Original Article

Knowledge among Students on the Role of Phonetics in the Construction of Removable Dental Prosthesis – A Cross-sectional Study

Akshaya Priya Punniyakotti, Anand Velayudhan*, Venkatakrishnan Cakku Jalliah, Tamizhesai Balavadivel, Lokesh Shanmugam, Keerthivasan Murugan Srinivasan

Department of Prosthodontics and Crown and Bridge, Tagore Dental College and Hospital, Chennai, Tamil Nadu, India.

Abstract

Background: Phonetics plays a major role in determining the success of removable dental prosthesis. Speaking with a new prosthesis can impose significant challenges to the patient. To overcome these challenges, it is crucial to understand the fundamental principles of speech generation and the specific mechanisms involved in sound production. Fabrication of a removable prosthesis with this in mind will create dentures with effective phonetic capabilities. The purpose of the study was to evaluate the knowledge among dental students undergoing internship training on the role of phonetics in the fabrication of removable dental prostheses. **Materials and Methods:** This study was conducted among 250 dental students undergoing their internship training program at various dental colleges around Chennai. A pre-validated questionnaire of 20 questions, which was divided into three sections: General knowledge, clinical correlations, and clinical evaluations, was employed. The knowledge of the students was evaluated and categorized as poor, average, good, and excellent. Evaluation was also made among the section to understand the # of students between general knowledge, clinical correlation, and clinical evaluation. **Results:** About 62% of the students had good knowledge of the role of phonetics in the construction of removable dentures. About 21.6%, 14%, and 2.4% of students have average, excellent, and poor knowledge, respectively. Among the three sections, clinical correlation to phonetics was better than knowledge and evaluation. **Conclusion:** A well designed prosthesis not only restores function and enhance aesthetics but also improves phonetics of the patients. When dentist are well aware of this it will help in fabricating a denture with the proper alignment of palatal countours with patient's tongue,ensuring optimal tooth position,occlusal plane,vertical dimension and palatal vault thickness.

Keywords: Knowledge, Phonetics, Removable dental prosthesis

Introduction

Phonetics is one of the important factors in determining the success of the removable dental prosthesis, along with mastication and esthetics.[1] When the patients wearing a removable dental prosthesis are able to communicate with good pronunciation and clarity, it gives them immense confidence. This will, in turn, motivate the patient to continue to use the removable dentures. The evaluation of phonetic can serve as useful guidelines during the fabrication of the removable prosthesis. It can help the operator evaluate the correctness of each step during the fabrication of the denture. Hence, a thorough understanding of phonetics equips the dentist to create prostheses that effectively address the primary goal of oral rehabilitation.[2-4]

Access this article online

Website: www.jrad.co.in

DOI: https://doi.org/10.53064/jrad.2022.15.4.496

Materials and Methods

Study population and participation

The study was carried out after obtaining approval from the ethical committee of Tagore Dental College and Hospital (IEC/TDCH/078/2023).

A pre-validated questionnaire[1] was distributed among 250 dental students undergoing their internship training program around Chennai between November 2023 and January 2024.

Address for correspondence: Dr. Anand Velayudhan, Department of Prosthodontics and Crown and Bridge, Tagore Dental College and Hospital, Chennai, Tamil Nadu, India.
Email: vanand.dnv@gmail.com

Received: Apr. 01, 2024; **Accepted:**Apr. 19, 2024; **Published:** Apr. 29, 2024

How to cite this article: Punniyakotti AP, Velayudhan A, Jalliah VC, Balavadivel T, Shanmugam L, Srinivasan KM. Knowledge among Students on the Role of Phonetics in the Construction of Removable Dental Prosthesis-A Cross-Sectional Study. J Res Adv Dent 2024;15(3):1-5.

The questionnaire also contained informed consent for their participation in the study.

Survey validation and preparation

It included 20 closed-ended, pre-validated questions.[1] Five of these assessed the student's general knowledge of the role of phonetics in the fabrication of removable dentures. Eight questions were used to evaluate the clinical correlation, and seven questions examined the use of phonetics in the clinical evaluation of the denture during each step in the construction of a removable dental prosthesis. Each question had three answers, namely, correct, incorrect, and I do not know. The answers were coded, and data input was made in Microsoft Office Excel. The responses were sorted into four categories depending on the number of correct responses: poor (≤5 correct answers), average (6–10 correct answers), good (11–15 correct answers), and excellent (16–20 correct answers).

Statistical analysis

The Statistical Package for the Social Sciences (SPSS v.24) was then used for data entry and analysis. Frequency distributions and percentages were utilized for the descriptive analysis of the data.

Results

Among the 250 dental students undergoing their internship training program at various dental colleges around Chennai, 175 (70%) were females and 75 (30%) were males. (Table 1) 2.4% of the students had a poor understanding of the role of phonetics; 21.6% had an average understanding; 62% had a good understanding; and 14% were excellent at understanding the role of phonetics in the fabrication of removable dental prosthesis. (Table 2) Among the three sections, the mean and standard deviation for general knowledge was 3.9 (±1.12), clinical correlation was 4.8 (±1.38), and clinical evaluation was 4.6 (±1.74).

Table 1: Based on the number of correct responses, participants' performance was categorized into four groups: poor (≤ 5 correct answers), average (6–10 correct answers), good (11–15 correct answers), and excellent (16–20 correct answers).

Groups	Frequency (n)	Percent (%)
Poor	6	2.4
Average	54	21.6
Good	155	62
Excellent	35	14

Table 2: Mean and standard deviation for each section

Total scores	Mean	SD(±)
General knowledge	3.79	1.12
Clinical correlation	4.80	1.38
Clinical evaluation	4.69	1.74

Discussion

When an individual becomes edentulous, the patients not only lose their teeth but also the clarity in their speech and efficient function. Rehabilitation of the missing teeth gives the patient confidence and social wellness. Speech is an important consideration in the success of the prosthesis. The awareness and knowledge among the dentists about the role of phonetics in the construction of removable dental prosthesis is vital to rendering a quality service to the patients. Phonetics also proves to be an extraordinary guideline for the evaluation of each step in the fabrication of the denture.[5] Some of the consonants that are important for clinicians to know can be divided into groups according to the anatomical structures that produce them.

- Palatolingual sounds: produced by the tongue, hard palate, or soft palate
- Linguo-dental sounds: produced by the tongue and teeth
- Labiodental sounds: produced by the lips and teeth
- Bilabial sounds: produced by the lips.[6]

Various phonetic techniques have been discussed in the literature:

In 1951, "Pound" enhanced phonetics by shaping the whole palatal region of the maxillary denture to imitate the natural palate. According to "Landa," the "s" sound indicates adequate "freeway space" and the "M" sound indicates a suitable rest posture.

In 1953 and 1956, "Silverman" used the "speaking technique" to measure patients' vertical measurements in natural teeth with and without dentures. Morrison recommended using the words "sixty-six" and "Mississippi" to locate the nearest speaking space. In 1967, "Kaire" used electrical techniques to measure the palatal pressure of the tongue while pronouncing certain palatolingual speech sounds within the present vertical dimensions (VDs) of occlusion.[7]

In the present study, the pre-validated questionnaire was divided into three sections, namely, general knowledge, clinical evaluation, and clinical correlation were employed (Table 3). In the general knowledge section, the initial query garnered the highest accuracy rate, with 90% of respondents selecting the correct option. This suggests that students possess a good understanding of how improper pronunciation can stem from various factors such as lack of lip support, misalignment of teeth, or changes in facial structure. In contrast, in the second question, 48% of students opt for the incorrect response "correct." The recommendation here was to evaluate phonetics during the wax try-in phase before inserting dentures. During this process, patients are instructed to articulate specific words like "Emma" or "Mississippi" without tooth contact. In addition, guidelines are provided for observing the positioning of the lower lip's vermillion border to the maxillary central incisor's incisal edge when pronouncing "55" and ensuring space between anterior teeth when articulating "33."[6,8] In the third question, 82.4% of respondents chose the correct answer, while 75.2% selected accurately for the fourth

Table 3: Frequency and percentage of responses for each question

Questions	n(%)			
General knowledge	**Correct**	**Incorrect**	**I do not know**	**Correct answer n (%)**
1. Improper pronunciation maybe the result of unsupported lips, errors in teeth positioning, or altered facial height	225 (90)	11 (4.4)	14 (5.6)	225 (90)
2. Phonetics evaluation is preferably performed at insertion appointment	120 (48)	112 (44.8)	18 (7.2)	112 (44.8)
3. Major phonetic problems could result from increased vertical dimension of occlusion	206 (82.4)	14 (5.6)	30 (12)	206 (82.4)
4. Phonetic method is the most popular method for vertical dimension of rest recording	188 (75.2)	36 (14.4)	26 (10.4)	188 (75.2)
5. Teeth position and proper denture base thickness are important for adequate speech	221 (88.4)	10 (4)	19 (7.6)	221 (88.4)
Clinical correlation				
6. "S" and "SH" are sounds that are created by air alone. Therefore, they are called voiceless speech sounds	171 (68.4)	42 (16.8)	37 (14.8)	171 (68.4)
7. "F" and "V" sounds are formed between the lips (Bilabial)	125 (50)	108 (43.2)	17 (6.8)	108 (43.2)
8. "T", "D" and "N" sounds appear when the tongue is pressed firmly against the anterior hard palate (tongue and hard palate)	212 (84.8)	18 (7.2)	20 (8)	212 (84.8)
9. "TH" sound is used to assess the height of maxillary incisors	158 (63.2)	38 (15.2)	54 (21.6)	38 (15.2)
10. "CH" sound is used to assess the length of maxillary incisors and tongue-tooth relation	142 (56.8)	52 (20.8)	56 (22.4)	52 (20.8)
11. The incisal edges should approximate each other, but not touch during the pronunciation of "S" sound	196 (78.4)	27 (10.8)	27 (10.8)	196 (78.4)
12. Overextension of posterior (distal) border of maxillary denture may be evaluated using some sounds	166 (66.4)	37 (14.7)	47 (18.8)	166 (66.4)
13. Incorrect horizontal and vertical positioning of maxillary incisors leads to mispronunciation of "K", and "D" sounds	149 (59.6)	47 (18.8)	54 (21.6)	47 (18.8)
Clinical evaluation				
14. To evaluate proper vertical dimension, ask the patient to say "M"	197 (78.8)	31 (12.4)	22 (8.8)	197 (78.8)
15. To check the height of anterior part of upper wax rim, ask the patient to say "S"	173 (69.2)	35 (14)	42 (16.8)	173 (69.2)
16. At try-in appointment, when the patient pronounces the letter "F", the lower lip should be in light contact with the incisal edges of maxillary incisors	195 (78)	21 (8.4)	34 (13.6)	195 (78)
17. "OLO" and "ELE" are used for vertical dimension evaluation	119 (47.6)	49 (19.6)	82 (32.8)	119 (47.6)
18. "Whistling" sound results when posterior teeth are set too far lingually	156 (62.4)	30 (12)	64 (25.5)	156 (62.4)
19. "Slurry"/s/,/sh/, and/th/sounds are caused by palatal placement of maxillary incisors or excess denture base thickness palatal to them	175 (70)	25 (10)	50 (20)	175 (70)
20. "F" sound will turn out like "V" sound if upper anterior teeth are arranged below the occlusal plane	157 (62.8)	26 (10.4)	67 (26.8)	157 (62.8)

question. These questions delved into the assessment of jaw relation and the concept of Silverman's closest speaking space (CSS), which measures mandibular vertical relation during phonetics.[9] According to Burnnet (1994) and Silverman (1952), it is affirmed that the CSS remains stable for each individual over their lifespan. This consistency enables the dynamic determination of the VD of occlusion in both dentate and edentulous patients.[10] Furthermore, phonetics plays a role in recording VDs at rest, as demonstrated by asking patients to pronounce "M" to assess lip contact and strain, which can indicate premature occlusal rim contact.[11] Fymbo (1936) highlighted that speech impairments often correlate with an elevated VD, leading to challenges in articulating certain sounds like b, m, p, f, and v. Landa (1947) suggested employing different phonetic assessments to ascertain the correct VD, focusing on sounds such as s, c, and z.[12] In the final question of the general knowledge section, 88.4% of participants correctly identified that a denture base that is too thick can negatively impact phonation. Specifically, a thicker denture base, particularly at the palate, can interfere with the clarity of consonant sounds such as "t," "d," "s," "c," "z," "r," and "l."[13] The thickness of the denture base plays a crucial role in proper phonation because the tongue makes solid contact with the anterior portion of the hard palate when pronouncing the consonants "T" and "D."[14]

In the clinical correlation section, 68.4% of students correctly chose the right answer for the sixth question. According to Rowe Arthur (1936), Mehringer E.J. (1963), and Pingo (2003), who explained the necessity of proximity between lower and upper incisor teeth to enable air passage for producing voiceless speech sounds like "S,"[6] the sound represented by the letter S necessitates the close proximity of the upper and lower incisors, enabling the airflow to pass through the narrow gap between the teeth. Similarly, the consonants Ch, J, and Z also rely on a comparable airflow pathway during their articulation.[15] Conversely, 43.2% of students erred in identifying the labiodental group of sounds represented by "F" and "V," which involve the lower lip contacting the maxillary incisal edge, whereas bilabial sounds like "B" and "P" are formed by lips.[6] With regard to the eighth question, 84.8% of students answered correctly that for consonants "T" and "D," the tongue should touch the anterior hard palate. A too-thick anterior hard palate in dentures can affect these sounds. However, only 15.2% and 20.8% of students chose the correct option "incorrect" for questions nine and ten, respectively, recognizing that the sounds "TH" and "CH"

belong to linguodental and linguopalatal groups, not indicative of maxillary incisor height.[6] According to Boucher, labiodental sounds are used to determine the height of the central incisors.[16] For questions 11 and 12, 78.4% and 66.4% of respondents answered accurately: when pronouncing the "s" sound, the upper and lower teeth come close together but do not make contact, leaving a small gap of approximately 1 or 2 mm.[6] As per Mehringer, E.J. (1963) and Prendergast, W.K. (1935), the area known as the post-dam significantly affects the articulation of palate velar consonants such as K, G, and the vowels I and E.[17] A thicker post-dam region can cause discomfort and difficulty in speech, potentially leading to nausea due to irritation of the tongue's dorsal surface.[6] If the denture extends onto movable tissues, it can cause them to loosen, rendering speech impossible for the patient. Only 18.8% of students correctly identified that incorrect horizontal and vertical positioning of maxillary incisors, resulting in mispronunciations of "K" and "D," was an incorrect answer choice.

In the clinical evaluation segment, the majority of students demonstrated proficiency by choosing the right answers. Specifically, 78.8% of students accurately responded to the query regarding evaluating the proper VD by instructing the patient to articulate the letter "M." This method is preferred over pronouncing letters like "P" or "B," as the passive lip contact involved in producing the "M" sound aids in determining VD, unlike the explosive effect observed with "P" and "B."[18] Regarding the assessment of the height of the anterior part of the maxillary occlusion rim, 69.2% of students correctly identified asking the patient to say "S" as the appropriate method. Similarly, 78% of students chose the correct answer regarding the positioning of the lower lip during the pronunciation of the letter "F" at the try-in appointment, emphasizing light contact with the incisal edges of the maxillary incisors.[6] When asked about using "OLO" and "ELE" for VD evaluation, 47.6% of students provided the correct response. This method, as per Marko *et al*., involves deducting 5.5 and 7.5 mm from the mandibular position when the patient says "OLO" or "ELE," respectively.[19] Furthermore, 62.4% of students correctly identified that a "whistling" sound indicates posterior teeth set too far lingually, causing the upper premolars to restrict the anterior portion of the tongue, resulting in an insufficient escape route for air.[6] In recognizing the causes of "slurry" sounds (/s/,/sh/, and/th/), 70% of students accurately attributed it to palatal placement of maxillary incisors or excess denture base thickness palatal to them. The occurrence of/s/sounds like/sh/is explained by the "stigmatismus lateralis" phenomenon, where inadequate tongue enclosure in the bicuspid region leads to air leakage from the tongue's lateral borders. Finally, for the last question, 62.8% of students correctly noted that pronouncing the letter "v" as "f" is more likely if the upper anterior teeth are positioned above the occlusal plane, while the letter "f" may resemble "v" if the upper anterior teeth are below the occlusal plane.[7] Almost 15 questions were answered correctly by more than 50% of the students, and five questions were answered correctly by <50% of the students.

The results of this study revealed that 62% and 14% of the students had a good and excellent knowledge of phonetics in removable dental prosthesis, which might be attributed to the application of their theoretical knowledge to the clinical situation. Furthermore, only 2.4% and 21.6% of the students had poor and average knowledge of phonetics. This can be addressed by incorporating dedicated lectures and advanced teaching and learning methods to simulate the clinical scenario and emphasizing the importance and relevance of phonetics in prosthesis construction. This study also found that clinical correlation was greater than general knowledge and clinical evaluation, indicating that students can correlate their understanding of phonetics but are unable to clinically evaluate it in practice. To ensure that the dentures aid in speech, dentists can also pursue courses in the field of speech science to enhance their critical understanding of the phonetic aspect of denture fabrication.[20] Incorporating problem-based learning (PBL) is an effective teaching method for dental undergraduate students. It helps integrate theoretical knowledge into clinical practice. Clinical scenario simulations during PBL training improve linguistic skills, logical thinking, and clinical practice abilities.[21] Implementing all of these measures to evaluate phonetics during the fabrication of a removable dental prosthesis not only improves the student's understanding of phonetic but also increases patient satisfaction and acceptance.

Conclusion

A well-designed prosthesis aims to restore both function and esthetics while also improving phonetics. Achieving precise alignment of the palatal contours of a maxillary complete denture with the patient's tongue can enhance speech clarity, provided that other factors such as tooth position, occlusal plane, VD, and thickness of the palatal vault are optimal. Given that oro-dental morphological features can influence an individual's speech, dentists should be aware of how adjustments in phonetics during treatment can impact speech performance.[22]

References

1. Abualsaud R, Al-Thobity AM, Qaw MS, Almaskin DF, Alzaher ZA, Khan SQ, *et al*. Students' awareness of the role of phonetics in construction of removable dental prostheses: A questionnaire-based cross-sectional study. Dent J (Basel) 2022;10:227.
2. Kessler HE. Study of tongue patterns is clue to better speaking dentures. Dent Survey 1958;34:1015-7.
3. Herbert S. Phonetic capability as a function of vertical dimension in complete denture wearers - a preliminary report. J Prosthet Dent 1970;23:621-32.
4. Moustafa AH. Clinical Complete Denture Prosthodontics, Post Insertion Denture Problems. 1st ed. Riyadh: King Saud University; 2004. p. 388.
5. Allen LR. Improved phonetics in denture construction. J Prosthet Dent 1958;8:753-63.
6. Jain CD, Bhaskar DJ, Agali CR, Singh H, Gandhi R. Phonetics in dentistry. Int J Dent Med Res 2014;1:31-7.
7. Bhat JT, Kumar N, Singh K, Tanvir H. Phonetics in prosthodontics: Its clinical implications in designing of prosthesis. Int J Appl Dent Sci 2021;7:84-93.
8. Heartwell CM, Rahn AO. Syllabus of Complete Denture, Recording Maxillomandibular. 4th ed. Philadelphia, PA, USA: Lea & Febiger;

1986. p. 279.
9. Silverman MM. Determination of vertical dimension by phonetics. J Prosthet Dent 1956;6:465-71.
10. Burnett CA. Clinical rest and closest speech positions in the determination of occlusal vertical dimension. J Oral Rehabil 2000;27:714-9.
11. Agarwal A, Upadhyay M, Singh N. Phonetics in Prosthodontics. Germany: LAP Lambert Academic Publishing; 2023.
12. Landa JF. The importance of phonetics in full denture prosthesis. Dent Digest 1935;41:154-60.
13. Chaturvedi S, Gupta N, Tandon A. Speech considerations. J Dent Med Sci 2015;14:34-6.
14. Zhang XX, Liu JZ. A review about the application of phonetic methods in deciding the jaws relation of complete denture. Hua Xi Kou Qiang Yi Xue Za Zhi 2021;39:105-7.
15. Fenn HR, Lindlow KP, Gimson AP. Clinical Dental Prosthetics. 2nd ed. New York: CBS; 2008. p. 302-8.
16. Boucher CO. Arrangement of teeth. In: Swenson's Complete Dentures. 6th ed. St. Louis, Mo: Mosby; 1970. p. 155-210.
17. Schierano G, Mozzati M, Bassi F, Preti G. Influence of thickness of resin palatal vault on closest speaking space with denture base. J Oral Rehabil 2001;28:903-8.
18. Liddelow FG. Clinical Dental Prosthodontics: Phonetics. Massachusetts: Butterworth and Co, Ltd. Publishers; 1989. p. 136-9.
19. Igić M, Krunić N, Aleksov L, Kostić M, Igić A, Petrović MB, *et al*. Determination of vertical dimension of occlusion by using the phonetic vowel "O" and "E". Vojnosanit Pregl 2015;72:123-31.
20. Sharry JJ. Complete Denture Prosthodontics. 3rd ed. United States: McGraw Hill Book Company; 1962. p. 130-48.
21. Wang W, Bi X, Zhu Y, Li X. Reforming teaching methods by integrating dental theory with clinical practice for dental students. PeerJ 2020;8:e8477.
22. Gupta R, Luthra RP, Gautam D. Phonetics in complete denture - a review. Int J Health Sci 2016;4:373-7.