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Phonetics in Complete Denture –A Review

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Abstract: **Fabrication of complete denture is an art but thorough knowledge of science behind its each component is utmost important. Complete denture not only restores the lost tissues and function but also speech. Each step in making of complete denture has a significant effect on speech and patients overall personality. This article enumerate these aspects of complete denture construction and their effect on speech production.**

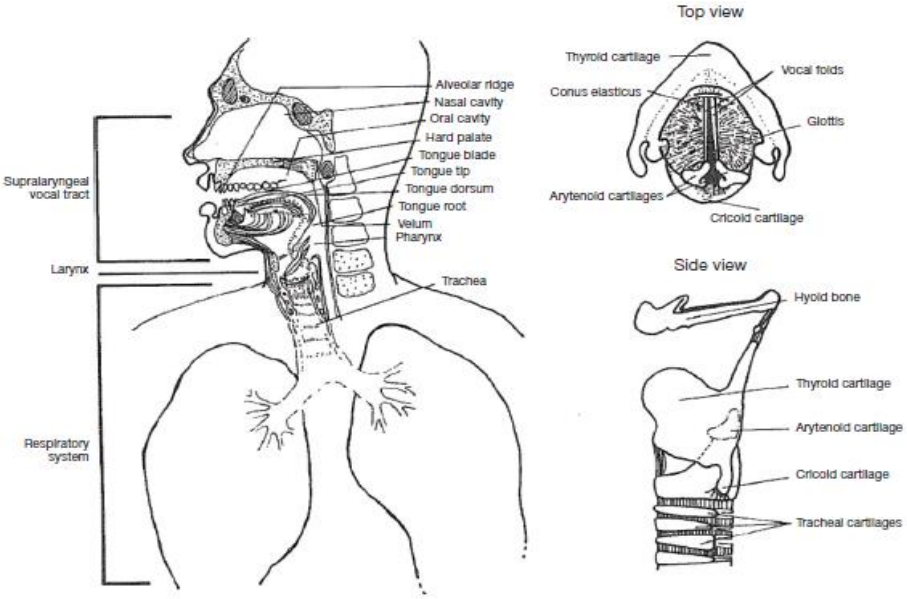
Keywords: **Denture thickness, Speech, Phonetic, Posterior palatal seal, Pronunciation.**

I. INTRODUCTION

Phonetics was studied as early as 2,500 years ago in ancient India, with Pânini's account of the place and manner of articulation of consonants in his 5th century BC treatise on Sanskrit. The major Indian alphabets today order their consonants according to Pânini's classification. Speech is a very sophisticated independent and unconscious activity. The loss of teeth and supporting structures alters the main articulatory cavity and produces a significant effect on the speech pattern proportionate to the location and magnitude of alterations. An empiric approach to the phonetic factor in denture construction frequently places the burden for compensating for speech changes for the adaptability of the tongue. Additionally significant is the fact that the speech mechanism is highly susceptible to degenerative diseases. If dentures are to contribute effectively to the functions of speech, dentists should use studies in the speech science field to increase their clinical knowledge of the phonetic factor in denture construction.[1,2]

II. THE ORGANS OF SPEECH

It should be mentioned that the human being does not possess the organs which are exclusively used for producing speech sounds. All the organs involved in pronunciation of speech sounds, and human speech in general, primarily fulfill other functions – the functions of swallowing and digesting food, respiratory functions, etc.



The organs of speech began to be utilised by human beings for the production of speech sounds in the course of their development as Homo sapiens.

When a thought which is to be communicated arises in the cortex a signal is transmitted through the nervous system to the organs of speech. The organs of speech, obeying this produce speech sounds by which the thought is expressed.[3]

Major anatomical components of the speech production system with the top and side view of the larynx.[4]

In this article we will discusses about the various reviews on phonetics and speech in relation to prosthetic dentistry.

Table.1: demonstrates the classification of speech sounds.

Voiceless speech sounds (created by air alone)		
Fricatives	Air is forced by tongue through a narrow aperture& is associated with friction	s, sh, th, f
Piosives	Explosive release of air	P, t, k
Affricatives	A combination of the friction & explosive elements	ch
Voice speech sounds (created by laryngeally produced noise)		
Vowels	Formed from continuous vocal cord vibrations; tongue & lip positions impart structural overtones	a, e, i, o, u
Voiced consonants	A combination of air produced sounds & laryngeal tone	b, d , j, m ,q , r
Classification according to anatomic sound formation		
Palatolingual Tongue & Hard palate	Tongue is positioned just behind the maxillary incisor teeth with the sides of tongue in contact with maxillary posterior teeth & alveolar ridge	s
Tongue & Hard palate	Tongue is placed firmly against the anterior hard palate	t, d ,n
Tongue & soft palate	Posterior dorsal tongue is raised to occlude with soft palate	k, g, ng
Linguodental	Tip of tongue is placed between maxillary and mandibular teeth	th
Labiodental	Formed by lower lip contacting the incisal edge of the maxillary incisor teeth	f,v
Bilabial	These sounds are formed between the lips	b,p,m

III. DISCUSSION

1. Influence of the thickness of the resin palatal vault on the closest speaking space with complete dentures:

Phonetic tests while patients are producing sibilant sounds enable the dentist to identify the smallest speaking vertical separation of the anterior teeth occlusal rims (Burnett, 1994). Silverman (1952) affirms that the closest 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.

The `CSS Technique', has gained wide acceptance and has been used in clinical research (Pound, 1966, 1977; Gillings, 1973). Burnett and Clifford (1993) demonstrated that the CSS can be consistently determined from reading a long passage of prose, a short sentence or from pronouncing individual words, each containing the sibilant sounds. Morrison (1959) suggested using the words sixty-six and Mississippi. On the basis of an extensive literature review, Burnett and Clifford (1993) stated that, in clinical practice, it is justified to create a CSS of 2 mm between the incisors in denture construction. However, it must borne in mind the variability of this parameter (from 0 to 10 mm) reported by Silverman (1952) and Geissler (1975).

Clemencon (1967) has claimed that it is possible to change the size of the CSS by changing the size of the spatial/S/clearance. He believes it is possible to increase the CSS by thickening the resin palatal vault of a complete denture. This procedure could allow an increase of the VDO, in cases in which it is too low from the aesthetic stand-point, avoiding contact between opposing teeth during speech.[5]

2. Clinical rest and closest speech positions in the determination of occlusal vertical dimension:

The assessment and establishment of occlusal vertical dimension (OVD) is a central tenet in the management of patients requiring fixed or removable prostheses. However, the clinical determination of what might constitute an acceptable OVD raises concerns regarding the rest vertical dimension, the temporomandibular joint and neuromuscular adaptation. A number of methods to evaluate and establish OVD are advocated but none has been shown to be scientifically more valid than any other (Rivera-Morales & Mohl, 1991).

The clinical rest position (CRP) is a commonly used reference point in the determination of OVD and when in this position there is a variable space between the maxillary and mandibular teeth, or alveolar ridges, which is referred to as the interocclusal distance. The dimension of the CRP is considered as a range, affected by a number of factors, rather than an absolute one (Tallgren, 1957; Wessberg, Epker & Elliot, 1983). The CRP of the edentulous is considered an unreliable means of re-establishing the original OVD (Sheppard & Sheppard, 1975; Lambadakis & Karkazis, 1992), but is still commonly used to determine a clinically acceptable interocclusal distance for these patients. The treatment of dentate patients with toothwear often employs management techniques which require an assessment of the original OVD (Turner & Missirlian, 1984; Watson & Tulloch, 1985). The amount of toothwear is, however, not easily equitable with loss of OVD as compensatory mechanisms may operate to maintain the staus quo (Berry & Poole, 1976). The most superior position of the mandible assumed during speech has long been advocated for the establishment of OVD (Silverman, 1951; Pound, 1966). However, more recent reports suggest that techniques based on speech sounds are not as reliable as they are generally regarded to be in the evaluation of OVD (Rivera-Morales & Goldman 1997).

3. Speech performance:

"Silverman" suggested that incorrect determination of the vertical dimension of occlusion and improper placement of anterior teeth frequently results in a lisp or substitution of the /th/ sound for the /s/ sound." Tanaka" found that in edentulous patients the placement of a denture resulted in overall improvement of speech with time. He noted that the sounds most frequently in error were the sibilant sounds and that palatal contour can affect certain speech sounds.

"Boucher" and "Allen" reported that edentulous patients tend to return to normal speech patterns relatively soon after insertion of dentures, whereas "Troffer" and "Beder" found that normal speech patterns were not observed weeks after the insertion of immediate dentures.[7]

4. Phonetics and obturators:

Although there are several different types of objective outcome measures for speech available, there are relatively few reports that include such measures for patients having undergone a maxillectomy. Mahanna et al reported results for two patients with and without a maxillary obturator. These authors reported near-normal acoustic measures of nasality, relatively high speech intelligibility measures after prosthetic rehabilitation for these two patients. Although the authors were successful in documenting speech outcomes, the number of subjects was small and there were no preoperative data to which the postoperative data could be compared. Tobey and Lincks documented the acoustic speech patterns of five patients and determined that prosthetic rehabilitation reduced nasal resonance in their patients. Acoustic analysis revealed a reduction in the amplitude of nasal formants such that speech was characterized by vowel formant patterns that approximated normal. This study provides support for the notion that a prosthesis will restore acoustic patterns to normal. However, although the study addressed the resolution of the impairment (ie, effective separation of the oral and nasal cavities), it did not address the functional aspect of speech after prosthetic rehabilitation (ie, the ability to communicate so that speech is understood). Finally, Yoshida et al reported intelligibility results for eight patients preoperative and postoperative, with and without prostheses. Their results revealed moderately high intelligibility scores with a maxillary prosthesis. While this study assessed intelligibility in an objective manner, it is questionable whether it assessed functional speech, as the intelligibility measures only included a syllable-production task instead of connected speech.[8]

5. Tongue factor:

Kaires measured the pressure of the tongue against palates of "correct" height and of incorrect heights. The pressures during speech, measured with strain gauges -an order of ounces-were greatest at the posterior portions of the palate, and

were greatest when the palate was of correct height. In constructing oral prostheses, dentists are primarily concerned with replacing structural losses; however, they are necessarily adding to regions having no structural loss, for example, the hard palatal region. In the articulation of speech, this is a most critical region. The anterior third of the palate has been referred to as the "playground of the tongue." Wright and others found that the level of the natural or optimal position of the tongue in most cases seems to be controlled by the vault of the palate. Extremely sensitive tongues become retracted after the insertion of an artificial palate. Yet there is no consensus as to the most desirable thickness for palates in complete dentures. Allen advocates making the palatal portion as thin as is practical. Over-all dentures range from 0.5 mm. to 10 mm. in thickness.[9]

IV. PROSTHETIC CONTEMPLATION

1. Denture Thickness and Peripheral Outline:

Martone constructed palates of four heights for two subjects with normal speech. Recordings were made of the subjects speaking with the artificial palates in place and with no artificial palate. The study showed a significant relationship between the thickness of the palate and the amount of speech impairment. The principle effect was in the articulation of consonants. The study revealed that

(1) front vowels were more affected by palates than back vowels

(2) consonants were affected by artificial palates more than twice as much as vowels

(3) speech deteriorated in direct proportion to the thickness of the palate.[10]

Allen (1958) found that an additional thickness of 1mm in the anterior palatal area made speech uncomfortable and indistinct. The denture base thickness in the postdam area will annoy the dorsum of the tongue which will hamper the speech and there is a likelihood of feeling of nausea and denture may be unseated during sounds. The upper denture base in posterior region must be kept thin and the posterior border should be merge with soft tissues[10]

2. Vertical Dimension:

Fymbo (1936) pointed out that defective speech is most frequently associated with increased vertical dimension which may result in difficulty in pronouncing sounds like b, m, p, f, v. Landa (1947) recommended various phonetic tests to determine proper vertical dimension using sounds such as s, c, z.

Silverman (1956) stated that sibilant sound "s" as a mean for determining the correct vertical dimension. He established the closest speaking space‖ and used this as clearance area between the dentures. The bilabial sounds like "m" is useful in determining the vertical dimension, when this sound is pronounced there will be passive contact between the upper and the lower lip, which aid in obtaining the correct vertical dimension.

Seifert E, Runte C, Riebandt M, Lamprecht - Dinnesen A, Bollmann F (2000) concluded that variations of thickness and or volume of dentures and of the vertical and horizontal dimension of occlusion may result in unpredictable audible changes to the voice. Patients should be informed about possible effects of modified or new dentures on their voice.[3]

3. 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 be pronounced like "v". The labiodental sounds like "f", "v" are helpful in determining the antero-posterior positioning of the upper incisors and the occlusal plane. If the occlusal plane is set too high the correct positioning of the lower lip may be difficult, if on the other hand the plane is too low, the lip will overlap the labial surfaces of the upper teeth to a greater extent than is required.

4. The Antero posterior Position of the Incisors:

Pound E.(1966) and Mehringer, E.J (1963):In setting the maxillary anterior teeth consideration of their labiopalatal position is necessary for the correct formation of the labiodental F, V and Ph.. The change in any direction will result in improper execution of /s/ sound. The labial angulation seem to have greater effect than palatal angulation. If the lower anterior teeth are arranged too lingually, the tongue is forced to arch itself upto a higher position and the airway is to be too small and there will be faulty pronunciation in /s/ and /z/ sounds.

5. The PPS Area:

Mehringer, E.J (1963) and Prendergast, W.K. (1935) One of the most important area which will affect the vowels I and E –and the palate velar consonants K, G. Increased thickness in the postdam area results in irritation of the dorsum of the tongue, impeding speech and possibly producing a feeling of nausea.

6. Width Of Dental arch:

Prendergast, W.K. (1935) and Sharry, J.J. (Ed), (1962) stated if the arch is narrow, which will crumple the tongue which affects the size and shape of the air channel results in faulty articulation of the consonants like t, d, l, n, s, t‘ where lateral margins of the tongue makes contact with palatal surfaces of the upper posterior teeth

7. Relationship Of Upper Anterior to Lower Anterior teeth:

Mehringer, E.J (1963) , Rowe Arthur T(1936)and Pigno MA, Funk JJ(2003):The S sound requires near contact of the upper and lower incisors so that the air stream is allowed to escape through a slight opening between the teeth. In abnormal protrusive and retrusive jaw relationships, some difficulty may be experienced in the formation of this sound, and it will probably necessitate adjustment of the upper and lower anterior teeth antero posteriorly, so that approximation can be brought about successfully. The consonants Ch, J and Z require a similar air channel in their formation. Silverman (1967) stated that the Whistle and Swish sounds are produced during speech due to air abnormally passing over the tongue and through the inter-incisal space. These sounds may be caused due to decreased overjet.[3]

V. CONCLUSION

Replacement of missing dentition with complete denture is a major event in patient‘s life. This brings drastic change to his/her activities. The denture should be such that the patient get along with it very comfortably and the most essential facet of this is speech. In complete dentures the impressions, accurate periphery, vertical dimension, arch form, position of the anterior teeth etc should be such that they allow natural articulators such as tongue ,lips to work efficiently with the morphological changes in the oral cavity thus results in pronunciation of each word to its fullest perfection. This article reveals all the steps of denture fabrication with its effect on speech which help in construction of a perfect complete denture.[1]

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