Management of Velopharyngeal Disorders. A Case Series

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Abstract

Patients with acquired defects or congenital malformations of the palate exhibit disturbances in speech, including hypernasality, nasal emission, and decreased intelligibility of speech. Maxillofacial prosthetic treatment can reestablish the palatopharyngeal integrity to provide the potential for acceptable speech. This article describes a case series of patients with palatopharyngeal disorders and their treatment approaches.

Speech is a learned process unique to human beings. Speech can be divided into different phases, including respiration, phonation, amplification, resonation, and articulation with integrated central nervous system coordination and auditory feedback. The source of air pressure is within the respiratory apparatus. Phonation is provided by the varying tensions, vibratory cycles, and intricate coordination of vocal folds of the larynx. The pharynx, the oral cavity, and the nasal cavity act as the resonating chambers that provide amplification and resonation to the voice.[1]

Resonance is the quality of the voice determined by the balance of sound vibration in the oral, nasal, and pharyngeal cavities. The palatopharyngeal valve, consisting of soft palate and pharyngeal walls is critical for speech, as it proportions the air stream between the oral and nasal cavities and influences voice quality.

Other functions of the palatopharyngeal valve elicited by the action of muscles of the soft palate and pharynx include blowing, sucking, and swallowing. Palatopharyngeal disorders may be broadly classified based on physiology and structural integrity into palatopharyngeal incompetence and palatopharyngeal insufficiency.

Palatopharyngeal incompetence is defined as the inability of an anatomically intact soft palate to contribute to a functional palatopharyngeal closure usually due to disease or trauma of a neurogenic or muscular nature.[2] Examples are patients with normal morphology whose movement of tissues is compromised, such as patients with neurologic deficits, cerebrovascular accidents, brain stem tumors, and traumatic injuries.

The Glossary of Prosthodontic Terms defines palatopharyngeal insufficiency as a condition where there is lack of effective closure between the soft palate and one or more of the pharyngeal walls during swallowing or speech sounds that require high intraoral pressure.[3] Nasal reflux may result in escape of air during speech, or hypernasality. This lack of closure may be due to palatopharyngeal incompetence, insufficiency, or from lack of movement of pharyngeal walls. Examples of palatopharyngeal insufficiency are patients with inadequate length of soft palate but whose movement of remaining tissues is within physiologic limits, such as congenital cleft palate, short soft palate (due to congenital or postsurgical scarring of the soft palate), and acquired palatal clefts.[4]

Clinical implications of palatopharyngeal disorders are that such patients exhibit problems like seepage of nasal secretions into the oral cavity, problems in deglutition and resonance, and articulation disturbances. Any malfunctioning of this valve can result in difficulty in swallowing, sucking, hypernasality, hyponasality, or impaired speech intelligibility.

This clinical report describes techniques in treating palatopharyngeal disorders and highlights a new technique of incorporating a palatal expansion appliance with the speech prosthesis for orthodontic palatal expansion.

Clinical report 1

An 18-year-old male patient was referred from the department of ear, nose, and throat to the dental clinic for the chief

Figure 1 Preliminary impression.

complaint of nasality of voice and weak voice associated with a loss of hearing that had developed 8 years prior. Previous medical history revealed sudden onset of fever, rhinolalia, and nasal escape of fluids from ipsilateral nostril. There was no significant finding with respect to the temporomandibular joints. Clinical examination revealed that the patient had complete permanent dentition with an anatomically normal palate. The palatopharyngeal function was evaluated by inspection of the soft palate and tested by asking the patient to suck water through a straw.[2] The patient was diagnosed with idiopathic soft palate paralysis (an isolated clinical entity of unknown cause).[5] A palatal lift prosthesis was advised. A lateral cephalograph was advised for verifying the placement of the palatal prosthesis.

The treatment plan was as follows:

1. A preliminary impression was made with irreversible hydrocolloid (Hydrogum, Zhermach Products, Badia Polesine, Italy) with stock tray, which was intended to record as well as displace the soft palate superiorly (Fig 1).
2. On the preliminary cast, wax spacer was adapted for the teeth, and an autopolymerizing resin tray was fabricated.
3. Molding procedure was done with low-fusing modeling compound (DPI Pinnacle Tracing Sticks, Dental Products India, Mumbai, India) in sessions with an interval of 48 to 72 hours considering patient fatigue. Speech was recorded, and the patient was made to listen to recorded speech for auditory feedback. Low-fusing modeling compound was added on the posterior aspect of the tray until appropriate displacement of the soft palate was achieved, and the prosthesis was quite broad and shaped like a beaver tail (Fig 2).
4. The adequacy of the lift prosthesis was confirmed by monitoring:
   a) The intelligibility of speech using nasal and velar sounds;
   b) Patient's ability to suck from a glass of water;
   c) Patient's ability to breathe and swallow with ease;

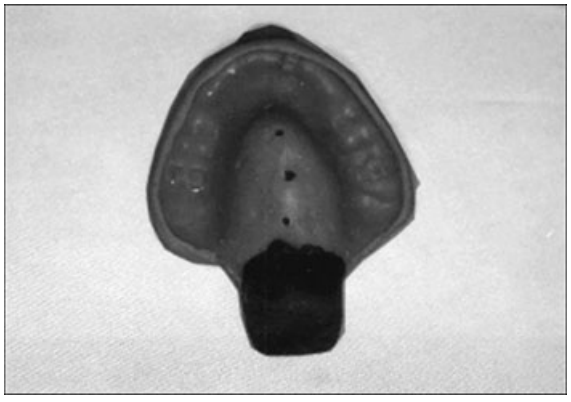

Figure 2 Molding procedure.

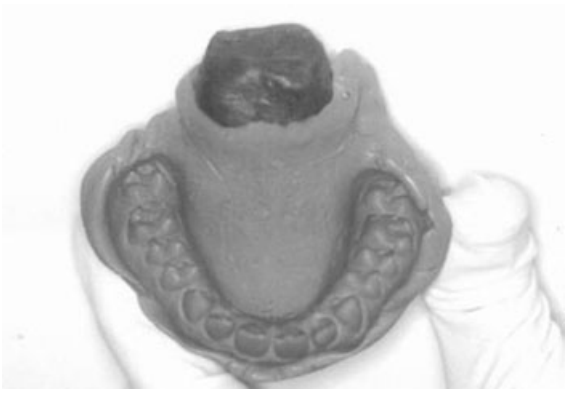

Figure 3 Elastomeric impression.

Figure 4 Master cast.

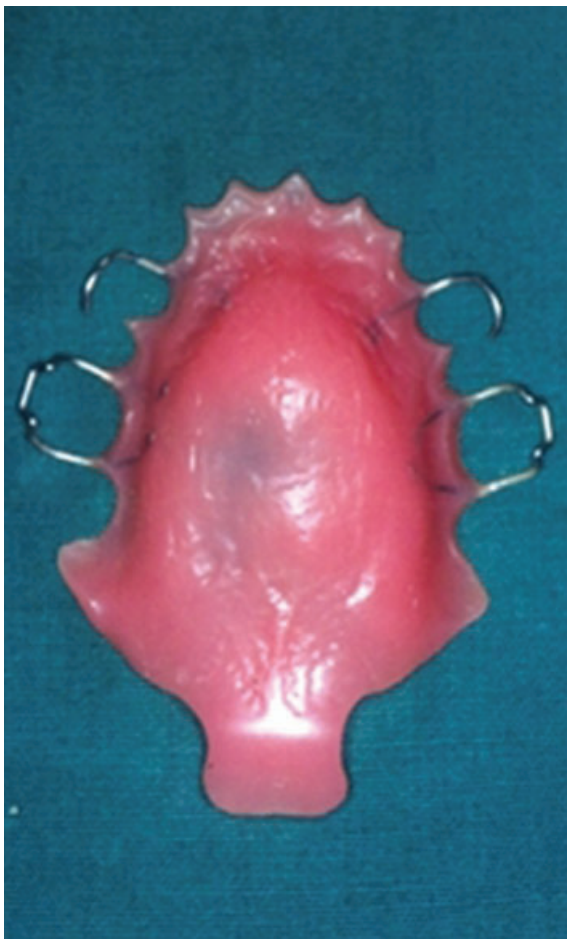

Figure 5 Wax up with Adams clasps.

d) Whether the patient was comfortable with the extension;
e) And by verifying the prosthesis with the cephaloradiographs.

5. The prosthesis could be overextended if the patient complains of gag reflex or if there is dislodgement of the prosthesis during the movement of the head, breathing, and swallowing.
6. The final impression was made with poly(vinyl siloxane) elastomeric impression material (Reprosil regular body, Dentsply International, York, PA) (Fig 3).
7. The definitive cast was made with dental stone (Kalstone, Kalabhai Dental, Mumbai, India), over which the waxing up was done with Adams wrought wire clasps on the first molar and circular wrought wire clasps on the distal undercut of the first premolar for retention, invested, and processed (Figs 4 and 5).
8. The prosthesis was then polished and inserted in the patient's mouth (Fig 6). The palatal lift prosthesis was monitored closely to ensure it did not cause soreness to the soft tissues and have adverse effects on dentition.
9. The prosthesis extension was verified with lateral cephaloradiographs (Fig 7).

Figure 6 Prosthesis inserted in patient's mouth.

Clinical report 2

A 10-year-old female patient was referred to the Department of Pedodontics for a chief complaint of nasality of voice. The patient had a congenital cleft of hard and soft palate (Fig 8).

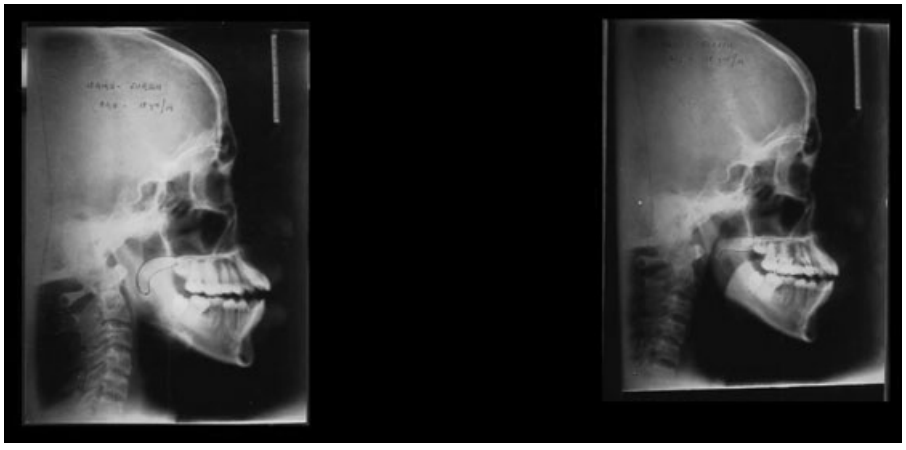

Figure 7 Lateral cephaloradiographs.

Figure 8 Velopharyngeal defect.

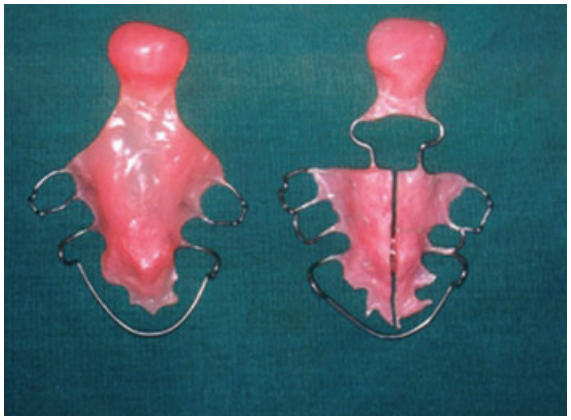

Figure 9 Palatal lift prosthesis with the maxillary palatal expander.

An operation for cleft at 18 months of age resulted in a short palate. Further surgery was not advised as the tissue was hypovascular and could result in a scar tissue. A maxillary passive obturator was placed at birth to act as a feeding plate to help her suckle. She had mixed dentition period with #11–13, 21, 22, 16, 54, 55, 63–65 (Fedaration dentaire internationale tooth numbering system). Radiographic investigation included an orthopantomograph. The patient was diagnosed as having palatopharyngeal insufficiency and incompetency, as the soft palate was insufficient to effect closure after maximum displacement by lift prosthesis. The patient also had insufficient maxillary arch width. A modified palatal lift prosthesis was advised with a rapid maxillary expansion screw as part of the orthodontic treatment to expand the maxillary arch. The treatment plan was as follows:

Figure 10 Prosthesis in patient's mouth.

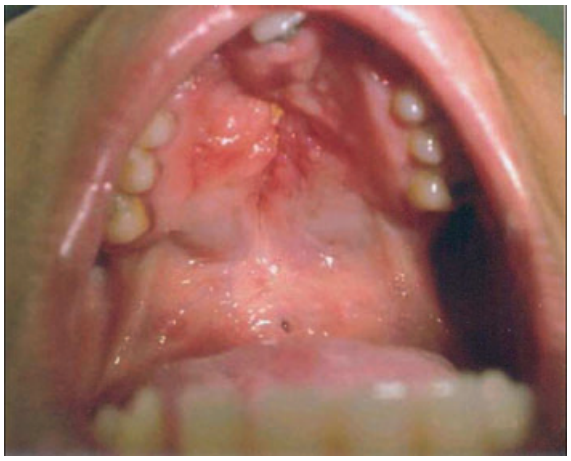

Figure 11 Repaired bilateral cleft of the lips, alveolar process and the palate in the patient.

1. Preliminary impression was made with irreversible hydrocolloid (Hydrogum) with stock tray, which was intended to record and displace the soft palate superiorly.
2. On the preliminary cast, wax spacer was adapted for the teeth, and an autopolymerizing resin tray was fabricated.
3. Molding procedure was done with low-fusing modeling compound (DPI Pinnacle Tracing Sticks). Low-fusing modeling compound was added on the posterior aspect of the tray until appropriate displacement of the soft palate was achieved.
4. The final impression was made with poly(vinyl siloxane) elastomeric impression material (Reprosil regular body). The definitive cast was made with dental stone over which waxing up was done, Adams wrought wire clasps were fabricated on first molar for retention, invested, and processed.

Figure 12 Prosthesis inserted in the mouth.

Labial bow with the rapid maxillary palatal expander was incorporated in the prosthesis (Fig 9).
5. The prosthesis was then polished and inserted in the patient's mouth (Fig 10).

Clinical report 3

A 29-year-old female patient was referred from the Department of Speech and Hearing for the fabrication of speech aid prosthesis. Her medical history and dental history revealed that she had undergone repair of bilateral cleft of hard palate, soft palate, lip, and alveolar process (Fig 11). Clinical examination revealed missing #17, 12, 21, 27, 36, an irregular broken arch, malocclusion with cross bite, and open bite of incisors. The patient was diagnosed having palatopharyngeal insufficiency.

The treatment plan was as follows:

1. Preliminary impression was made with irreversible hydrocolloid (Algitex, Dental Products India) with stock tray, which was intended to record and displace the soft palate superiorly.
2. On the preliminary cast, wax spacer was adapted for the teeth, and an autopolymerizing resin tray was fabricated.
3. Molding procedure was done with low-fusing modeling compound (DPI Pinnacle Tracing Sticks). Low-fusing modeling compound was added on the posterior aspect of the tray, and the patient was asked to perform the circular movements side to side, bend her head forward and back, speak, and swallow to record the physiologic activity of the pharyngeal muscles.
4. The final impression was made with poly(vinyl siloxane) elastomeric impression material (Reprosil regular body).
5. The definitive cast was made with dental stone (Kalstone) over which waxing up was done; triangular wrought wire clasps were fabricated on the second premolar, along with circumferential wrought wire clasps on the mesial undercuts on the first molars for retention, invested, and processed.
6. The prosthesis was then polished and inserted in the patient's mouth (Fig 12).

Discussion

There are some guidelines for the palatal lift prosthesis based on fluoroscopic and naso-endoscopic studies:[6,7]

1. There should be a gap of 5 mm between the speech bulb and posterior pharyngeal wall at rest.
2. The angle of the bulb relative to the palatal plane should be approximately 20°.
3. McKerns and Bzoch showed that in men,[8] the typical relation of the soft palate to the posterior pharyngeal wall is at a point above the palatal plane. For women, contact is found to occur at or below the palatal plane.
4. Many dentists have attempted to approximate pharyngeal tissues overlying the anterior tubercle of the first cervical vertebra on the basis that it is the area of maximum constriction.
5. The speech bulb should be placed in the location of the greatest posterior pharyngeal and lateral pharyngeal wall activity, as voice quality is best judged when the speech bulb is placed at this position.
6. The inferior/superior dimensions and the weight of the prosthesis may be reduced without any apparent effect on nasal resonance.[9]

The assessment of palatopharyngeal function in speech includes:

1. *Visual method*. It can identify problems related to structure, but not those related to the palatopharyngeal function for speech. It has been shown that the middle third of the soft palate typically makes contact with the posterior pharyngeal wall in an individual with normal speech. The lower one-third of the soft palate, which includes the uvula, drapes inferiorly and may angle anteriorly, blocking visual inspection of the site of closure.
2. *Speech assessment.* Checking the inappropriateness of the nasal air during oral consonant production, overall intelligibility.
3. *Digital palpation of the hard and soft palate*.
4. *Soft tissue X-rays of the head.*

Treatment modality includes presurgical orthopedics, pharyngoplasty, and soft palate lengthening techniques. Correction of palatal defects needs substitution and compensation. The goal of substitution is to provide a substitute palate with adjacent structures that permit palatopharyngeal function. Substitution is achieved surgically when a surgeon closes the opening in the palate, removes a blockade, or grafts with substitute material. Prosthodontically, obturation of space is done by means of a prosthesis. Prosthetic elevation and stimulation of the soft palate by means of a palatal lift prosthesis treat palatal incompetence. Obturation of the palatopharyngeal lumen by speech obturator treats palatal insufficiency.[1]

In the case of a palatal lift prosthesis as in Clinical Reports 1 and 2, the velar and pharyngeal extensions are subjected to a constant displacing force. The rotational forces of the palatal lift appliance will usually pivot around the first molar area. This may require clasping into distal undercuts to resist downward force of the soft palate against the lift end of the prosthesis. Therefore, in Clinical Reports 1 and 2, Adams clasps on first molars, circular clasps on first premolars, and a labial bow were fabricated.

The use of a wrought wire acrylic resin base prosthesis can be used as a trial measure when attempting to position a soft palate to determine the amount of lift force necessary and the potential for successful treatment. In many cases, this prosthesis may be the only intervention necessary, as the lifting action can stimulate enough pharyngeal activity to eliminate the need for a palatal lift appliance.[10]

Treatment with a prosthesis can stimulate the palatopharyngeal function and increase the neuromuscular response by gentle stimulation of the pharyngeal muscles through consistent speech exercises. There is a marked nasopharyngeal stimulation in which the patient often develops compensatory muscle contraction requiring frequent reduction in the size of the pharyngeal section of the prosthesis;[11,12] however, adverse effects of the prosthesis might be a relapse of nasality and opening of occult submucosal clefts.

There have been preferences to sequentially build up the velar portion, but current thought favors positioning the soft palate at the desired level in one procedure. This will place a significant rotational force on posterior abutments and place a vertical labial force on anteriors. Therefore, adequate occlusal and cingulum rests are essential, and a labial bow may be beneficial in the acrylic resin base prosthesis. Splinting of the anterior teeth and molar clasps should be forgiving if long-term use is anticipated. For increases of anterior indirect retention interiorly in the form of anterior extension, and posterior retention in the form of orthodontic bands with buccal tie wings if crown length and undercuts are inadequate, wrought wire clasps are necessary. Success of the palatal lift appliance depends on the number of maxillary teeth present that can provide retention for the prosthesis with an easily placed flaccid soft palate.[10]

In cases of speech aid prostheses, movement of the prosthesis is not expected, as the prosthesis does not lift the palate but obturates the palatopharyngeal lumen. But if movement is noticed, it could be because of:

1. Low position causing tongue encroachment.
2. Superior extension when head posture was not considered during the impression procedures to record soft palate position.[2]

Speech is to be evaluated to assess the progress of the patient. Patients were subjected to the Bloomer Mini Test of Speech Articulation, which includes the following:[6]

1. We bought my father two new sun lamps.
2. You should choose a red coat hanger.
3. Bobby pulled down two go-carts.
4. The thing is very full.
5. Send his shoe measure to Charlie Jones.
6. Why won't you let her run?
7. Mary never sang.
8. Go get a bigger egg.
9. Mama made some lemon jam.
10. Buy baby a bib.

The patient's speech was evaluated, and also as per the local language, sentences were framed to conform to the consonants of the speech. The objective analysis of speech was recorded with speech analysis software VAGMI, where an audiological feedback principle was used. The patient's speech was recorded preoperatively, and the patient was given feedback on his or her nasalized sounds. The patient's speech was recorded postoperatively, and a comparison was made.

The patients showed a marked reduction in nasality and improved speech intelligibility, especially of the velar sounds. All the patients showed marked improvement in speech after 18 months and were evaluated periodically every 3 months.

Conclusion

The prosthodontist plays a vital role in the management of palatopharyngeal disorders as vital functions of mastication, deglutition, and speech production can be restored with the help of a prosthesis. Palatal lift prosthesis serves to reduce hypernasality and thus improves the intelligibility of speech. Above all, it contributes to improving the patient's self-esteem. Patient selection is the key to success in prosthodontic management of palatopharyngeal disorders. The prosthodontic criteria of patient selection are healthy oral tissues, adequate retention and stability of the prosthesis, patient compliance, and no excessive gag reflex. The advantages of prosthodontic treatment are that the treatment is relatively simple, noninvasive, and versatile, and can accommodate a variety of defects. A speech prosthesis can eliminate hypernasality and produce stimulation of the soft palate and does not hinder growth and development.

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