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RESEARCH ARTICLE

PERCEPTUAL AND ACOUSTIC ANALYSIS OF SPEECH WITH RESPECT TO POSTERIOR PALATAL SEAL AREA IN COMPLETE DENTURE PROSTHESIS WEARERS

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ABSTRACT

The unique complexity of the oral cavity and adjacent areas presents a continual challenge to prosthodontist. Patients usually maintain acceptable speech if the dentures satisfy the requirement of function and esthetics. However, some patients with dentures encounter difficulty and their speech becomes a major concern. Recording the posterior palatal seal area in complete denture fabrication has always been an attempt by the clinicians. It not only provides a psychological satisfaction in terms of good fit but also provides comfort and better adaption to functions like mastication and speech. The purpose of this study is to compare the perceptual and acoustic characteristics of velar sounds in an edentulous patient, with and without Posterior palatal seal area recorded in the denture of complete denture wearers.

Materials and methods: Thirty completely edentulous Malayalam and Kannada speaking subjects aged 45-55 years were included for the study. Conventional complete denture was fabricated for each subject participating in the study. Posterior palatal seal area was recorded in the denture with fluid wax technique in the patient's mouth and the subjects were evaluated perceptually and acoustically with (fluid wax record simulating P.P.S) and without (scrape off the P.P.S recorded with wax) the record of posterior palatal seal area. Velar Stop consonants in monosyllables /ka/ and /ga/ were used for acoustic analysis for all the subjects and Kannada as well as Malayalam articulation tests appropriate for the language of the subjects were used, for perceptual analysis. All the samples recorded were subjected to acoustic analysis using PRAAT software (version 4.5.06; Paul and David, 2006). The following parameters were extracted: Burst duration, Voice onset time, and Formant frequencies.

Results: Acoustic analysis showed a significant relation between the acoustic characteristics of velar sounds and the posterior palatal seal area recorded in the denture.

Conclusions and clinical implications: The study implies that Prosthodontist can contribute effectively as a team member, working with Speech Language Pathologist in the appropriate fabrication of the denture, by evaluating the patient's speech with respect to posterior palatal seal area recorded in the intaglio surface of the denture (post-dam area).

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INTRODUCTION

Speech is a unique, complex, dynamic motor activity through which we express our thoughts and respond to control our environment. It is the most powerful tool possessed by our species, and the degree to which we employ it effectively contributes to the character and quality of our lives. Various studies were carried out to note the effect on speech with the use of different palatal forms, labial and buccal inclination of teeth, increase in vertical dimension in complete denture prosthesis (Meyer Silverman, 1953). Ichikawa, Komoda, Horiuchi and Matsumoto (1995) studied the influence of alteration in the oral environment produced by either palatal augmentation or by an increase in the vertical dimension of occlusion on temporal aspects of consonants (/k/ and /s/) (Horiuchi Tanaka, 1973). They noticed voice onset time and consonant duration were influenced by palatal augmentation.

Studies on denture users were focusing only on rating of speech intelligibility. But minimal evidence has been found in literature till date on posterior palatal form and its effect on speech. Hence the present study is aimed to assess following two changes in speech with respect to posterior palatal seal area in complete denture wearers.

- Audition (perceptual)
- Acoustic (voice onset time, formant frequencies, burst duration)

Auditory perception by speech therapist is the state of the art in analyzing speech intelligibility as the overall phonetic outcome of oral rehabilitation. However the assessment of speech disorders also called as intelligibility by professionals is highly subjective and shows limited reliability because of differences in speech therapist's experience as well as variable test conditions. Articulation tests done by multiple evaluators are considered to be suitable for obtaining reliable results. However, the use of multiple evaluator is rather time consuming (Horiuchi Tanaka, 1973). Acoustic analysis of speech intelligibility is a computer-based technique for the objective evaluation of speech. This method is recently been evaluated for the automated analysis of edentulous patients and patients with complete dentures (Stelzle, 2010). Speech is classified into surds, sonant and consonants. The production of English consonants involve six stops called as 'stop consonants' as the air travels in the oropharyngeal cavity for the production of sound and are listed as Bilabial, Labiodentals, Linguodental, Linguoalveolar, Linguopalatal and Linguovelar. Out of the six stops consonants, five are affected by teeth position except for the Linguovelar (velar) sounds /k/, /g/ and /ng/ which is affected by the extent and seal of the posterior palatal area on the soft palate (Horiuchi Tanaka, 1973). Complete dentures can be fabricated without a perfect record of the posterior palatal seal area seen in the patient's mouth wherein the post-dam area recorded in the intaglio surface of the denture fails to make intimate contact with the soft palate, and vice versa. If posterior palatal seal area is not recorded well in the denture, there always exists a gap between the posterior most part of the denture and the soft palate as there is no contact between the two during functional movement of the soft palate. This invariably changes the acoustic characteristics of velar sounds in terms of burst duration, voice onset time and formant frequencies. It is suggested that incorporating a perfect record of the posterior palatal seal area in the denture would improve the velar sounds of the patient and thus would improve the overall speech intelligibility of an edentulous patient undergoing complete denture prosthetic rehabilitation. In this study, Patient was taken to the speech language pathologist to record and analyze the speech samples collected for velar sounds, perceptually and acoustically for the patients undergoing complete denture prosthetic rehabilitation with and without the posterior palatal seal area record in the denture.

MATERIALS AND METHODS

The subjects in this study are the patients visiting the department of Prosthodontics, A. B. Shetty Memorial Institute of Dental Sciences, Mangalore in association with department of speech language pathology, KSHEMA, Mangalore. For the purpose of the study, 30 completely edentulous patients in the age range of 45 to 55 are taken randomly. PRAAT software for acoustic analysis are used in the department of speech language pathology, KSHEMA, Mangalore. Paitents that were included in the study were completely edentulous and had acceptable articulation of speech. Patients were free from speech defects which are associated with changes in oral form and structure (cleft lip and palate, glossectomy case, neuromuscular problems, oral pathological lesions). Patients who are first time denture wearers were included in the study and were native speakers of Kannada or Malyalam language and can read their languages. Qualified speech language pathologists evaluated the speech perceptually and acoustically. Patients already having some discrepancy in speech which might hinder in comparison and any pathological changes in the oral form and structure were excluded from the study.

Methodology

Thirty completely edentulous patients were selected for the study. Subjects were informed about instruments and procedures to be performed and consent was taken. Primary impression were made using conventional techniques and master cast was poured using Type III gypsum product. Maxillary and mandibular denture base was fabricated on the master casts. Occlusal rim was then prepared and was adjusted in the patient's mouth to register the maxillo-mandibular relations. Occlusal rim with recorded maxillo mandibular jaw relation was mounted on articulator and artificial teeth were arranged. Teeth arrangement and occlusal plane orientation of the trial denture base was verified, processed , finished and polished. At the time of fit-in, the posterior palatal seal is recorded with fluid wax (physiologic technique of recording posterior palatal seal area). Patient was taken to the speech language pathologist to record and analyze speech samples perceptually and acoustically with the denture having PPS area recorded with fluid wax in the posterior most part of the denture simulating post-dam area. Three qualified speech language pathologist rated the speech samples collected for perceptual analysis. Same appointment the fluid wax is scraped off and the patient is re-evaluated for the same speech and velar stop consonant monosyllable /ka/ and /ga/ in particular for acoustic analysis. Hence the variables used in this study are: Denture with post-dam area record and denture without post-dam area record.

For standardization all the patients will be asked to repeat the same set of words**.** All sound recordings was done on same digital recorder using a microphone**.** Same group of speech language pathologist analyzed the speech. Thickness of all the dentures in the palatal area was kept 2mm. Posterior palatal seal area was recorded by fluid wax technique on to the posterior most part of the processed and polished denture (at the time of fit in). Fluid wax technique utilizes a special mouth temperature wax which is painted on to the posterior most intaglio surface of the denture, between the two vibrating lines transferred to the denture by indendible pencil. Then this denture having the record of posterior palatal seal area was placed in patient's mouth and articulation test was done both perceptually and acoustically and the same articulation tests

was repeated for perceptual and acoustic analysis when the wax was scraped off (simulating absence of posterior palatal seal area record in the denture)(Fig 1,2,3).

Fig.1. Illustrates Posterior palatal seal area recorded with fluid wax

Fig. 2. Illustrates insertion of denture for recording speech intelligibility, for perceptual and acoustic analysis with posterior palatal seal area recorded with fluid wax

Fig. 3. Illustrates insertion of denture for recording speech intelligibility, for perceptual and acoustic analysis without the posterior palatal seal area record (fluid wax simulating P.P.S was scraped off)

Articulation Test

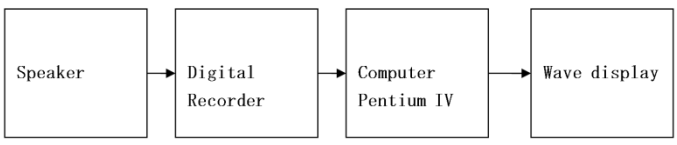
For perceptual analysis the articulation test was done and the material contained word list from Kannada Articulation Test (Babu and Rathna, 1985) and Malayalam Articulation Test (Maya, 1990). The samples were collected by three qualified speech language pathologists and these samples were subjected to perceptual analysis for speech intelligibility rating. For acoustic analysis only velar sounds was taken into considerations. Linguovelar (velar) sounds like /ka/ and /ga/ which is affected by the extent and seal of the posterior palatal area on the soft palate was taken into considerations. Patient was asked to speak stop consonants like /pa/, /ta/, /ka/, /ba/, /da/, and /ga/.

Data Collection for perceptual analysis

One subject at a time was examined and the reading samples of that subject were recorded in two conditions. In condition 1, the patient is asked to read the word list from the articulation test list for speech intelligibility when he/ she is wearing the denture with posterior palatal seal area recorded with fluid wax and recording is carried out. In Condition 2, the articulation test for speech intelligibility is performed again without Posterior palatal seal area recorded in the denture (scraping off the wax).

Data Collection for Acoustic analysis

One subject at a time was examined and the reading samples of that subject were recorded in two conditions. In condition 1, the patient is asked to speak the stop consonants like /pa/, /ta/, /ka/, /ba/, /da/, /ga/ out of which only velar sounds like /ka/ and /ga/ was taken into considerations for acoustic analysis in terms of burst duration, voice onset time and formant frequencies, when he/she is wearing the denture with posterior palatal seal area recorded with fluid wax. In Condition 2, Same recordings for acoustic analysis was done again without Posterior palatal seal area recorded in the denture (scraping off the wax).The following steps explain the procedure involved in the data collection. The speech samples were recorded in a sound treated room at Speech Science Laboratory of K.S.Hegde Hospital which is used for voice sample recording. Subject was seated comfortably on a chair opposite to the investigator across the table. The following instruments were used for the study: Logitech Microphone, Acer Desktop Computer, Praat software (Paul and David, 2009; version 5.0.37), and a Speaker/ Headphone. Block diagram showing the arrangement of instruments for the purpose of recording and analysis of speech below.



The Kannada Articulation Test or Malyalam Articulation Test was given to the subjects depending on their native language for reading. The instructions were given in Kannada or Malyalam verbally. The experimenter clarified any doubts by the subjects.

Recording for acoustic analysis

As the subject read the word list, speech output was recorded using Praat software, through the microphone kept at a distance of 10 cm away from the mouth of the subject at a sampling rate of 16 kHz and stored for further analysis. The total time taken to record the samples for each subject varied from 15 to 20 minutes approximately. The data recorded from 30 complete edentulous patients formed the material for analysis. Samples were randomised and study design was a *single-blind study* as the speech pathologist analysing the samples is unaware of the sample he/she is analysing. The perceptual analysis was done by the trained speech pathologist and the test groups were randomised and named as Denture I and Denture II, and speech intelligibility was rated in terms of good, satisfactory and poor. The acoustic recordings were digital and difference between the variables was assessed on objective parameters by speech therapist for the following parameters: Burst duration, Voice onset time and Formant frequencies. As the data was interpreted by PRAAT software so there was no chance for examiner bias. The assessed data thus obtained from PRAAT software for 30 completely edentulous patients are tabulated and mean and median was calculated and results were statistically analysed by using "Wilcoxon Sign rank test".

RESULTS

The results obtained from the study are depicted in Tables (1 to 4) and Graphs (1 to 5).

Table 1. Intelligibility rating for speech with and without posterior palatal seal area record which was subjective (1= Good, 2= Satisfactory, 3= Poor)

Stop consonants	With P.P.S Record	Without P.P.S Record
/pa/	2	2
/ta/	2	2
/ka/ (velar)	2	2
/ba/	2	2
/da/	2	2
/ga/ (velar)	2	2

Perceptual Analysis

Table 1. Shows Intelligibility rating for speech with and without posterior palatal seal area record which was subjective. Three qualified speech pathologists rated the quality of speech and their opinion regarding speech intelligibility was satisfactory throughout as been stated by the table above. Hence inter-examiner reliability is considered to be highly reliable. Intelligibility rating was done by rating in terms of good, satisfactory and poor having a score of 1, 2, and 3 respectively as shown in the table 1. Their opinion did not differ for the speech intelligibility with and without the posterior palatal seal area recorded in the denture. Table 2(a). Shows Wilcoxon Signed Ranks Test for stop consonant monosyllable /ka/. Data was calculated from the PRAAT software for Burst duration, Voice onset time, and formant frequencies by speech pathologist for stop consonant monosyllable /ka/. Wilcoxon Signed Ranks values for velar stop consonants monosyllable /ka/ was calculated to be Z= -4.78. Whereas standard normal table value Z_α= 1.96. As $/Z_{cal} /> Z_\alpha$, null hypothesis is rejected and p< 0.001which is highly significant is obtained. Median calculated for the stop consonant monosyllable /ka/, for all thirty patients in terms of burst duration (B.D) was calculated to be 14.26 msec and 21.36 msec, with and without the posterior palatal seal area record respectively. Median for voice onset time was calculated to be 28.43 msec and 38.21 msec with and without posterior palatal seal area record respectively. And the median for the formant frequencies with the posterior palatal seal area record at different level of the vocal tract i.e. F1, F2, F3, F4 was calculated to be 822.09 Hertz, 1404.65 Hertz, 2547 Hertz and 3598.87 respectively and without posterior palatal seal area record, the recorded median value was 740.22 Hertz , 1334.27 Hertz , 2427.37 Hertz , 3440.55 Hertz for F1, F2, F3, and F4 respectively. The results showed that more time is required to produce velar sounds monosyllable /ka/ in terms of burst duration and voice onset time, if posterior palatal seal area is not recorded well as there always exists a gap between the post dam area and the soft palate. Patient has difficulty in speech as the time required for the break in articulation of the tongue and soft palate followed by the vibration of the vocal cord is delayed. This is because the palatal coverage hinders the tactile feedback mechanism to a large extent, and therefore limits the ability to properly articulate. Whereas formant frequencies recorded with the posterior palatal area record in the intaglio surface of the denture showed more resonance frequency as compared to without the record. This is because the vibrating air channel for the sound production in the vocal tract is altered because of the presence of gap between the post dam area and the soft palate. So less vibrating air channel carrying the velar sound monosyllable /ka/ exists the oral cavity and hence low frequency record.

Table 2(b). Shows Wilcoxon Signed Ranks Test for stop consonant monosyllable /ga/. Datas was calculated from the PRAAT software for Burst duration, Voice onset time, and formant frequencies by speech pathologist for stop consonant monosyllable /ga/. Wilcoxon Signed Ranks values for velar stop consonants monosyllable /ga/ was calculated to be Z= -4.782 using SPSS software, version 20. Whereas standard normal table value Z_α= 1.96. As $/Z_{cal} /> /Z_\alpha/$ null hypothesis is rejected and p< 0.001which is highly significant is obtained. Median calculated for the stop consonant monosyllable /ka/, for all thirty patients in terms of burst duration (B.D) was calculated to be 19.42 msec and 27.32 msec, with and without the posterior palatal seal area record respectively. Median for voice onset time was calculated to be 85.42 msec and 98.00 msec with and without posterior palatal seal area record. And median for formant frequencies with the posterior palatal seal area record at different level of the vocal tract i.e. F1, F2, F3, F4 was calculated to be 865.55 Hertz, 1572.42 Hertz, 2750.21Hertz and 3894.46 respectively and without posterior palatal seal area record, the recorded median value was 849.87 Hertz , 1428.97 Hertz , 2633.90 Hertz , 3719.29 Hertz for F1, F2, F3, and F4 respectively. The results showed that more time is required to produce velar sounds monosyllable /ga/ in terms of burst duration and voice onset time, if posterior palatal seal area is not recorded well as there always exists a gap between the post dam area and the soft palate. Patient has difficulty in speech as the time required for the break in articulation of the tongue and soft palate followed by the vibration of the vocal cord is is delayed.

Table 2. Acoustic analysis of speech for Velar Stop consonants in monosyllables /ka/ and /ga/:
Table 2(a). Wilcoxon Signed Ranks Test for Velar Stop consonants in monosyllables /ka/

Parameters	With P.P.S Record	Without P.P.S Record	Z	P
1) Burst Duration (msec)	14.26	21.38	-4.78	<0.001 (VHS)
2) Voice onset time (msec)	28.43	38.21	-4.78	<0.001 (VHS)
3)Formant Frequencies (Hz)				
a) F1 (Hz)	822.09	740.22	-4.78	<0.001 (VHS)
b) F2 (Hz)	1404.65	1334.27	-4.78	<0.001 (VHS)
c) F3 (Hz)	2547.28	2427.37	-4.78	<0.001 (VHS)
d) F4 (Hz)	3598.87	3440.55	-4.78	<0.001 (VHS)

(P.P.S: Posterior palatal seal area, V.H.S: Very highly significant)

Table 2(b).Wilcoxon Signed Ranks Test for Velar Stop consonants in monosyllables /ga/

STOP CONSONANTS /ga/ (n=30)

Parameters	With P.P.S Record	Without P.P.S Record	Z	P
1) Burst Duration (msec)	19.42	27.32	-4.78	<0.001 (VHS)
2) Voice onset Time (msec)	85.52	98.00	-4.78	<0.001 (VHS)
3)Formant Frequencies (Hz)				
a) F1 (Hz)	765.55	749.87	-4.78	<0.001 (VHS)
b) F2 (Hz)	1572.42	1428.97	-4.78	<0.001 (VHS)
c) F3 (Hz)	2750.22	2633.90	-4.78	<0.001 (VHS)
d) F4 (Hz)	3894.46	3719.29	-4.78	<0.001 (VHS)

(P.P.S: Posterior palatal seal area, V.H.S: Very highly significant)

Table 3. Mean, Median, and Standard deviation for Stop Consonants /ka/

Statistics :												
	With PPS.	Without PPS.	With PPS.	Without PPS.	With PPS.	Without PPS.	With PPS.	Without PPS	With PPS.	Without PPS.	With PPS.	With out PPS.
N	30	30	30	30	30	30	30	30	30	30	30	30
	B.D.		V.O.T		(F1)		(F2)		(F3)		(F4)	
Mean	14.63	21.88	28.32	37.64	807.90	754.50	1411.50	1343.10	2529.85	2409.54	3617.82	3414.05
Median	14.26	21.38	28.43	38.21	822.10	740.20	1404.60	1334.30	2547.28	2427.37	3598.87	3440.55
Std. Deviation	1.769	2.538	1.646	1.851	48.96	48.28	36.30	36.10	60.95	61.05	58.51	194.34

(P.P.S.- Posterior palatal seal area)

Table 4. Mean, Median, and Standard deviation for Stop Consonants /ga/

Statistics:												
	With PPS.	Without PPS	With PPS.	With out PPS	With PPS.	With out PPS	With PPS.	With out PPS	With PPS.	With out PPS	With PPS.	With out PPS
N	30	30	30	30	30	30	30	30	30	30	30	30
	B.D		V.O.T		(F1)		(F2)		(F3)		(F4)	
Mean	19.51	27.23	85.47	97.84	869.4	851.5	1567.10	1429.70	3604.0	2620.00	3912.70	3618.50
Median	19.42	27.32	85.52	98.00	865.5	849.9	1572.42	1429.00	2750.2	2633.90	3894.50	3719.30
Std. Deviation	1.35	1.66	4.79	5.75	10.92	9.62	21.16	25.60	46.32	53.20	45.30	355.40

(P.P.S-Posterior palatal seal area)

As the palatal coverage hinders the tactile feedback mechanism to a large extent, and therefore limits the ability to properly articulate (MilIer *et al.,* 1955). Whereas formant frequencies recorded with the posterior palatal area record in the intaglio surface of the denture showed more resonance frequency as compared to without the record. This is because the vibrating air channel for the sound production in the vocal tract is altered because of the presence of gap between the post dam area and the soft palate. So less vibrating air channel carrying the velar sound monosyllable /ka/ exists the oral cavity and hence low frequency recorded. Table 3. Shows, Median, and Standard deviation for Stop Consonants /ka/ and the data was used for the bio statistical analysis using Wilcoxon Signed Ranks Test, with SPSS (statistical package for social science) Version 20. Table.4. Shows, Median, and Standard deviation for Stop Consonants /ga/ and the data was used for the bio statistical analysis using Wilcoxon Signed Ranks Test, with SPSS (statistical package for social science) Version 20.

DISCUSSION

In the present investigation, an assessment of the effect of speech intelligibility was carried out, and for this purpose, the speech data of the same edentulous patient was analysed perceptually and acoustically, with and without the record of posterior palatal seal area in the denture. Thirty edentulous patients had their speech recorded with (fluid wax simulating P.P.S) and without (scrape off the fluid wax) the record of posterior palatal seal area. Perceptual analysis was done subjectively for stop consonants monosyllable /pa/, /ta/, /ka/, /ba/, /da/, /ga/ as well as and Kannada and Malayalam articulation tests appropriate for the language of the subjects were used, for the same individual. Speech intelligibility was rated by three different qualified speech pathologist in terms of good, satisfactory and poor (MilIer *et al.,* 1955). Whereas acoustic analysis was done for velar stop consonants monosyllable /ka/ and /ga/ using an automated speech

recognition system (PRAAT software) that measured speech in terms of burst duration (B.D.), voice onset time (V.O.T.) and formant frequencies (F1, F2, F3, F4). Complete denture prosthesis, with and without the record of posterior palatal seal area did not show any significant difference in the speech when analysed perceptually by three different speech pathologist. All the three raters, rated the speech to be satisfactory. As the perceptual analysis method used to assess speech sounds is a subjective method so a total of three trained speech pathologists were chosen to analyse the samples. Multiple-choice tasks by multiple evaluators are considered to be suitable for obtaining reliable result. The study was a single- blinded study as test samples were randomised and none of the examiners knew which sample they were analysing. Whereas when acoustic analysis was done for velar stop consonant monosyllable /ka/ and /ga/, a very significant result was obtained in terms of burst duration, voice onset time and formant frequencies. Burst Duration is the time required for a noised burst heard immediately after the break in contact of the articulator. This period is usually measured in milliseconds. Voice onset time is the duration of the period of time between the release of a plosive and the beginning of vocal fold vibration. It is usually measured in milliseconds and a Formant frequency as is measured as an amplitude peak in the frequency spectrum of the sound. The formant with lowest frequency is called f1 followed by f2, f3, f4. In the agreement of the present study, an improvement in the intelligibility of patients with an edentulous maxillary arch was stated in studies that used a perceptual rating of speech intelligibility or spectral analysis to assess single distorted sounds.

In these studies, the articulation of fricative sounds in particular posed with the problem for the edentulous speakers, which may explain reduced intelligibility (Wada *et al.,* 2011). The maxillary incisors and their positions were found crutial for speech production, and there are many studies concerning the size and thickness of complete denture on speech production. Subjective evaluation of the effect of the mandibular prosthesis on the quality of life was done. Studies in this area implicate that the mandibular prosthesis seem to influence masticatory function or stability to a greater extent than does speech production (Kessler, 1957). Hence this study was focused on the effect of speech on the complete denture wearers wherein denture with P.P.S area record and without P.P.S area record in the same patient was taken into account. When comparing the data collected, with and without P.P.S area record for velar stop consonants monosyllable /ka/ and /ga/ it was concluded that in pronunciation for both the stop consonants there was significant difference in the acoustic characteristics. More time was recorded for the production of velar sounds in terms of burst duration and voice onset time, measured in milliseconds for the denture without P.P.S record and vice versa. Whereas for the formant frequencies, denture without P.P.S record showed less frequencies at different locations of the vocal tract and vice versa. Minimum being just above the vocal chord and it increased as it proceeded towards the open end of the oral cavity. A possible explanation may be the fact that the complete dentures lack retention and stability because of the lack of adequate seal at the posterior palatal seal area. Hence, macro and micro movement of the mucosal base may interfere with the articulation, reducing the intelligibility of speech (Wada *et al.,* 2011). For the production of velar sounds like /ka/ and /ga/, the tounge makes articulation with the soft palate as it raises up. Velar sounds are produced as this articulation breaks and the vibration in the vocal tract starts. Inadequate record of the posterior palatal seal area would result in a gap between the tissue surface of the denture and the mucosal lining of the soft palate, which would hamper the speech produced in terms of formant frequencies, burst duration and voice onset time as some of the vibrating air channel would percolate into the gap present at the posterior most part of the denture. This assumption is supported by the data obtained for the acoustic parameters that showed spread of duration in terms of milliseconds for both burst duration and voice onset time, when posterior palatal seal is not recorded and vice versa. Whereas for formant frequencies, the recorded data showed reduced frequency when posterior palatal seal area was not recorded and vice versa. Additionally, the palatal coverage itself and its influence on the geometry of the oral cavity are known to be the main factors for reduced speech intelligibility in complete denture wearers (Hyung-Jun Kong, 2008).Posterior Palatal seal area coverage hinders the tactile feedback mechanism to a large extent, and therefore limits the tongue to properly articulate with the soft palate for velar sound production[5]. Since every alteration in the oral cavity may cause impairment in the speech production, it is consequently assumed that appropriate record of the posterior palatal seal would not alter the acoustic characteristics of speech in extended palatal coverage. Speech is a global parameter for the success of a prosthetic rehabilitation. A computer based, automatic, rater- independent speech is a useful tool to evaluate voice quality in terms of burst duration, voice onset time and formant frequencies. The study implies that Prosthodontist can contribute effectively as a team member, working with Speech Language Pathologist in the appropriate fabrication of the denture, by evaluating the patients speech with respect to posterior palatal seal area recorded in the intaglio surface of the denture (post-dam area).

Conclusion

In the present investigation, it was possible to demonstrate the impact of posterior palatal area record in the denture on the quality of speech in terms of burst duration, voice onset time, and formant frequencies by performing objective and automatic speech analysis acoustically. Within the limitations of this in vivo study, the following conclusions could be drawn: There is a statistical significant difference in Burst duration of speech, showing more spread of velar sounds in terms of milliseconds, without the record of posterior palatal seal area and vice versa. With the proper record of posterior palatal seal area in the denture, voice onset time showed less spread of velar sounds in terms of milliseconds. There is a statistical significant difference in formant frequencies of velar sounds, showing more frequencies in terms of Hertz, with the record of posterior palatal seal area and vice versa. Perceptual analysis (purely subjective) did not show any difference when articulation test was performed by three different qualified speech language pathologist. Hence to conclude, speech language pathologist can contribute effectively as a team member in the fabrication of complete denture prosthesis (George Chierici and , 1973).

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