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Research Article

ACOUSTIC SPEECH EVALUATION ON INDIVIDUALIZE REPLICATED PALATAL ANATOMY IN THE MAXILLARY COMPLETE DENTURE IN TWO EVEN THICKNESS

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ABSTRACT
Speech sound may be analysed in terms of frequency, intensity, and duration. Such acoustic characteristics are related to physical properties of sound resonation and air flow. Although speech sounds are most readily heard, they may be "seen" spectrographs record shows an inked plot of varying intensity for different frequencies. A spectrograph does provide a visual record of acoustic phenomena.

Key words:- Acoustic analysis, Replication Palatal anatomy, Formants.

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INTRODUCTION

The speech sounds may be differentiated based on the relationship of formants created as laryngeal sound vibrates (resonates) in the pharyngeal and oral cavities. In spectrographic data, which illustrate the relationship between different vowels and consonants in terms of acoustic (first two formants) and physiologic (tongue position within the mouth factors).

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Consonantal Articulation

Consonants are articulated speech sounds, and all require articulation to impede, constrict, divert, or stop the airstream at the proper place and time to produce the desired sound. Stops are characterized by stoppage and sudden release of the airstream and require complete occlusion of the articulators involved (/p/,/t/,/k/) Fricatives are produced by the airstream being forced through loosely closed articulators or a narrow passageway. (/s/./sh/) Affricates /s/ and /*ch*/ are produced by a combination of stop and friction, accomplished by the articulation of the tongue and anterior hard palate. Diversion of the airstream is characterized by a stoppage

at one point to permit escape at another. (/m/,/n/) Vowels included in the pronunciations involve tongue palatal contact [1].

Tongue Palatal Patterns

It was found that no two subjects contacted the same area in pronouncing a given consonant.[2] The tongue-palate patterns for the /s/ and /sh/ are of particular interest. Phonetics can be performed well with adequate space for the tongue movement. The elevated tongue may not appear to touch the palate. For the back consonants, this may be due to variations in the thickness of the palatal mucosa and velum.

The tongue is a very important organ in the production of speech one cannot achieve sounds such as "S" and "Z" without the help of the tongue.[3] it may impede and selectively restrict the channel of air stream with precise contact against the teeth and palatal areas thus articulating the basic laryngeal sound or non phonated air steam into recognizable speech.[4] The loss of teeth and supporting structures, alter the main articulatory cavity and produces a marked impact on this speech pattern.

This inarticulate period, even thickness palate for proper tongue contact is difficult, time-consuming, or expensive, however, it does require some knowledge of the fundamentals of phonetics and precise knowledge of the normal tongue contact areas for speech articulation. These patients often require a tactile sense to orient the tongue and also, the lack of texture on the palatal portion of a complete denture can impede proper articulation. The palatal rugae and the incisive papilla can often serve as a 'cue'.[5-8]

Earlier authors (bloomer and Luchsinger and Arnold) [9] are suggesting nearly exact replication of the natural anatomy, into the denture base have supported the notion of duplicating the palatal rugae this has not been verified, nor has it become general practice, for speech purposes.

The purpose of this study is to reproduce, quick and easy methods of adding entire individualized natural anatomical palatal contour, in two even thickness (1.5mm and 2mm) into permanent denture base, including the incisive papilla, palatine suture, and palatal rugae to newly fabricated complete dentures, for the enunciation of normal speech immediately after insertion, thereby, eliminating or considerably reducing post insertion practice period, and evaluate the speech improvement [9].

AIM OF THE STUDY

To evaluate the difference in immediate speech improvement on the individualized replicated palatal contour of two different thickness, in modified maxillary complete dentures.

Objectives

1. To evaluate the speech improvement in the modified palatal contour of the maxillary complete denture in two different even thicknesses. (1.5 mm, 2.0 mm,)
2. To evaluate the speech quality in the conventional complete denture.
3. To compare the speech quality improvement immediately after insertion.

Speech evaluation

1. Immediately following the insertion of the conventional complete denture, and modified complete upper dentures.
2. Two weeks following the insertion of the dentures.

To assess' better difference, the orders of insertion were given as follows;

1. without denture (Group 4)
2. with conventional denture (group3)
3. Modified palatal contour with 2.0 mm thickness (group 2)
4. Modified palatal contour with 1.5 mm thickness (group 1)

Review of the literature

Snow 1899 [10] described the significance of adequate but not excessive contour in the anterior palatal and premolar areas, central and lateral lisping may develop in the patient's speech when the contour is incorrect.

David M. Watt 1978 [11] Incisive papilla is a guide that the vestibular surface of incisor teeth is placed 8-10 mm anterior to the incisive foramen.

Pound. E 1951 [12] discussed the development of an entirely new concept of denture form fashioning the palate areas is most important from the phonetic standpoint.

Mc Dowell 1936 [13] states the size and shape of the hard palate which acts as a sounding board probably has much to do with the quantity of the voice. The degree of influence of the textures of the lining of the cavities is probably very small.

Allen L.J 1958 [14] stated that to develop a normal "S" and "SH" sound it may be necessary to thicken the incisive Papilla region to prevent the jet of air emitted by the median sulcus of the tongue from escaping towards the vault. Bulking of the tongue palatal contact area and the area of the incisive papilla will facilitate proper enunciation and eliminate much of the post-insertion practice period [15,16].

Goyal BK, Greenstein P. 1982 [17] described a method for contouring the palatal vault to create individualized functional room for the tongue using wax impressions that are then rebuilt with acrylic resin.

MATERIALS AND METHODS

This study was performed to evaluate the speech improvement in modified complete Maxillary denture in two even thickness. A total number of ten completely edentulous patients were selected from the outpatient department of Prosthodontics, Tamil Nadu government dental college and hospital, Chennai. Out of the ten patients, 5 were male and 5 were female patients. The patients were selected, based on the following criteria listed below.

Patients undergoing denture construction for the first time, Patients with considerably minimal resorbed ridges, Patients with class1 skeletal relationship of the ridges, Normal neuromuscular coordination / Physiological function, Normal tongue, and their movements., Normal speech and hearing, Age group of patients between 55 and 75 years.

The equipment and materials were used to conduct the study

Dental flask, Indigenously designed metal plate with a carbon coating, digital Vernier caliper, Creative Digital sound recorder, Computer with spectrogram software, A mean value articulator with changeable mounting plate, Surveyor. Sharp knife, Wax Knife, Hot plate, Alcohol torch, Spatula, Wax carver Type 2 dental plaster, Dental stone, Modeling wax, Sticky wax, pencils, Impression compound, Tracing compound Heat-cure polymerizing resin, Alcote or Vaseline paper cups, Polishing materials, Pink base plate wax, Lab putty, Duplicating silicone, Zinc oxide Eugenol impression past.

METHODOLOGY

Edentulous individuals of age selected from 60 to 75 years were taken in this study. With good health, good neuromuscular co-ordination/Physiologically normal function, and un resorbed ridges with Angle's Class I maxillomandibular skeletal relationship.

Primary impressions, the secondary impression was taken. Maxillomandibular relations were recorded on modified permanent denture bases. Mounting and tooth arrangement were done on a mean value articulator, and occlusal equilibration was carried out by remounting the dentures after processing with routine lab and clinical procedures. Another conventional complete denture was made for the same individual by using a regular processing method, without making any modification in the 2mm thickness record base.

Using the novel technique [18] the fabrication of modified palatal surface contour was processed. Two duplicate master casts were prepared by, using duplicating silicone to process the modified permanent acrylic resin denture bases achieving similar surface structure in two different thickness viz:1.5mm, 2.0mm.

Then occlusal rim was fabricated, jaw relation recording and teeth arrangement was done. the trail dentures in 1.5mm and 2 mm thickness denture bases were tried in the patient's mouth. Then the wax trail dentures were flasked then processing with heat cure acrylic resin was performed in the usual manner.

All the patients had normal speech patterns and showed, no impediment in conversational speech. The speech samples of the patients were not evaluated against those of another sample but, they were compared with his/her speech without the denture. All the patients were exhibited normal physiological function except the edentulousness.

Speech pathologists evaluated each task performed, by the patients for speech intelligibility using the spectrogram. The recording was made, with Sony digital voice recorders and stored in the audio wave data file in PC using Hi-Speed USB 3.0. All recordings were made in a sound-proof room.

The patient was seated in a chair in an upright position, and a digital recorder kept or holds by hand 10 inches away from the mouth. The recording was made with ten CV (consonant Vowel) syllables given to them by a speech pathologist for acoustic speech sound analysis by spectrogram. This procedure was executed, for all the ten subjects selected for this study.

Acoustic analysis by spectrogram

A spectrogram is a visual representation of an acoustic signal. i.e. spectrograms [19] the shape of the spectrogram contains significant information, about the quality of speech. One can distinguish more objectively, the difference between the spectrograms of understandable and clear sound and unintelligible and unclear sound. The spectrograms can be obtained from a short part, a sample of the speech signal. Thus, a word can be presented by a set of spectrograms. Speech spectrograms contain quantitative data of a sound, which strongly correlates to the speech system.

After the recordings were completed for the patients, the wave data are transferred to Computer using Praat software for evaluation. All the recordings on the digital recorder were as per the study design and Speech Data collection for speech samples were submitted to the speech-language pathologist at Madras ENT Research Foundation, Chennai.

The recording was evaluated the acoustic quality of the speech sounds by qualified speech pathologists to obtain quantitative data for analysis. The characteristics of the speech evaluated were clarity, intelligibility, and articulation. Each patient's speech recordings were done in ten stimulus speech sounds tasks. The data were then tabulated and submitted for statistical analysis.

RESULTS

An objective analysis of speech sounds was done in MERF (Madras ENT Research Foundation) and statistics analysis with SPSS software and using Multiple range test (Duncan test) with a significant level .05 and harmonic mean cell size = 7.0000.

The ten edentulous patients include 5men and 5woman were provided with conventional and modified complete dentures as a sample, that are grouped into (Group-1,2,3,4) representing edentulous, conventional, 2 mm, 1.5 mm, palatal thickness respectively.

Analysis of variance by Variable frequency in the sound spectrogram (Formants-F1, F2, F3, F4) was done, by placing complete dentures immediately after fabrication and 2 weeks after the insertion. The results are shown in tables 1- 5. The analysis was also done within groups and between groups and the P.value was calculated. Seven sounds were recorded and tabulated.

The results finding shows in chart 1-7, there is significance with individual sounds in different thicknesses of the dentures, as well as between the conventional and modified dentures on the mean value, but overall statistically significant were the P.value >.5.

Fig. 1. Metal ring designed to standardize uniform thickness of upper permanent denture base

Fig. 2. Flask with ring for processing

Fig. 3. Ring placement on the base of the rim & Heat cure acrylic pack

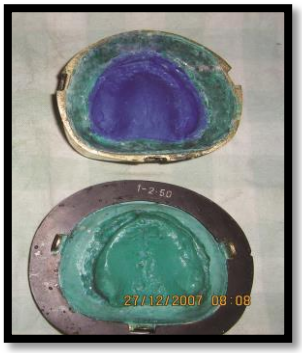


Fig. 4. Cured upper denture base polished surface(similar surface structure

Fig. 5. Completed teeth setting for trail

Fig. 6. Verifying central incisor positioning using a vernier caliper

Chart: 1

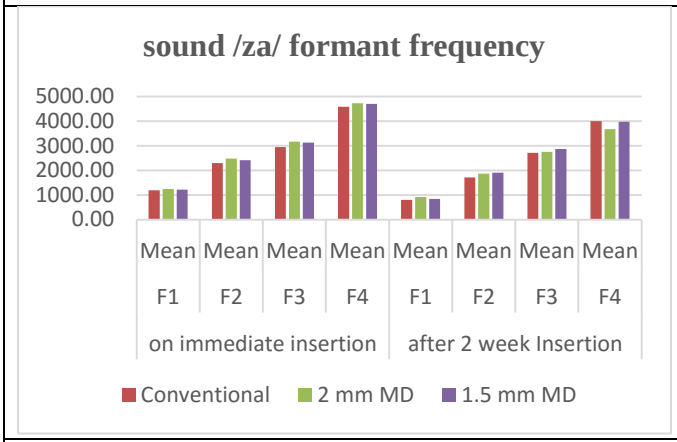


Chart: 2

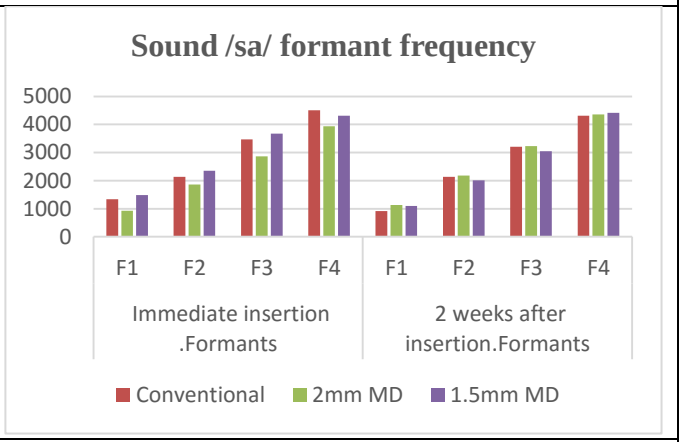
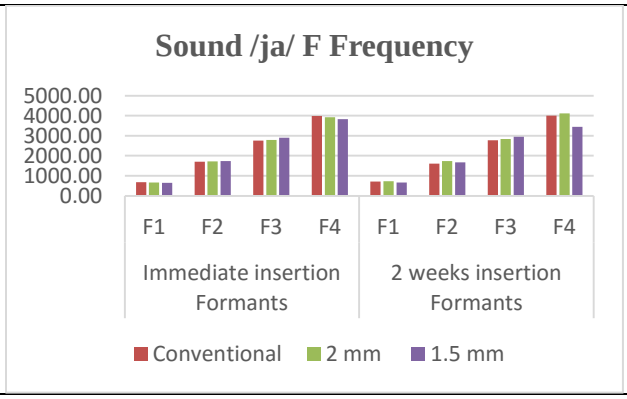


Chart: 3



The effects of appliances of various thicknesses on speech sounds

Signals of speech sounds of the sibilants-/s/,/z/, linguodental -/la/, linguopalatal-/cha/,/ta/,/na/, palatal-/Ja/, were analyzed and compared within groups and between groups and the results are presented in (charts:1-19) using mean value.

From these results it was observed:

1. Denture palatal contour changes alter the resonance cavity of the vocal tract and strongly influence the distribution of the sound's energy in the higher frequency region;
2. Denture palatal plate changes, disturb the harmony of different sounds in a word;

Chart: 5-12 shows, the /za/ sound in (1.5 mm) between 2 mm indicates the significance of immediate insertion in F3.

The significance was found on the /s/ sound also in group-1, between group-2 on immediate insertion and in formant (F1) 2weeks after insertion. sound /ja/ in 1.5mm & 2mm modified dentures shows, significance after 2 weeks insertion in the comparison between conventional denture, in F1.and in F2 1.5 mm shows significance between all groups after 2-week insertion. In F3 2mm shows significance within all groups.

DISCUSSION

In this study, the palatal vault is produced in the permanent base that provided better fitting and stability and produced, in two even thicknesses which had close contact with the tissue surface that improved stability and retention. It also provided better space for the tongue. Moreover, in this study, it was also compared that two even thickness of the maxillary denture with the conventional denture. These modified dentures showed improved speech (table 1- 4) with the level of confidence. General recommendations suggest a thickness of between 1.5 mm for these denture bases [20].

Rothman [1] says –the primary concern in phonetics is the changes in the stream of air as it passes through the oral cavity, here the thickness of the upper palatal plate seems to be important since it reproduces the space between tongue and palate. Considering the above view, the maxillary denture bases were made with uniform and desire thickness, which provided better speech improvement.

The palate is a static structure, in the anterior maxillary region. In normal dentitions, this area provides two structural components important to speech, the mucous membrane and the palatal rugae. The mucous membrane contributes to a sensory surface that serves as

a biofeedback unit. Along with the tongue and the auditory system, to monitor the articulatory process.

When it is covered by artificial structure rather than sensitive material, this feedback system is weakened. Such weakening is associated with a decrease in the skill of self-monitoring and self-correction in the patient. Thus speech sound distortion will be the result of the substitution of plastic for natural tissue in the palatal region.

The role of palatal rugae in speech has long been a point of contention. Certainly, there must be individual differences, and some dentists might have seen more patients with problems related to this area rather than have others. if one accepts the concept that first there must be obstructions to create turbulence in the outgoing airstream and second that there should be some landmark which the tongue recognizes as the location where it produces a particular sound best, then one may conclude that there is some value in considering the role of the rugae.

Most of the consonant sounds involved in the articulation of speech with these principal structures (static articulator-teeth, palate, and dynamic articulator-tongue).so when the tongue has to function against this additional thickness, which added on the palatal structure of the denture causes altered speech pattern immediately after wearing the denture. But the tongue can adopt and even produce normal speech within a few weeks to a month. The adaptation may progress slowly, some patients require a longer period to get the same result [21].

SUMMARY

Speech samples were obtained from ten edentulous patients, who became edentulous recently, at two periods following the use of dentures. The /s/, /sh/, /na/,/la/and /ta/ sounds showed improvement; however individual speech sounds developed differently. Selected judgments of preference were compared to their corresponding spectrograms.

Among the ten speech samples tested in this study. after the insertion of a 1.5mm thickness modified complete denture base shows better improvement than the conventional denture.

CONCLUSION

Spectrograms sound analyzers were employed to analyze and interpret speech difficulties related to the complete dentures and findings. Quantitative evaluation was attempted from the spectrographs, the visual interpretation has given interesting results when related to the speech sounds studied and this was confirmed by the panel of speech pathologists and they assessed the quality of the sounds.

The correlation between the quality of speech and denture morphology is of importance in phonetic research in prosthodontics. Speech spectrograms contain significant information about the quality of speech and thus together with computer analysis can be used for the objective diagnosis of the status of a speech system, for example, the phonetic quality of artificial dentures. However, the spectrographic analysis must be backed up by auditory and articulatory information.

REFERENCES

1. Robert Rothman- Phonetic considerations in denture prosthesis. *The Journal of Prosthetic Dentistry*, 11(2), 1961, 214-223.
2. Sharry JJ. Complete denture prosthodon Zarb GA, Bolender CL. Prosthodontic treatment for edentulous patients: Complete dentures and implant-supported prostheses. *12th ed. CV Mosby; 2004; 34-50.*
3. tics. 3rd ed. London: *McGraw – Hill Book Company; 15-27.*
4. John Beumer III, Thomas A. Curtis, Maxilofacial Rehabilitation, Prosthodontic and surgical consideration *1996,p- 285 - 288*
5. Alexander L. Martone and John W. Black An approach to prosthodontics through speech science : : Part V. Speech science research of prosthodontic significance *The Journal of Prosthetic Dentistry, 12(4),1962, 629-636,*
6. Hamlet SL, Cullison BL, Stone ML. Physiological control of sibilant duration: insights afforded by speech compensation to dental prostheses. *J Acoust Soc Am 1979;65:1276-85.*
7. Hamlet SL. Speech adaptation to dental appliances: theoretical considerations. *J Baltimore Coll Dent Surg 1973;28:52-63.*
8. Hamlet SL. Speech compensation for prosthodontically created palatal asymmetries. *J Speech Hear Res 1988;31:48-53*
9. Palmer JM. Structural changes for speech improvement in complete upper denture fabrication. *J Prosthet Dent 1979;41:507-10*
10. w, G. B.: The Proper Configuration of the Lingual Surfaces of Dental Plates, *Dent. Advertiser 20: 51-54, 1889.*
11. David M. Watt, Tooth positions on complete dentures**,** *Journal of Dentistry, 6, No. 2, 1978, pp. 147-160.*
12. Pound, E. Esthetic Dentures and their Phonetic Values. *J Prosthet Dent 1:98-111, 1951*
13. McDowell, E.: The Role of Speech Training in a Program of Orthodontic Treatment, *Int. J. Orthodontia 22:105-113, 1936.*
14. Allen, L.J. Improved Phonetics in Denture Construction. *J Prosthet Dent 8:753-763, 1958.*

15. Sears, V. H.: Principles and Technics for Complete Denture Construction, *St. Louis, 1949. The C. V. Mosby Company, p. 317.*
16. Chierici G, Parker ML, Hemphill CD. Influence of immediate dentures on oral motor skill and speech. *J Prosthet Dent 1978; 39: 21–28.*
17. Goyal, B.K. and Greenstein, P. Functional Contouring of the Palatal Vault for Improving Speech with Complete Dentures. *J Prosthet Dent 48:641-646, 1982.*
18. Gunasekar.C.et.al. Novel Technique for Replication of Natural Palatal Anatomy onto the Maxillary Permanent Denture Base with in Even Thickness. International Journal of Prosthodontics and Restorative Dentistry 2017; 7(3): 92-96.10.5005/jp-journals-10019-1184.
19. Lechner, S.K. and Lautenschlager, E.P. Processing changes in maxillary complete dentures. *J Prosthet Dent 52:20-24, 1984.*
20. Michael G. Reeson, Achieving an even thickness in heat-polymerized permanent acrylic resin, *J Prosthet Dent 1999;82:359-61.*
21. Petrovic A. Speech sound distortions caused by changes in complete denture morphology. *J Oral Rehabil 1985;12:69-79.*

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