The journal of
PROSTHETIC AND IMPLANT DENTISTRY
Official Publication of Indian Prosthodontic Society
Kerala State Branch

VELOPHARYNGEAL DEFECTS AND THEIR PROSTHODONTIC MANAGEMENT – A REVIEW

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Introduction

Maxillofacial prosthetics is the branch of prosthodontics concerned with the restoration and/or replacement of stomatognathic and craniofacial structures with prostheses that may or may not be removed on a regular or elective basis.[1]

-GPT 9

Maxillofacial prosthesis is any prosthesis used to replace part or all of any stomatognathic and/or craniofacial structures.[1]

-GPT 9

Success in maxillofacial prosthetics depends on the full cognizance of the principles that underlie facial harmony, anchorage and retention, weight bearing and leverage, durability, tissue compatibility and tolerance.

The velopharynx is a dynamic anatomic structure which is essential for normal breathing, eating and speech. The soft palate acts as a separator between the oral and nasal cavities. Impairment of velopharyngeal function can be caused by either insufficiency or incompetency.

Definitions

1. **Speech aid prosthesis-** a removable maxillofacial prosthesis used to restore an acquired or congenital defect of the soft palate with a portion extending into the pharynx to separate the oropharynx and nasopharynx during phonation and deglutition, thereby completing the palatopharyngeal sphincter.(GPT9)[1]

2. Palatal lift prosthesis - a maxillofacial prosthesis that elevates the soft palate superiorly and aids in restoration of soft palate functions that may be lost because of an acquired, congenital or developmental defect.

Definitive palatal lift prosthesis- is usually made for patients whose experience with a diagnostic palatal lift has been successful, especially if surgical alterations are deemed unwarranted.

Interim palatal lift prosthesis- is usually made as a diagnostic aid to assess the level of possible improvement in speech intelligibility. (GPT 9)[1]

3. Obturator - a maxillofacial prosthesis used to close a congenital or acquired tissue opening, primarily of the hard palate and/or contiguous alveolar/soft tissue structures (GPT-7)[2]

Speech

Speech, as formulated, executed, perceived and decoded, is unique to humans. The production of speech requires the selective modification and control of an outgoing airstream through the complex and skilled coordination of more than 100 muscles within the respiratory, laryngeal, velopharyngeal and oral mechanisms. This intricate process begins within the CNS, but also relies on PNS.

Components of speech[3]

Kantner and West divided speech into 5 components:-

1. Respiration
2. Phonation
3. Resonation
4. Articulation
5. Neural integration

Chierici and Lawson added a sixth component

6. Audition

The successful and acceptable production of speech depends on the successful performance of these factors.

Respiration: speech begins with brief inhalation followed by extended expiration, during which pulmonary air interacts with resonating tubes and chambers in the throat, mouth, nose an cranium to produce audible speech signal for speech to be produced, alveolar pressure must exceed atmospheric pressure so that an outward flow of air will occur.

Phonation: vocal folds and the associated laryngeal musculature play a vital role in speech production. For unvoiced sounds, air from the lungs passes through an open larynx and is modified by downstream articulatory structures to produce speech sounds that are periodic in nature. For voiced sounds, air from the lungs sets adducted vocal folds into vibration, which creates a periodic sound wave that is selectively resonated and filtered within the vocal tract.

Resonation: the sound produced at the level of the vocal folds is not the final acoustic signal that is perceived as speech. The pharynx, oral cavity and nasal cavity act as resonating chambers by selectively filtering some frequencies and damping others, thus refining tonal quality.

Articulation: articulation occurs when resonated sounds reaches the oral cavity. The sound wave are formed into speech by the action of the moveable articulators, including the mandible, tongue, lips and soft palate against the immoveable articulator structures including the hard palate, alveolar ridge and teeth. Tongue is considered the most important articulator.

Neural integrity: speech is integrated by the CNS at both peripheral and central levels.

Mac Neilage and DeClerk stated that at least 17000 different motor patterns are required during speech.

Audition: ability to receive acoustic signals, vital for normal speech. Hearing permits reception and interpretation of acoustic signals and allows the speaker to monitor and control speech output.

Speech defects[4]

Of the 6 components of speech, resonance and articulation are the most relevant in maxillofacial prosthesis and are closely related.

Resonance disturbances are basically of 4 forms

1. Hypernasality-increased nasality
2. Hyponasality- decreased nasality
3. Mixed nasality-variation between too much and too little resonance
4. Cul-de-sac resonance-acoustic energy is resonated in the pharynx, behind a more anterior constriction,instead of freely flowing through the oral cavity.

Articulation deficiencies

Mostly in patients with acquired mandibular defects.

1. Obligatory errors: weakened consonants and

nasal air emission

2. Compensatory errors: patient makes an effort to produce a sound before it reaches an inappropriate palatopharyngeal opening thereby averting inappropriate flow of air through the nasal cavity.

Velopharyngeal anatomy and physiology

The velopharyngeal complex is divided into various anatomical components: *soft palate, posterior pharyngeal wall, lateral pharyngeal wall.*

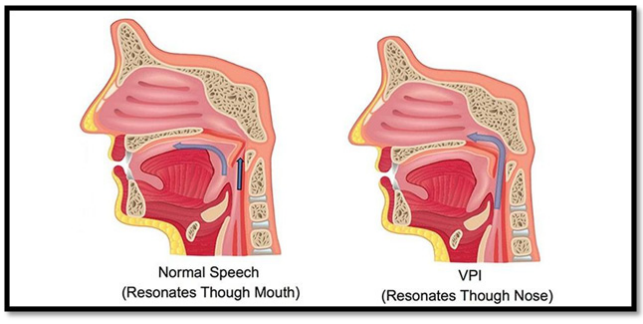
Velopharyngeal closure is attained by synchronous and sphincteric movements of the entire muscle complex.

Velopharyngeal mechanism

Velopharyngeal mechanism is a precisely coordinated valve formed by several muscle groups. At rest, the soft palate drapes towards so that the oropharynx and nasopharynx are open and coupled to allow normal breathing through the nasal passage.

During speech, when velopharyngeal closure is required, 4 patterns of closure is exhibited [Skolnick et al.]

1. Coronal pattern of closure
2. Circular closure
3. Circular closure with passavant's ridge
4. Sagittal closure.



Classification of velopharyngeal defects

1. Based on etiology
   a. Congenital
   b. Acquired
   c. Developmental
2. Based on anatomy and physiology
   a. Palatopharyngeal insufficiency
   b. Palatopharyngeal incompetence
   c. Palatopharyngealinadequancy

According to Taylor,

Palatopharyngeal insufficiency: when some or all of the anatomic structure of the soft palate is absent.

Palatopharyngeal incompetence: soft palate is of adequate dimensions,but lacks movement because of disease or trauma affecting muscular and/or neurologic capacity.

Palatopharyngeal inadequacy: includes incompetence and/or insufficiency but may also suggest a reduction or absence of pharyngeal wall function.

Prosthodontic rehabilitation

1. Palatopharyngeal inadequacy

- Main objective of prosthodontics rehabilitation is to prevent food and fluid leakage into the nose and to improve speech.
- Obturatoris fabricated.
- The prosthesis will include a pharyngeal and palatal/base section

Type of obturator

Immediate and delayed obturator

Immediate surgical obturation is most useful in dentulous patients, where the entire soft palate has to be resected. The principle advantage of using immediate surgical obturators for soft palate

defects is support and retention of the surgical packing. Some disadvantages are, Firstly, the drape of the intact soft palate precludes from obtaining an impression of the nasopharynx, where the normal velopharyngeal closure occurs and where the surgical obturator should be located. Secondly, functional movements of the velopharyngeal mechanism cannot be recorded either prior to or during surgery. Thirdly, the pharyngeal tissues which are peripheral to the defect will usually exhibit little movement during function in the immediate postoperative period. Fourthly, the extent of tumours in this region is more difficult to visualize; hence, it is more difficult to delineate the surgical margins presurgically.

Delayed surgical obturation: In edentulous patients, or in patients with limited medial or lateral posterior border resections, a delayed obturation may be the treatment of choice. In edentulous or partially edentulous patients, consideration should be given to attachment of the delayed surgical obturator to the existing maxillary complete or partial denture

Interim obturator

Definitive obturator

Patients exhibiting considerable movement of the residual velopharyngeal complex during function have excellent prognosis for achieving normal speech with prosthesis. The obturator is attached to a conventional prosthesis. If the patient is dentulous, a removable partial denture framework retains the obturator. The obturator should be rigid. Therefore, it does not attempt to duplicate the movements of the soft palate. It is a fixed platform of acrylic resin, which provides surface contact for the remaining musculature of the velopharyngeal mechanism during function. If the lateral and posterior pharyngeal walls exhibit normal movement, a space will exist between these structures and the obturator when these tissues are at rest. This space permits breathing through the nasal cavity. Subtelny et al., reported that a group of patients who could not speak successfully and had restorations with pharyngeal sections that extended below the palatal plane. Contact between the palatal extension section and the dorsum of the tongue was observed

2. Palatopharyngeal insufficiency

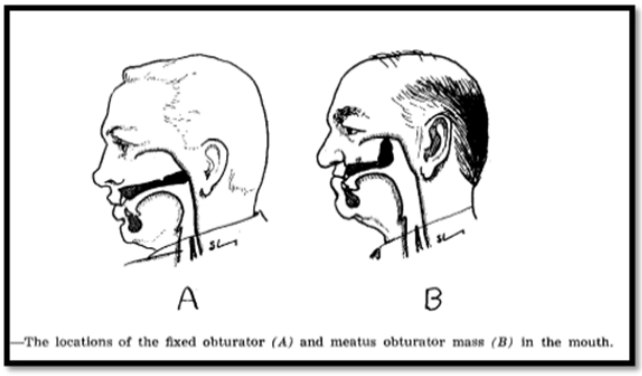
- Main objective is to provide a prosthesis that does not displace the soft palate but replaces the missing portion of the soft palate.
- Pharyngeal prosthesis/speech bulb prosthesis/speech aid prosthesis is fabricated.

Types of pharyngeal obturators [According to Sharry]

Hinged type (Olinger 1952)

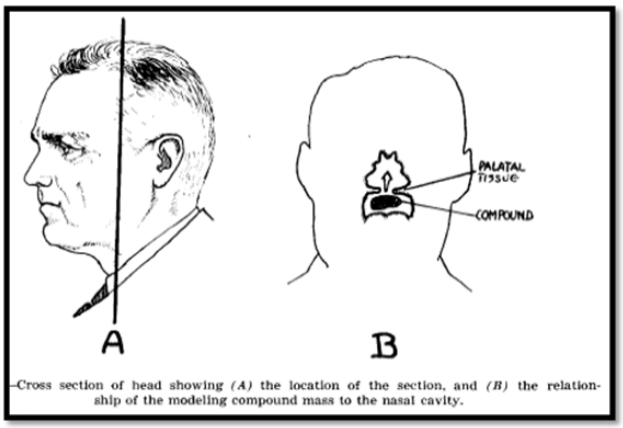
Fixed type (Suersen,1868)

Meatus obturator (Schalit 1946)



The locations of the fixed obturator *(A)* and meatus obturator mass *(B)* in the mouth.

Fixed and meatus obturator[8]



Cross section of head showing *(A)* the location of the section, and *(B)* the relationship of the modeling compound mass to the nasal cavity.

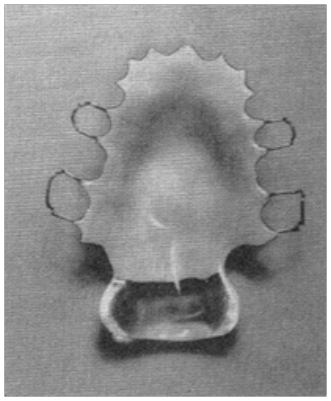
Cross section of meatus obturator[8]

Hinged type pharyngeal obturator[9]

3. Palatopharyngeal incompetence

- Main objective is to fabricate a device to position the soft palate which is normal in anatomy but has reduced functioning or no functional ability.

- Palatal Lift prosthesis (Gibbons and Bloomer,1958) is provided.



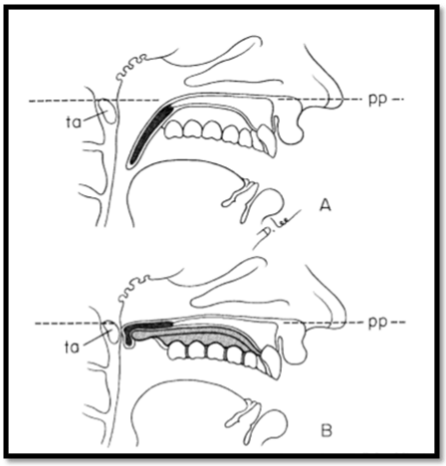
palatal lift prosthesis

Types of palatal lift prosthesis

Interim palatal lift prosthesis

Definitive palatal lift prosthesis

Prosthetic treatment with a palatal lift prosthesis was first reported by Gibbons and Bloomer. This type of prosthesis is especially useful for patients with velopharyngeal incompetence. The objective is to displace the soft palate to the level of normal palatal elevation,thus enabling closure by pharyngeal wall action. If the length of the wall is insufficient to effect closure after maximal displacement, the addition of an obturator behind the displaced soft palate may be necessary.[6]



Palatal lift prosthesis in position.[7]

Conclusion

The primary objective in each case would be to construct a prosthesis which will restore the defect, improve aesthetics and thereby benefit the morale of patient. The improvements in aesthetics and function are not only essential for the patient's physical well being, but they also contribute to his/her mental attitude.

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