Review Article

Prosthodontics in velopharyngeal incompetence

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The development of sophisticated surgical techniques and procedures in the past decade has greatly enhanced the rehabilitation of congenital cleft palate patients. However, some of these patients may present oral and / or systemic factors contraindicating surgical intervention. In addition, since total elimination of surgical failure has not yet become a reality, there exists a patient population for whom rehabilitation must be approached with the help of a prosthodontist. The function of a prosthodontist is to restore the basic vital functions of mastication, deglutition and speech production. To accomplish this, the prosthodontist is most concerned with the preservation of residual teeth, the health of the periodontium, the physiology of residual soft palate musculature and the activity of the anatomic structures identified with the palatopharyngeal sphincters. This article provides an overview of palatopharyngeal incompetence.

Key words: Cleft palate, hypernasality, palatal lift appliance, palatopharyngeal incompetence, speech obturator, videofluorographic, videonasoendoscopy

The vicissitudes of morphogenesis expresses never so cruelly as in the case of oro-facial clefts. Patients with cleft palates have many problems like impaired articulation, problem in deglutition and seepage of nasal secretions into the oral cavity. The complexity of these problems requires numerous healthcare professionals co-operating to provide the specialized knowledge and skill necessary for comprehensive care. Interested, well-informed and resourceful dentists have made remarkable contributions toward fulfilling the communicative needs of cleft palate individuals.

This has been accomplished by the construction and placement of prosthetic appliances. Basically, these prosthetic "aids to speech" serve to obturate any opening or cleft of the palate and frequently carry an extension into the pharynx designed to improve or supplement velopharyngeal valving. An understanding of normal velopharyngeal function and an appreciation of the consequences of abnormal function seem to be prerequisites to any meaningful discussion of data relating to cleft palate prostheses.

NORMAL PALATOPHARYNGEAL FUNCTION FOR SPEECH

When there is an impairment of the palatopharyngeal port, speech is typically characterized by excessive nasal resonance (hypernasality), inappropriate audible nasal air emission and a decrease in intraoral air pressure during the production of oral speech sounds. Thus, speech in such cases may be only partially intelligible. An understanding of normal palatopharyngeal physiology is a prerequisite to adequately assess the palatopharyngeal port, which may or may not be functioning and subsequently may or may not be contributing to speech intelligibility.

At rest, the soft palate drapes from the posterior border of the hard palate, leaving an opening from the back of the oral cavity. The respiratory airflow and vocalized sound are directed through this passage way during normal nasal breathing and humming with a closed mouth. However, complete closure of the palatopharyngeal port is required for breathing through the mouth, for the production of normal oral (nonnasal) speech sounds or for other oral activities such as swallowing, blowing, sucking and whistling [Figure 2]. This closure pattern is basically sphincteric and is comprised of three distinct but integrated activities[1] [Figure 1].

1. The upward and backward movement of the soft palate as it makes contact with the posterior pharyngeal wall.
2. The mesial movement of the lateral pharyngeal wall (primarily the palatopharyngeus and salpingopharyngeus) as they make contact with the lateral margins of the soft palate.
3. The anterior displacement of the posterior pharyngeal wall as it makes contact with the elevated soft palate.

Although not all normal speakers necessarily use all

three of these components to achieve palatopharyngeal closure, a failure of the port to close can usually be attributed to one or more of these factors resulting in velopharyngeal incompetence.

Velopharyngeal incompetence

Velopharyngeal incompetence is the functional inability of the soft palate to effect a complete seal with the posterior and / or lateral pharyngeal walls[2] [Figure 3].

Rehabilitation of velopharyngeal incompetence in cleft palate patients is challenging for both surgical and prosthetic fields.

Causes of velopharyngeal incompetence

- Cleft palate
- Traumatic injuries to neuromotor system and / or the peripheral efferent cranial nerves.
- Cerebrovascular accidents!
- Brain stem tumours and
- Neuromuscular diseases such as multiple sclerosis and cerebral palsy.[3]

Clinical features of velopharyngeal incompetence

- Escape of air resulting in nasal speech that may be unintelligible.
- Middle ear infections like otitis media due to obstruction of the eustachian tube.
- Nasal regurgitation
- Psychological problems!
- Social discrimination[4]

Treatment options

Treatment of velopharyngeal incompetence in patients with cleft palate includes surgical and prosthetic treatment.

Surgical treatment is considered as a permanent solution and should be preferred if conditions so permit.

Prosthetic treatment is considered as the last resort and its use must be clearly indicated by oral conditions.

Indications for prosthodontic care

For unoperated patients:

A surgical repair of a cleft palate is to be preferred to speech aid prosthesis. However, there are some situations in which prosthesis should be the choice of treatment.[5] Some such situations are as follows:

1. A wide cleft with a deficient soft palate: Some clefts of this type do not lend themselves to surgical repair by means of local flaps.
2. A wide cleft of the hard palate: Surgery is not possible due to limited amount of local tissues.
3. Neuromuscular deficit of the soft palate and pharynx: A repair of the palate would not be conducive to

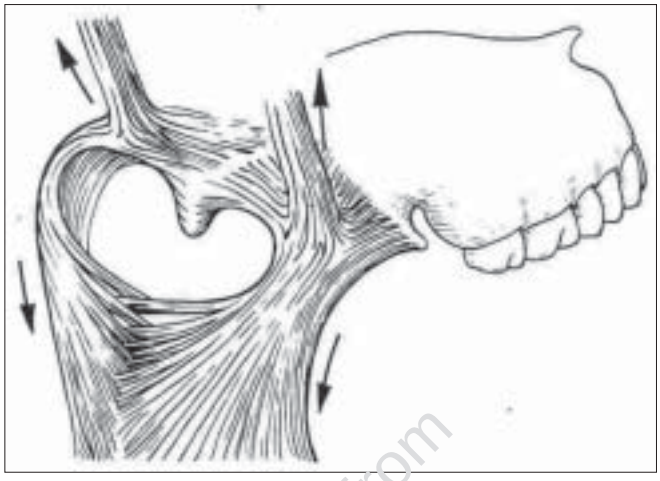

Figure 1: Primary component of palatopharyngeal function including palatal elevation, medial movement of lateral wall and anterior movement of posterior wall

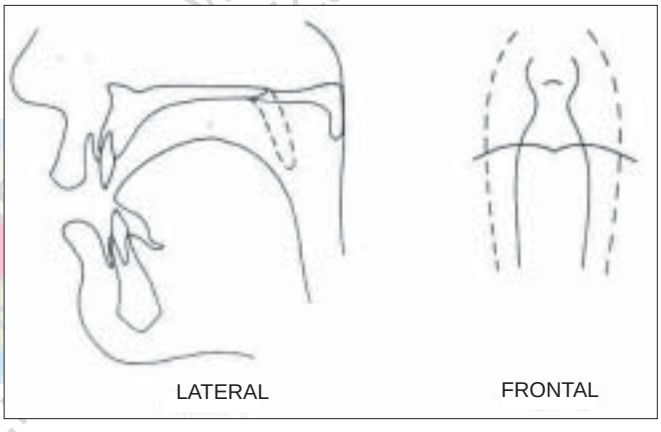

Figure 2: Tracing of video fluoroscopic image from lateral and frontal views of palatopharyngeal port during rest and during function for speech

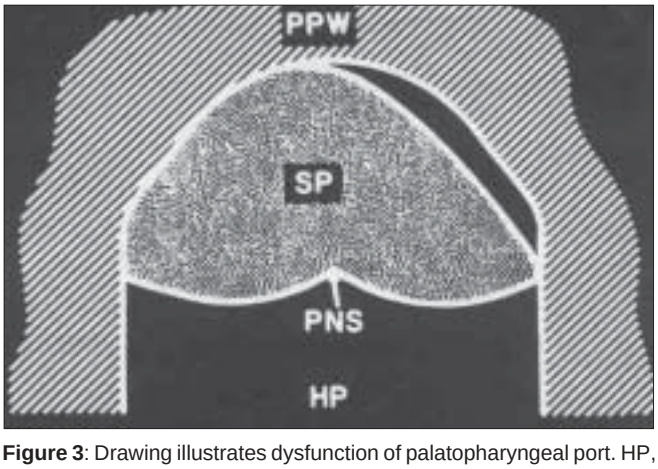

Figure 3: Drawing illustrates dysfunction of palatopharyngeal port. HP, hard palate; PNS, posterior nasal spine; PPW, posterior pharyngeal wall; SP, soft palate

the development of good speech. It is difficult to create and maintain a pharyngeal flap large enough to produce competent palatopharyngeal valving without obstructing the airway in the presence of a neurogenic deficiency of the critical muscles. In this case, the pharyngeal section of a speech aid prosthesis may serve better to reduce nasality and nasal emission.

4. Delayed surgery: When surgery is delayed for medical reasons or when the surgeon prefers to repair the palate at a later stage, the cleft palate may be temporarily closed with a speech aid prosthesis.
5. Expansion prosthesis to improve spatial relations: An expansion prosthesis may be used to restore and / or improve spatial relations of the maxillary segments prior to surgery.
6. Combined prosthesis and orthodontic appliance: An orthodontic appliance may be combined with a prosthesis to move malposed teeth into a more favorable alignment.

In operated patients:

1. Incompetent palatopharyngeal mechanism: If the clinical and cineradiographic analyses suggest that the patient is near a functional closure, prosthesis may serve as a physical therapy modality. The pharyngeal section of the prosthesis is gradually reduced as muscle function improves and the prosthesis is eventually discarded.[5]
2. Surgical failures: Prosthesis should be considered when a patient presents a palate which is low vaulted, heavily scarred and contracted or one which has a large perforation or multiple perforations.

Contraindications of prosthodontic care

1. Feasibility of surgical repair: Only when a surgical closure of the cleft will produce an anatomic and functional repair.
2. Mental retardation: A mentally retarded patient is not a good candidate for prosthesis. An appliance needs reasonable personal care and a mentally retarded individual may not be capable of such care.
3. Uncooperative patient and parents.
4. Uncontrolled dental caries: The edentulous condition itself is not a contraindication for a speech aid prosthesis.
5. Lack of a trained prosthodontist: The prosthodontist engaged in cleft palate rehabilitation should be thoroughly familiar with the anatomy and physiology of the regions involved and with the basic rules governing fixed and removable partial denture prostheses. Specifically he should have received adequate training in cleft palate prosthodontics.

Objectives in prosthodontic speech appliance constructions

1. Socially acceptable speech
2. Restoration of the masticatory apparatus
3. Esthetic facial and dental harmony
4. Psychologic adjustment of the patient to the condition

Other objectives include

1. Each part of the prosthesis must be designed to suit the individual patient and situation in relation to his oral and facial balance, masticatory function and speech.
2. All techniques and disciplines in removable partial and complete dentures should be kept in mind in designing the maxillary part of the prosthesis. The preservation of the remaining dentition and surrounding soft and hard tissues in cleft palate patients is one of the main objectives.
3. The prosthetic speech appliance requires more retention and support than other restorations. In adult patients, the crowning and splinting of the abutment teeth increase the retention and support of the prosthesis.
4. Full considerations should be given to the prosthetic treatment of the reduced vertical dimension of occlusion in the cleft palate patient. Lack of lateral and vertical growth of the maxillae and partial eruption of the deciduous and permanent teeth are often seen in patients with congenital cleft palates. Gingivectomy is performed to expose enough of the clinical crown. These teeth are only used for support of the prosthesis and not for retention.
5. The weight of the prosthetic speech appliance should be kept to a minimum.

Thus, a prosthodontist can best contribute to the total care of the patient with a cleft palate by participating in all the phases of treatment from birth to the completion of growth.

In 1958, Gibbon and Bloomer[6] were the first to advocate the use of a palatal lift appliance (PLA) to treat paralytic dysarthria involving insufficient rhinopharyngeal closure. In the case of a cleft palate, this PLA will not serve any purpose. In such circumstances, a pharyngeal extension on the speech obturator can be used.

DIAGNOSIS OF PALATOPHARYNGEAL INCOMPETENCE

Diagnosis[7] can be done by the following methods

1. Oral assessment: Oral assessment can only identify problems related to structural anatomy 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 [Figure 4].

2. !Speech assessment: To determine!
   - !Whether the palatopharyngeal dysfunction is ! consistent or intermittent.
   - ! The degree to which this dysfunction is contributing ! to the overall impairment of speech.

Speech assessment includes:!
- Oronasal resonance!
- !Inappropriateness of nasal air flow during oral ! consonant production!
- Speech articulation!
- !Overall speech intelligibility!

3. Videofluorographic assessment: Multiview ! fluoroscopy including lateral and frontal projection ! can be used to evaluate the function of the ! palatopharyngeal port during the production of ! controlled samples of connected speech.[1]!

Lateral view shows:!
- !Soft palate mobility and elevation!
- !Soft palate movement patterns relative to speech ! samples
- ! Linear dimensions of the residual palatopharyngeal ! inadequacy

Frontal view shows:!
- !Symmetry of soft palate elevation!
- ! Symmetry, position and extent of medial movement ! of lateral pharyngeal walls!
- !Vertical position where the maximum medial ! excursion occurs relative to the point of attempted ! soft palate-posterior pharyngeal wall contact!

The tracing of videofluoroscopy provides a "blue ! print" that will aid the prosthodontist in defining ! the initial length, configuration and position of the ! prosthesis. This blue print provides the basis on ! which the best estimate of the initial length, shape ! and position of the speech bulb can be made.

4. Videonasoendoscopy: Like videofluoroscopy, ! the palatopharyngeal port can be observed and ! recorded (both visual image and simultaneous sound ! recording) during speech using videonasoendoscopy. ! Unlike !fluoroscopy, nasoendoscopy does not use ! radiation and thus can be used as long and often ! as needed.

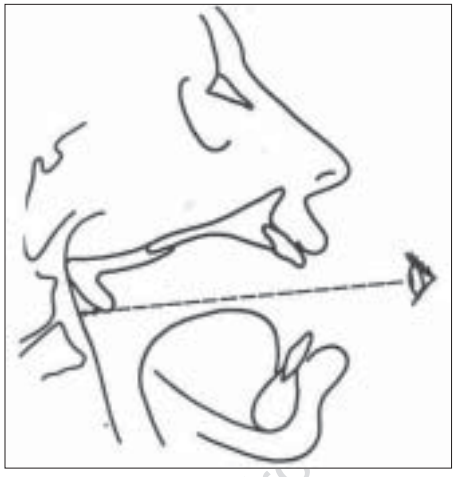

Figure 4: Drawing illustrates limitations of visual inspection of palatopharyngeal closure.

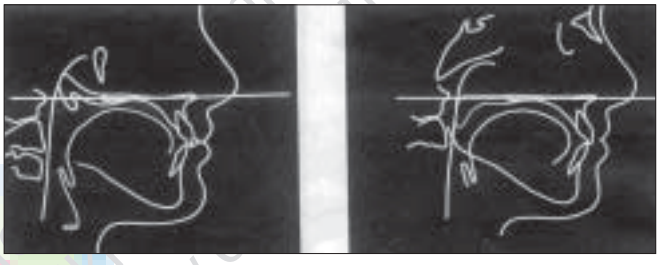

Figure 5: (Left) line drawing illustrates typical configuration palatal closure for men with normal speech, (right) for women with normal speech

Figure 6: Radiograph showing pharyngeal bulb at the level of first cervical vertebra

GUIDELINES FOR PALATAL LIFT APPLIANCE POSITION

Based on the fluoroscopic and nasoendoscopic ! studies,!

1. There should be a 5 mm gap between the bulb ! and posterior pharyngeal wall at rest.
2. Angle of the bulb relative to the palatal plane ! should be approximately 20°.
3. Mckerns and Bzoch[8] showed that in men, 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 [Figure 5].

4. Many dentists have attempted to approximate pharyngeal tissue overlying the anterior tubercle of the first cervical vertebra on the basis that this was the area of maximum constriction[9] [Figure 6].
5. The speech bulb should be placed in the location of the greatest posterior pharyngeal and lateral pharyngeal wall activity since voice quality is judged bestwhen the speech bulb is at these positions.
6. The inferior-superior dimensions and weight of speech bulb may be reduced without any apparent effect on nasal resonance. (The lateral dimension of the bulb does not change significantly as the position is varied).

CONCLUSION

Palatopharyngeal dysfunction during speech can be diagnosed by general chair-side measures. A specific treatment plan, surgery, speech therapy and / or prosthodontic treatment plan can best be determined by multiview fluoroscopy and nasoendoscopy. Whereas most patients with palatopharyngeal incompetency are treated with operations or speech therapy or both, there are individuals who may benefit most from palatal lift prosthesis than from other treatments. To achieve maximum benefit of a palatal lift prosthesis, the prosthodontist and speech pathologist together must use the technology of fluoroscopy and nasoendoscopy in the design, placement and modification of the prosthesis.

REFERENCES

1. Skolnick ML. Videofluoroscopic examination of the velopharyngeal port during phonation in lateral and base projections-a new technique for studying the mechanics of closure. Cleft Palate J 1970;7:803-16.
2. Skolnick ML, McCall GN, Barnes M. The sphincteric mechanism of velopharyngeal closure. Cleft Palate J 1973;10:286-305.
3. Spratley MH, Chenerey HJ, Murdoch BE. A different design of palatal lift appliance: A review and case reports. Aust Dent J 1998;33:491-5.
4. Chalian VA, Drane JB, Standish SM. Maxillofacial prosthesis, Multidisciplinary practice. The Williams and Wilkins Company: 1972. p. 358.
5. Mazaheri M. Prosthetics in cleft palate treatment and research. J Prosthet Dent 1964;14:1146-58.
6. Gibbons P, Bloomer H. A supportive type prosthetic speech aid. J Prosthet Dent 1958;8:362-9.
7. Turner GE, Williams WN. Fluoroscopy and nasoendoscopy in designing palatal lift prostheses. J Prosthet Dent 1991;66:63-71.
8. McKerns D, Bzoch KR. Variations in velopharyngeal valving: The factors of sex. Cleft Palate J 1970;7:652-62.
9. Aram A, Daniel J. Subtently. Velopharyngeal function and cleft palate prosthesis; J Prosthet Dent 1959;9:149-57.

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