



EVALUATION OF IMMEDIATE SPEECH IMPROVEMENT IN THE REPLICATED NATURAL PALATAL CONTOUR OF THE MAXILLARY COMPLETE DENTURE

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ABSTRACT

Phonetics in complete edentulism is one of the major problems. This can be improved by replicating the palatal anatomy. The technique used in the study for immediate speech improvement in the modified complete denture.

Key words:- Palatal contour, Replication of palatal anatomy, Modified maxillary denture, Spectrogram.

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INTRODUCTION

Speech sounds can be differentiated respectively based on acoustic properties. They can also be differentiated based on physical properties [1]. Air molecules may be moved by 1. A restricted air current (noise) or 2. Vibrated air.

Speech sounds consist of one or both of these elements. The physical properties of speech sounds – namely, phonated sound and airflow are related to acoustic characteristics of frequency and intensity. The vowel sounds (phonated with little air) tend to have lower frequencies and higher intensities. The voiceless

consonants, p, t, k, f, th, s, sh, ch, and h (not phonated but with the noise produced by restricted air) tend to have higher frequencies and lower intensities.

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. The tongue is the principal articulator for speech. 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 [2]. 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 [3,4].

In constructing oral prostheses, the dentist is primarily concerned with replacing structural losses however we are necessarily adding to regions having no

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structural loss, for example, the hard palate region. In the anterior third of the palate has been referred to as the **“Playground of the tongue”**

Restoring patients’ speech is an important goal in complete denture fabrication. Normally, most patients can adapt their speech production, to compensate for the presence of a denture.

The purpose of this study is to reproduce, quick and easy methods of adding entire individualized natural anatomical palatal contour, into the permanent denture base, thereby, eliminating or considerably reducing post insertion practice period, and evaluate the speech improvement [5-9].

AIM OF THE STUDY

This study aims to evaluate the difference in the clarity of speech between a conventionally made maxillary complete denture and in the replicated palatal contour of maxillary complete dentures.

Objectives

1. To evaluate the speech improvement in the modified palatal contour of maxillary complete denture
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;
without denture, with the conventional denture, Modified palatal contour

Review of the Literature

Rothaman.R 1961[10] considered the primary concern in phonetics the changes in the stream of air as it passes through the oral cavity.

Yllpo 1955 [11] studied the quantity of voice as altered by the linings of the mouth which could simulate the quality of voice as altered by the linings of the mouth which could simulate an oral prosthesis.

Hyung-Jun Kong,2008 [12] described by altering the palatal contour of the maxillary denture for a patient who has sibilant distortions, improved intelligibility of the sounds, and/or a reduced period of adaptation can be achieved. He describes a technique for customizing the palatal contour of a maxillary complete denture with auto polymerizing acrylic resin to improve the intelligibility.

Bloomer & Luchsinger and Arnold 1958 &1965 [13] suggested nearly the exact replication of the natural

anatomy into the denture base has supported the notion of duplicating the palatal rugae.

MATERIALS AND METHODS

This study was performed to evaluate the speech improvement in modified complete Maxillary denture. A total number of ten completely edentulous patients were selected from the outpatient wing of the Department of Prosthodontics, TamilNadu government dental college and hospital, Chennai. Out of the ten patients 5 male and 5 female patients.

First-time denture wearer, Patients with class I skeletal relationship of the ridges, Normal neuromuscular coordination / Physiological function, Normal tongue, and their movements, Normal speech and hearing, Age group of patients between 45 and 65 years.

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 paste.

METHODOLOGY

Primary, the secondary impression was taken. Maxillomandibular relations were recorded on a modified permanent denture base. The mounting and tooth arrangement was 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.

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 rating system.

Processing methods for fabrication of modified palatal surface contour

From the laboratory analog, made up of die stone which represents, the denture supporting tissues surface. one duplicate master casts were prepared by, using duplicating silicone to achieve a similar surface

structure in processed permanent acrylic resin denture base in 2.0mm thickness. To reproduce the exact natural anatomy of the palatal surface, known as “anatomical contour” in even thickness, without losing the original surface details of the impression, the modified permanent denture bases were prepared [14].

The occlusal rim was fabricated, jaw relation recording and teeth arrangement, and the trial denture in a 2 mm thickness modified denture base was tried in the patient’s mouth. The wax trial dentures were flaked then processing was performed.

The recording was made, with creative digital music videos/photos/voice recorders -512 MB and stored in the audio data file in PC using Hi-Speed USB 2.0. All recording was 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 by four tasks given to them by speech pathologists include narration, reading, nasality and articulation, conversation (the chart for analysis of characteristics of speech), by speech sample recording for perceptual evaluation and spectrogram analysis. This procedure was executed, for all the ten subjects selected for this study.

The spectrogram is a visual representation of an acoustic signal. 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, they were transferred to the Computer 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 in MERF (Madras ENT Research Foundation), Chennai.

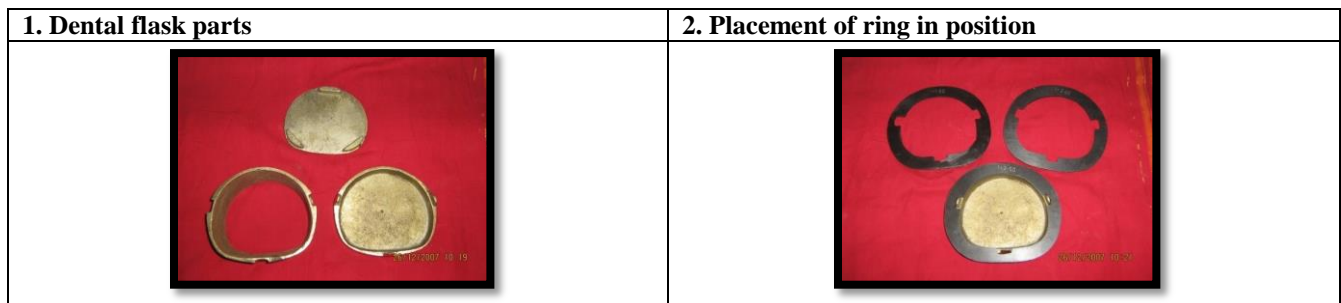
The recording was evaluated with Rating of The Speech Sample by a panel of four qualified speech pathologists. The characteristics of the speech evaluated were clarity, intelligibility, and articulation. Each patient’s speech recordings were done in four tasks. The data were then tabulated and submitted for statistical analysis.

RESULTS

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) representing edentulous (reference), Control group conventional (2mm), research group modified 2mm palatal thickness respectively. The results finding shows in Table 1 & chart 1-3, there is significance with individual sounds in modified dentures, as well as between the conventional and modified dentures on the mean value, but overall statistically significant were the P.value >.5. Key: 1. Normal, 2. Minimally deviant, 3. Mildly deviant, 4. Moderately deviant, 5. Moderately severe deviant, 6. Severely deviant, 7. Very severely deviant.

Table 1. Subjective Analysis

Subjective Analysis						
Grade for speech						
Group	Speech linguistic Pathologist				Group Total	
	SLP I	SLP 2	SLP 3	SLP 4	total	P-Value
	Mean	Mean	Mean	Mean	Mean	
Edentulous	2	2	2	3	2	0.0543
Conventional Denture	3	2	3	3	3	
Modified Denture	3	3	2	3	3	
Grand Total	2	2	2	3	2	





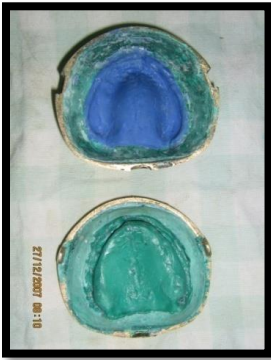


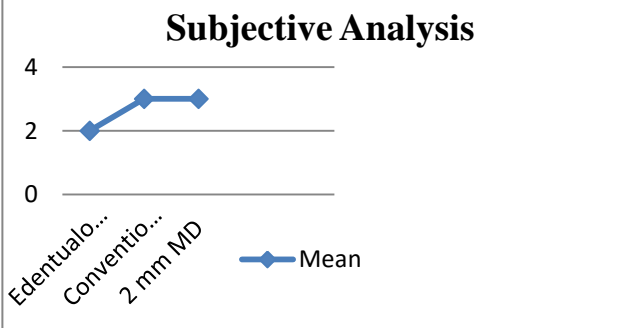
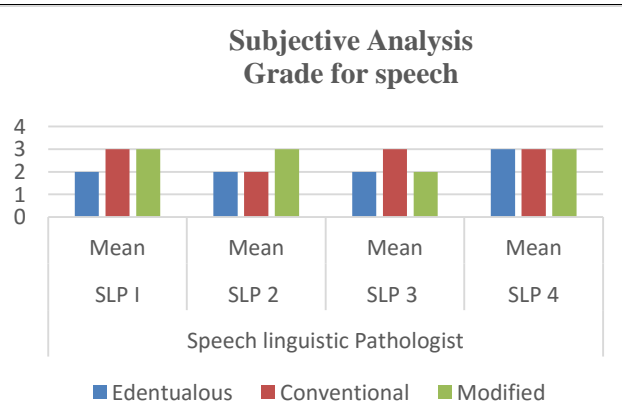
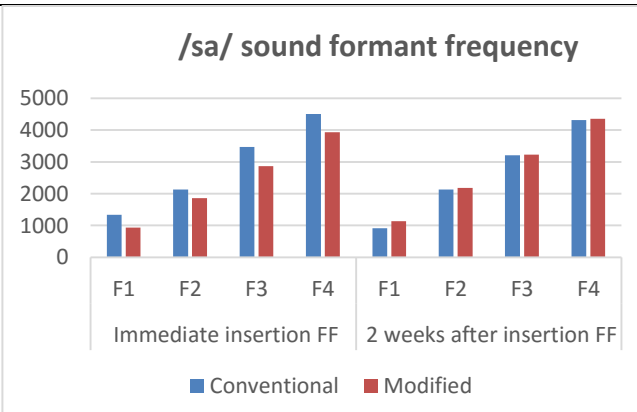
<p>3. Block out the undercut</p> 	<p>4. Lab putty placement over the cast</p> 																																			
<p>5. Poured stone in body of the flask/replication by separating the flask</p> 	<p>6. Ring placement on the base of the rim & Heat cure acrylic pack</p> 																																			
<p>7. Cured Maxillary denture base</p> 	<p>Chart: 1</p> <p>Subjective Analysis</p>  <table border="1"> <caption>Subjective Analysis Data</caption> <thead> <tr> <th>Category</th> <th>Mean</th> </tr> </thead> <tbody> <tr> <td>Edentulous</td> <td>2.0</td> </tr> <tr> <td>Conventional</td> <td>3.0</td> </tr> <tr> <td>2 mm MD</td> <td>3.0</td> </tr> </tbody> </table>	Category	Mean	Edentulous	2.0	Conventional	3.0	2 mm MD	3.0																											
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<p>chart No: 2</p> <p>Subjective Analysis Grade for speech</p>  <table border="1"> <caption>Subjective Analysis Grade for speech Data</caption> <thead> <tr> <th>SLP</th> <th>Edentulous</th> <th>Conventional</th> <th>Modified</th> </tr> </thead> <tbody> <tr> <td>SLP 1</td> <td>2.0</td> <td>3.0</td> <td>3.0</td> </tr> <tr> <td>SLP 2</td> <td>2.0</td> <td>2.0</td> <td>3.0</td> </tr> <tr> <td>SLP 3</td> <td>2.0</td> <td>3.0</td> <td>2.0</td> </tr> <tr> <td>SLP 4</td> <td>3.0</td> <td>3.0</td> <td>3.0</td> </tr> </tbody> </table>	SLP	Edentulous	Conventional	Modified	SLP 1	2.0	3.0	3.0	SLP 2	2.0	2.0	3.0	SLP 3	2.0	3.0	2.0	SLP 4	3.0	3.0	3.0	<p>Chart: 3</p> <p>/sa/ sound formant frequency</p>  <table border="1"> <caption>/sa/ sound formant frequency Data</caption> <thead> <tr> <th>Formant</th> <th>Immediate insertion FF</th> <th>2 weeks after insertion FF</th> </tr> </thead> <tbody> <tr> <td>F1</td> <td>1200</td> <td>1000</td> </tr> <tr> <td>F2</td> <td>2000</td> <td>1800</td> </tr> <tr> <td>F3</td> <td>3500</td> <td>2800</td> </tr> <tr> <td>F4</td> <td>4500</td> <td>3800</td> </tr> </tbody> </table>	Formant	Immediate insertion FF	2 weeks after insertion FF	F1	1200	1000	F2	2000	1800	F3	3500	2800	F4	4500	3800
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Chart 3 shows /s/ sound speech improvement on immediate insertion in conventional denture than in modified. After two weeks the modified shows better than a conventional denture.

Adaptation to new dentures

All the modified denture shows in charts 1-3, which represents the frequencies from lower to higher in all formants indicating better adaptation on immediate insertion. According to Kent⁶⁸ normal fundamental frequency is 125Hz (typical for an adult male), then the next three harmonics would have frequencies of 250,375,500 Hz, respectively. And fundamental frequency is 250Hz (typical for an adult female), then the next three harmonics would have frequencies of 500, 750, 1000 Hz, respectively.

The perceptual analysis (chart No: 1) by speech linguistic pathologist's data finding gives that overall modified denture shows, minimally deviant from normal than other dentures. The findings in all modified dentures showed, immediate improvement of speech quality when compared with the conventional denture. In addition to that, the sensory feedback mechanism also improved in modified dentures.

DISCUSSION

The quality of speech in edentulous patients wearing new complete dentures was analyzed in this study. The quality and clarity of speech with modulation was assessed, with the conventional complete denture and a complete denture with modified palatal contour. The findings in all modified dentures showed, immediate improvement of speech quality when compared with the conventional denture. In addition to that, the sensory feedback mechanism also improved in modified dentures.

Palmer et.al [13] says that a *nonanatomic papilla placed on the oral surface of the denture somewhat posterior to the incisive papilla location* (at about the location of the incisive canal) could serve as both a source of turbulence and for tactile locating purposes. This tiny papilla tried out first in wax, is conical, about 3 to 4 mm in diameter at its base, but perhaps only 1 to 3 mm in height. Some patients with a tongue that grooves with difficulty should have a papilla more transversely elongated into almost rugae-like structures. They suggested *nearly exact replication of the natural anatomy into the denture base*¹³ by duplicating the palatal rugae, this suggestion is implemented in our study and reproduced the same in the modified upper complete denture.

Luzerne G. Jordon said if, after the patient-worn the denture, it is decided that *some evidence of rugae would improve phonetics*. He also said to produce mat surface on the maxillary denture (providing a tissue-like surface as possible) against which the tongue could

function more naturally during the speech, food manipulation, and deglutition.

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. However, 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.

There is a clear indication that modified maxillary denture does help in producing normal speech pattern immediately after insertion, moreover, reproduction of the rugae, incisive papilla offer, more physiologic and natural tactile sensation to the tongue, than, the functionally contour palatal vault.

In this study, the rugae of the same individual are replicated, in even thickness with the entire palatal surface so, there is no chance of thickening by adding rugae pattern with wax or modifying technique adopted earlier for improving phonetics, and no need of thinning out the denture base in the anterior region for the accommodation of tongue. *which contradicted with the Landa's statement and questionable whether her suggestion is now to accept.*

The controversy in the literature, in the concept of replicating rugae in the anterior part of the palate in the prosthesis, is avoided in this study by modifying the palatal contour without adding extra thickness in the maxillary denture.

SUMMARY

Speech adaptation after rehabilitation of the edentulous patient with complete dentures is based on a very complex interaction of articulatory, myofunctional, psychosocial, and other factors. To gain an insight into the underlying mechanisms, it is necessary to understand, how different sounds are produced and what major anatomical structures are involved. The source-filter model describes the physiology of speech. The source is the air that flows out of the lungs through the trachea and vocal cords. Air vibrations of around 132Hz (men)–223 Hz (females) enter the vocal tract (supra-glottis–throat–mouth– nose). Depending on the position of lips, teeth, tongue, and palate, certain frequencies will be filtered. Anatomical structures play a key role in the pronunciation of different sounds.

Speech samples were obtained from ten edentulous patients, who became edentulous recently, Four trained speech therapists assessed each patient's speech by the method of grading from normal to severely deviant- the scale 1-7 and paired the comparison. Words spoken in the edentulous state were paired with words

spoken at two stages of denture wear. The analysis revealed a preference by the judges for the speech sounds that were made 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 [13-16].

CONCLUSION

The natural palatal contour of the permanent record base, with the anatomical replication, gave extremely good results over the conventional complete denture as follows;

1. Provided near approximate guidelines for setting the artificial anterior teeth by giving the reference point of the incisive papilla.
2. The rugae pattern mark also provided a reference mark to position the upper canine teeth.
3. Speech improvement in immediate insertion and post-insertion practice was reduced.
4. By replicating the natural palatal contour on the maxillary denture for a patient who has sibilant distortions, improved intelligibility of the sounds, and a reduced the period of adaption.

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