. Dental clinicians' observations of combination therapy in PAP-intolerant patients. *Sleep Rev* 2015;5:18-21.
8. Denbar MA, Essick GK, Schramm P. Hybrid therapy: a case study using hybrid therapy to treat a soon to be deployed soldier with obstructive and central sleep apnea. *Sleep Rev* 2012;6:38-46.
9. Prehn RS. New applications for combination therapy (abstract). *Sleep Breath* 2013;17:888.
10. Gay P, Weaver T, Loube D, Iber C. Evaluation of positive airway pressure treatment for sleep related breathing disorders in adults. *Sleep* 2006;29:381-401.

**Corresponding author:**

Dr Ronald S. Prehn  
1001 Medical Plaza Dr  
Suite 200  
The Woodlands, TX 77380  
Email: [rprehn@tmjtxas.com](mailto:rprehn@tmjtxas.com)

**Acknowledgments**

The authors thank W. Keith Thornton, DDS, the inventor of the TAP-PAP CM, who offered his expertise in the development of this technique and guidance in the improvement of this critical CPAP interface.

Copyright © 2015 by the Editorial Council for *The Journal of Prosthetic Dentistry*.