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REVIEW ARTICLE

Phonetics in complete dentures

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ABSTRACT

Speech is a learned function that requires adequately developed nervous system, clear vision and hearing ability. Failure in development of any of these systems or the components involved in the production of speech will result in defective phonation. A prosthesis fabricated for a patient should be mechanically functional, esthetically pleasing and should allow proper phonation . Therefore, a prosthesis should be fabricated in such a way that it does not hinder speech. A clinician may often come across situations where prosthodontic treatment is required to correct the speech. A prosthodontist, therefore must have a good understanding of production of speech and the various components of speech. This review article presents the importance of phonetics in complete denture patients.

INTRODUCTION

Phonetics is a complex phenomenon of the emission of voice, the combination of phonemes at different frequencies. Each person's voice is unique and is determined by the size of the resonator system which comprises of the oral cavity, larynx, pharynx, vocal folds, paranasal sinuses, that vibrates at different frequencies to produce sound. phonetics can also guide proper rehabilitation with complete denture. Speech can identify natural anterior tooth position. Speech can also assess the occlusal vertical dimension, extent of denture border, thickness of denture base and other important parameters.

HISTORY

- In 1949 'Sears' recommended grooving the palate just above the median sulcus of the patient.
- In 1951 'Pound' was successful in improving phonetics by contouring the entire palatal aspect of the maxillary denture to simulate the normal palate
- 'Landa' suggested the use of 's' sound to determine the adequacy of 'free way space' & 'M' sound to establish a desirable 'rest position'.
- 1953 & 1956, 'Silverman' used 'speaking method' to measure patient's vertical dimension in natural teeth with dentures & without dentures.

- ‘Morrison’ suggested the use of the word, ‘sixty six’ & ‘Mississippi’ to determine closest speaking space
- 1967, ‘Kaire’ reported & determined the palatal pressure of the tongue in the pronunciation of selected palatolingual speech sounds, by electronic means under predetermined vertical dimensions of occlusion.

COMPONENTS OF SPEECH

- Respiration
- Phonation
- Resonation
- Articulation
- Neurological Integration
- Ability To Hear Sounds

CLASSIFICATION OF SPEECH

1. **Vowels : a, e, i, o, u**

- The vocal cords are activated by the production of these sound.
- The tip of the tongue lies on the floor of the mouth either in contact with or close to the lingual surfaces of the lower anterior teeth and gums.
- Vowel sounds are affected adversely by setting the mandibular anterior and posterior teeth lingually off the ridge. Setting the mandibular teeth too far lingually crowds the tongue in the floor of the mouth and makes the production of vowel sounds defective. The tongue is often seen to be broad after a prolonged edentulous period,so the crowding of the tongue may be experienced even when the teeth are set in the correct positions. If the denture is correct phonetically for the consonant sounds, the vowels present little or no trouble.

2. **Consonants: p, b, m, s, t, r, z.**

- The production of consonants requires the airstream to be impeded, diverted, or interrupted before it is released.
- Voiced or breathed sounds.
- Vocal cords may or may not vibrate.
- Consonants are further divided into categories:

- Plosives/stops
- Fricatives
- Affricatives
- Nasal
- Liquid
- Glides

CLASSIFICATION OF CONSONANTS BASED ON THE PLACE OF THEIR PRODUCTION

Consonants may be classified according to the anatomic parts involved in their formation:

1. Linguopalatal sounds, formed by tongue and hard/soft palate.
2. Linguodental sounds, formed by the tongue and teeth
3. Labiodental sounds, formed by the lips and teeth
4. Bilabial sounds, formed by the lips.

Tongue is positioned just behind the maxillary incisor teeth with the sides of tongue in contact with maxillary posterior teeth & alveolar ridge .Tongue is placed firmly against the anterior hardpalate .Posterior dorsal tongue is raised toocclude with soft palate. Tip of tongue

isplaced between maxillary andmandibularteeth,formed by lower lipcontacting the incisal edge of themaxillary incisor teeth.

USE OF PHONETICS IN DENTURE CONSTRUCTION

The loss of one or more teeth can alter phonetics. Spaces created by tooth loss are, at times, closed by the tongue, lips or cheeks. Phonetic articulation is often difficult, and can cause increased salivation. There are various causes of speech sound problems in complete denture wearers.

Phonetics can be used to facilitate different phases of denture construction :

- Determination of Vertical Dimension
- Determination of Neutral Zone
- Anterior Teeth Placement

DETERMINATION OF VERTICAL DIMENSION

The exact measurement of the natural vertical dimension is most essential in the successful practice of many phases of dentistry. It has been found that the greatest cause of full denture difficulties is the failure to duplicate the normal vertical dimension. The maintenance of a correct freeway space is fundamental to restore a good phonatory space.

RECORDING REST POSITION

1. Have the patients repeat the name Emma until they are aware of the contacting of the lips as the first syllable em is pronounced.
2. Engage patient in a conversation to divert their attention. A pause in speech, followed by relaxation as indicated by a drop in mandible, is indication for measurement.

RECORDING VERTICAL DIMENSION OF OCCLUSION

It has been suggested that the mandibular position during the pronunciation of sibilant sounds can be used to establish OVD (Silverman MM. 1953; Pound E. 1977)

It is believed that closest speaking space for each individual is constant throughout life. In addition, it was stated that speech positions are not affected by the removal of teeth.

The speaking method of measuring vertical dimension is a physiologic phonetic method which measures vertical dimension by means of the closest speaking space. This space is measured before the loss of the remaining natural teeth to give us the patient's natural vertical dimension which can be recorded and used at later dates. The same closest speaking space should be reproduced in full dentures as is found in the natural dentition. This space is also the means of proving that vertical dimension must not be increased.

- Phonetics tests of the vertical dimension consist more of listening to speech sound production than of observing the relationships of teeth during speech : James D. Anderson.
- S sound : Silverman M., Pound
- M sound : Wagner
- Emma, Mississippi: Turrel

Three thirty-three: there should be enough space for the tip of the tongue to protrude between the anterior teeth.

Fifty-five: the incisal edge of the maxillary central incisors should contact the vermillion border of the lip at the junction of the moist and dry mucosa.

The Speaking Method, Meyer M. Silverman, 1953 The patient is seated in an upright position without the use of the headrest, with the eyes forward, and the occlusal surfaces of the upper posterior teeth parallel to the floor. The measurement is taken under identical conditions of posture and vigor of speech. The head must not tilt forward or backward, and

the patient should speak rapidly in a calm and relaxed manner. A particular observation must be made that the patient does not consciously control the movement of the mandible, as any variation from normal might affect the measurements. Direct the patient to close into centric occlusion, with the upper and lower teeth together in maximum occlusal contact. Draw the centric occlusion line with a sharp pencil on a lower anterior tooth at the horizontal level of the incisal edge of the opposing upper anterior tooth. Have the patient say "yes," and while the phonetic sound s is being pronounced, draw the closest speaking line on the same lower anterior tooth at the horizontal level of the upper incisal edge. The distance between the centric occlusion line (lower line) and the closest speaking line (upper line) is called the closest speaking space. This closest speaking space is the measurement for vertical dimension.The closest speaking space may vary in different individuals. In the series of patients examined, (Silverman, Meyer M, 1951) the measurements ranged from 0 to 10 mm., which proves that there is no such thing as "an average" in measuring vertical dimension. Measurement must be made with accuracy as it has been found that increasing the vertical dimension only one millimeter will cause discomfort to the patient.

The closest speaking space to measure the vertical dimension in this speaking method must not be confused with the free-way space of the centric relation method (Niswonger, M. E., 1934). The free-way space establishes vertical dimension when the muscles involved are at complete rest, and the mandible is in its rest position. The closest speaking space measures vertical dimension when the mandible and muscles involved are in the active full function of speech.

SPEECH TESTS

The phonetic aspect of denture construction deserves equal consideration with esthetics and mechanics and should be checked at the time of the waxed try in when it is possible to alter palatal contour to accommodate speech articulation.

First test is of random speech and is best accomplished by engaging the patient in conversation and obtaining a subjective speech.

The second test is to specific speech sounds. This is best accomplished by having the patient pronounce six or eight words containing the sound and then combining these words into a sentence.

In the third test, the patient is asked to read a short paragraph containing an abundance of s, sh, and ch sounds.

According to Nagle and Sear (1962) , when we ask a patient to say a speech sound such as "f" or "v" or even the sibilant "s", we are establishing an artificial relationship; even if we ask the patient to to express the famous words "Mississippi" or " fifty-five", we are still establishing an artificial speech situation which a patient may perform satisfactorily. Such a view of speech does not imply the symbolic , communicative and psychologic aspect of speech in which phonetics is only an automatic contributory phenomenon rather than the focal point of a speech situation. Thus, a patient may subordinate the swallowing and respiratory function in order to pass the phonetic speech test for the the prosthodontist. A better speech test for a denture involves engaging the patient in meaningful conversation in which he (1) express himself emotionally and employs his facial muscles in the expression of thought, (2) modifies and adjusts his respiratory rate and vigor in response to these emotional moods, and (3) repeatedly swallows his accumulated saliva. Such a speech evaluation at the try-in session requires adequate time in which to talk and to ask the patient to change his seat, to sit, and to walk about. It also requires stable baseplates. The speech test which requires such time also offers one of the best ways to evaluate the esthetics of the denture, for when a patient talks he reveals the exent of his animation, and we may thus observe the range of movements of the muscles during function (Nagle RJ and Sear VH, 1962).

USING PHONETICS TO DETERMINE THE CLASS OF OCCLUSION

This technique was suggested by Earl Pound. Through this technique we can precisely record the patient's class of occlusion, vertical dimension, centric occlusion and incisal guidance. This technique involves to determining the "S" position. Allow the patient to relax in the hinge position and note the amount of retrusion. The sum of movements will indicate the patient's occlusion and also when closed at this position we will be able to make conclusion about the patients original vertical dimension. If there is 2 to 3mm of retrusion, the incisal edges of lower anterior teeth will be seen close to the cingulum of the upper anterior teeth. Henceforth this will automatically adopt a class - 1 occlusion. If there is distal movement of anterior teeth of more than 3mm for the "S" position, the incisal edges of lower anteriors will be distal to cingulum of upper anteriors and many a times may be against the palatal soft tissues assuming a class -2 relation. If there is no distal movement from the "S" position the incisal edge of lower anteriors will be positioned in edge to edge relation, therefore assuming a class -3 relation.

PALATOGRAPHY

The tongue plays a major role in speech. It changes position and shape for the pronunciation of each of the vowels, and it is the principal articulator for the consonants. In pronouncing the consonants, the tongue contacts various portions of the teeth, the alveolar ridge, and the hard palate. Since these structures are either replaced or covered by the denture, it was basic to the study to know exactly which portions of these structures are normally contacted by the tongue in pronouncing a given consonant. To accomplish this, palatograms were made on a group of dentulous individuals, with normal speech, who were chosen so as to incorporate a maximum variety of tooth arrangement, tooth occlusion, arch form, arch size, vault form, and vault depth . It is a group of techniques to record contact between the tongue and the roof the mouth to get articulatory records for the production of speech sounds. Palatograms are the areas of tongue contact for a given sound displayed on an artificial palate through a medium of talcum powder.

1. The artificial palate made must be uniformly adapted, no adhesive must be used.
2. Patient who have severe gagging must not be used for making palatograms.
3. The patient has to be trained to open his mouth after uttering the desired word.
4. The tracing material must not be distasteful and its consistency should permit easy application
5. The palate has to be thoroughly dried before the medium is applied and the medium must have a contrasting colour so that it can be easily identified .
6. Talc is considered the best material that can be used for palatogram, although activated charcoal, chocolate powder where also used.

FACTORS AFFECTING PHONATION

1. Influence of the thickness the palatal vault on closest speaking space.

Phonetic tests while patients are producing sibilant sounds enable the dentist to identify the smallest speaking vertical separation of the anterior teeth occlusal rims .Burnnet(1994), Silverman(1952) affirms that theclosest speaking space (CSS) of each individual is constant throughout life. This would allow dynamic determination of the vertical dimension of occlusion (VDO) in both dentate and edentulous patients.

2. Denture thickness and peripheral outline

- Front vowels are more affected by palates than back vowels.
- Consonants were affected by artificial palates more than twice as much as vowels.
- Speech detoriated in direct proportion to the thickness of the palate.
- Decreased air volume and loss of tongue space in the oral cavity due to thick dentures.

- Thicker denture base specially at the palate would affect the clarity of the sounds/t/,/d/,/s/,/c/,/z/,/r/and /l/.

3. **Post dam area- the extension of the denture base12** is very important for a stable and retentive denture .if the borders are on to the movable tissues it tends to dislodge and patient will not be able to speak. Also liguopalatal consonants such as k, ng, g, and c(hard) are affected by incorrect post dam extensions. Mehiringer E J(1963) and Prendergart W.K (1935) one of the most important area which will affect the vowels I and E and the palate – velar consonants K.G.
4. **Width of the denture** Prendergart W.K (1935) and SharryJJ(1952) stated that is arch is narrow it will crumple the tongue which affects the size and the shape of the air channel resulting in faulty occlusion of the consonant like d,n,l,s,t where lateral margins of the tongue makes contact with the palatal surface of the upper posterior teeth.
5. **Relationships of the upper anterior teeth with lower anteriors.** Mehringer E.J(1963) Rowe Arthur (1936) and Pingo (2003): The S sound requires near contact of the upper and lower incisor teeth so that the air stream is allowed to escape through a slight opening between the teeth. Silverman(1967) stated that the whistle and swish sounds are produced during speech due to air abnormally passing over the tongue and through the interincisal space.
6. **Vertical Dimension:14**Fymbo (1936) pointed out that defective speech is most frequently associated with increased vertical dimension which may result in difficulty in pronouncing sound like b, m, p, f, v. Landa (1947) recommended various phonetic tests to determine proper vertical dimension using such sound as s, c, z.
7. **The Occlusal Plane:** Earl Pound (2006) and Rothman R (1961) concluded if upper anteriors are too short of occlusal plane the word “v” will more likely pronounce as “f”. If upper anteriors are arranged below the occlusal plane the word “f” will pronounced like “v”. The labiodental sounds like “f”, “v” are helpful in determining the antero-posterior positioning of the upper incisors and occlusal plane

CONCLUSION

The importance of phonetics in the field of prosthodontics is undeniable. It is mandatory for a clinician to have a working knowledge of the production of speech. Role of phonetics in fabrication of complete denture should be evaluated properly .Since speech is fundamental to us therefore, it is essential that a clinician delivers a prosthesis that allows clear speech.

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