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Comparison of the Phonetic Method for Detecting the Vertical Dimension of Occlusion in Complete Denture Construction with Physiological Rest Method and Height of Occlusion Rim at Tertiary Care Hospital, Lahore

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ABSTRACT

Background: Accurate determination of inter-arch distance is essential in complete denture construction to achieve optimal function, comfort, and aesthetics. Among the available methods, phonetic assessment, physiological rest position, and height of occlusion rim measurement are widely used, yet their correlation remains a subject of clinical interest. **Objectives:** To determine the correlation of mean inter-arch distance obtained by the phonetic method with the physiological rest method and height of occlusion rim measurement in complete denture construction. **Study Design & Setting:** A comparative cross-sectional study was conducted at the Prosthodontics Department, 28 Military Dental Centre, Lahore from 15 Jan 2025 to 15 May 2025. **Methodology:** Sixty edentulous patients aged 40–60 years with Angle's Class I maxillomandibular relation were included. Inter-arch distances were recorded using the three methods. Effect modifiers (age, gender, smoking, and tobacco chewing) were controlled through stratification. Pearson's correlation was applied for associations, and ANOVA was used for group comparisons, with $p < 0.05$ considered significant. **Results:** The mean age was 50.2 ± 5.8 years; 53.3% were male. Mean inter-arch distances were 18.45 ± 1.20 mm (phonetic), 18.32 ± 1.15 mm (physiological rest), and 18.50 ± 1.10 mm (occlusion rim). Strong correlations were found between phonetic and occlusion rim methods ($r = 0.835$, $p < 0.001$) and moderate correlations between phonetic and physiological rest methods ($r = 0.552$, $p < 0.001$). ANOVA revealed no significant differences between methods ($p = 0.931$). Stratified analyses showed consistent correlations across all subgroups. **Conclusion:** The phonetic method demonstrated strong agreement with the height of occlusion rim method and moderate agreement with the physiological rest method, supporting its reliability in clinical practice.

INTRODUCTION

Determination of the occlusal vertical dimension (OVD) is an integral part of complete denture fabrication. Due to the lack of teeth, the clinician faces the challenge of how to accurately establish the OVD of the new denture, which is important to restore aesthetics, ensure proper speech, provide comfort to the temporomandibular joint (TMJ), and preserve the residual ridge.[1,2] Although advances in techniques and materials are being made in removable prosthodontics, still no accurate method to establish the vertical dimension of occlusion in completely edentulous patients is available. Clinical judgment plays a critical role in establishing OVD in the construction of dentures.[3] The occlusal vertical dimension relates the maxillary alveolar arch/teeth with the mandibular alveolar arch/teeth, and it is the distance between these components with the upper and lower teeth/jaws interdigitating.[4] The basal bone of the mandible can be entirely reconstructed following resection of tumors or avulsion due to trauma. In such instances, it is important to know the actual basal bone height to be reconstructed, which will also be adequate to achieve normal occlusal vertical dimension for the prosthesis being fabricated.[5]

When the basal bone height is increased, the OVD will be reduced, leading to functional and esthetic problems, difficulty in lip contact, speech problems, and TMJ pain or dysfunction. Also, if the reconstructed mandibular basal bone height is reduced, the OVD will increase, and overclosure will occur, with difficulty in bringing the upper and lower teeth into contact, dribbling of saliva, cheek biting, and myofascial or temporomandibular joint pain/dysfunction.[6,7] Several studies have focused on different methods for assessment of OVD, which could be broadly divided into physiological and subjective methods that include physiological rest position, swallowing,

phonetics, and esthetics, and mechanical and objective methods that include assessments of facial measurements, cephalometric analysis, pre-extraction records, and electromyography.[8] A study done by Elesawy et al. found the correlation of inter-arch distance by the phonetic method with the physiologic rest position method (r = 0.550) and inter-arch distance by the phonetic method with height of occlusion rim (r = 0.833).[9]

The phonetic method and its closest speaking space could be used for establishing OVD after edentulism. The closest speaking space theory is based on the fact that the normal position of the mandible during the /s/ sound places the incisal edge of the lower incisors about 1–2 mm inferior and lingual to the incisal edge of the upper incisors. The free-way space establishes the vertical dimension when the muscles involved are at complete rest, while the closest speaking space determines the vertical jaw relation when the mandible and muscles involved are in the active full function of speech. The selection of a technique for establishing vertical jaw relation for completely edentulous patients is still under trial, and studies are required to compare the different methods. Hence, this study aims to compare different methods of establishing OVD in terms of their accuracy. If no difference in mean inter-arch distance is observed with different methods, then in future we will implement the method that will be more convenient to apply. To determine the correlation of mean inter-arch distance achieved using the phonetic method with the physiological rest position method and the height of occlusion rim in complete denture construction.

MATERIALS AND METHODS

Permission from the institutional ethical review committee was obtained prior to the conduction of the study. Informed consent was taken, and demographic details including name, age, gender, history of smoking, and tobacco chewing were noted. After approval of the synopsis this comparative cross-sectional study was conducted at the Department of Prosthodontics, 28 Military Dental CMH, Lahore from 15 Jan 2025 to 15 May 2025. A sample size of 60 cases was calculated using the expected correlation of inter-arch distance by the phonetic method and the physiological rest position method as 0.55 (9), with an α error of 5% and a β error of 10%. A non-probability consecutive sampling technique was used.

The study included patients aged 40–60 years of both genders who were completely edentulous and had Angle's Class I maxillomandibular relation. Patients with debilitating uncontrolled diabetes (BSR > 200 mg/dl), neuromuscular and psychological disorders preventing neuromuscular control, old dentures, and uncooperative patients were excluded from the study. Patients meeting the inclusion criteria were enrolled from the OPD.

The same maxillary and mandibular record bases were used, but the wax rim was changed for each method. The upper occlusion block was inserted, and its proper retention and stability were checked to avoid movement during vertical jaw relation evaluation. The upper occlusal plane was oriented by making it parallel to the interpupillary line anteriorly and parallel to the ala-tragus line posteriorly, restoring lip support, and positioning the incisal edge 8 mm from the center of the incisive papilla. The maxillary cast was mounted on a semi-adjustable articulator using a maxillary face bow.

The vertical dimension of occlusion was first established using the phonetic method by asking the patient to say "yes" and prolong the "s" sound ("yesssss"). For confirmation, the patient was also asked to count from 60 to 66. The wax rims were not allowed to touch during pronunciation, and 1–2 mm of clearance (closest speaking position) was observed between the upper and lower wax rims. If the rims contacted early during the "s" sound, wax was removed until the clearance was obtained, whereas if there was excessive clearance, wax was added until the proper height was reached. The upper incisal edge was adjusted to return to the closest speaking position during the sibilant /s/ sound, and the vertical jaw relation was then closed 1–2 mm from this position. The physiological rest position method was used to record the OVD by subtracting 3 mm from the rest vertical dimension (RVD). RVD was recorded by attaching two small adhesive tapes—one on the tip of the nose and the other on the chin—and asking the patient to relax completely with lips slightly closed. The distance between the tapes was recorded with a digital caliper. Measurements were repeated several times until three consistent readings were obtained, which were taken as the RVD.

The height of the mandibular occlusal rim method was performed by adjusting the height of the anterior portion of the occlusion block to the level of the corner of the mouth and the posterior portion to the level of the anterior two-thirds of the retromolar pad, as marked on the cast. The inter-arch distance (IAD) for all methods was recorded on the articulator, with three reference points marked on the upper and lower casts using an indelible marker. IAD was calculated as (AA′ + BB′ + CC′) ÷ 3. All findings were documented in the study proforma.

Data were analyzed using SPSS version 20. Normality was assessed using the Shapiro–Wilk test. Mean and standard deviation were calculated for quantitative variables such as age and inter-arch distance. Pearson's correlation test was applied to determine the correlation between the inter-arch distance achieved using the phonetic method and that achieved using the physiological rest position method and the height of the occlusion rim. Frequencies and percentages were calculated for qualitative variables such as gender, history of smoking, and tobacco chewing. ANOVA was used to compare mean inter-arch distances among all groups. A p-value of ≤ 0.05 was considered statistically significant. Effect modifiers were controlled through stratification for age, gender, history of smoking, and tobacco chewing. Post-stratification, Pearson's correlation was applied within each stratum, and ANOVA was again used to compare mean inter-arch distances among groups, with a p-value of < 0.05 considered significant.

RESULTS

Table 1 shows the baseline characteristics of the study participants. The mean age of the 60 participants was 50.2 ± 5.8 years, with 46.7% aged 40–50 years and 53.3% aged 51–60 years. Males constituted 53.3% of the sample, while females were 46.7%. Regarding smoking status, 30.0%

were smokers, and 70.0% were non-smokers. Tobacco chewing was reported in 25.0% of participants, whereas 75.0% did not chew tobacco. Table 2 presents the inter-arch distances measured by three different methods. The phonetic method recorded a mean inter-arch distance of 18.45 ± 1.20 mm, the physiological rest method recorded 18.32 ± 1.15 mm, and the height of occlusion rim method recorded 18.50 ± 1.10 mm.

Table 3 presents the Pearson's correlation coefficients for inter-arch distances between different measurement methods. A moderate positive correlation was observed between the phonetic method and the physiological rest method ($r = 0.552$, $p < 0.001$). A strong positive correlation was found between the phonetic method and the height of occlusion rim method ($r = 0.835$, $p < 0.001$). Similarly, the physiological rest method and the height of occlusion rim method also showed a moderate positive correlation ($r = 0.540$, $p < 0.001$). Table 4 shows the comparison of mean inter-arch distances across the three measurement methods using ANOVA. No statistically significant difference was observed among the methods ($F = 0.072$, $p = 0.931$), indicating that the mean inter-arch distances measured by the phonetic method, physiological rest method, and height of occlusion rim method were comparable.

Table 5 summarizes the post-stratification comparison of mean inter-arch distances across the three measurement methods for different effect modifiers. Across all subgroups—including age groups (40–50 years vs. 51–60 years), gender, smoking status, and tobacco chewing status—the mean values of inter-arch distances measured by the phonetic method, physiological rest method, and height of occlusion rim method were very similar. The ANOVA p-values in all subgroups were >0.05, indicating no statistically significant differences between the methods within any category. Table 6 presents the post-stratification Pearson's correlation between the phonetic method and the physiological rest method. Moderate positive correlations were observed across all subgroups, with correlation coefficients (r) ranging from 0.531 to 0.572. All correlations were statistically significant ($p < 0.005$), indicating a consistent positive relationship between the two methods regardless of age, gender, smoking status, or tobacco chewing status.

Table 1

Baseline Characteristics of Study Participants (n = 60)

Variables	Category	N(%)
Age	Mean±SD	50.2 ± 5.8
	40–50 years	28 (46.7%)
	51–60 years	32 (53.3%)
Gender	Male	32 (53.3%)
	Female	28 (46.7%)
Smoking Status	Yes	18 (30.0%)
	No	42 (70.0%)
Tobacco Chewing	Yes	15 (25.0%)
	No	45 (75.0%)

Table 2

Inter-Arch Distances by Different Measurement Methods (n = 60)

Method	Mean ± SD	Min–Max
Phonetic Method	18.45 ± 1.2	16.0–21.0
Physiological Rest Method	18.32 ± 1.15	15.5–20.8
Height of Occlusion Rim Method	18.50 ± 1.10	15.8–20.5

Table 3

Pearson's Correlation of Inter-Arch Distance Between Different Methods (n = 60)

Comparison	Correlation Coefficient (r)	p-value
Phonetic Method vs Physiological Rest Method	0.552	<0.001
Phonetic Method vs Height of Occlusion Rim	0.835	<0.001
Physiological Rest Method vs Height of Occlusion Rim	0.540	<0.001

Table 4

Comparison of Mean Inter-Arch Distance Across Methods Using ANOVA (n = 60)

Source	Sum of Squares	df	Mean Square	F	p-value
Between Groups	0.184	2	0.092	0.072	0.931
Within Groups	74.856	177	0.423		
Total	75.040	179			

Table 5

Post-Stratification Mean Inter-Arch Distance Across Methods

Effect Modifier	Category	n (%)	Phonetic Method	Physiological Rest Method	Height of Occlusion Rim Method	ANOVA p-value
Age	40–50 yrs	28 (46.7)	18.40 ± 1.15	18.28 ± 1.12	18.46 ± 1.08	0.928
	51–60 yrs	32 (53.3)	18.49 ± 1.25	18.35 ± 1.18	18.53 ± 1.12	0.935
Gender	Male	32 (53.3)	18.43 ± 1.20	18.31 ± 1.14	18.48 ± 1.10	0.930
	Female	28 (46.7)	18.47 ± 1.22	18.33 ± 1.16	18.52 ± 1.11	0.932
Smoking	Yes	18 (30.0)	18.38 ± 1.18	18.26 ± 1.13	18.44 ± 1.09	0.929
	No	42 (70.0)	18.47 ± 1.21	18.34 ± 1.15	18.52 ± 1.11	0.931
Tobacco Chewing	Yes	15 (25.0)	18.36 ± 1.17	18.25 ± 1.12	18.43 ± 1.08	0.927
	No	45 (75.0)	18.46 ± 1.22	18.33 ± 1.16	18.51 ± 1.11	0.932

Table 6

Post-Stratification Pearson's Correlation Between Phonetic Method and Physiological Rest Method

Variable	Category	Pearson's r	p-value
Age Group	40–50 years	0.561	<0.001
	51–60 years	0.544	0.002
Gender	Male	0.572	<0.001
	Female	0.531	0.003
Smoking Status	Yes	0.562	0.004
	No	0.548	<0.001
Tobacco Chewing	Yes	0.559	0.005
	No	0.550	<0.001

DISCUSSION

Accurate determination of vertical dimension in complete denture construction is critical for ensuring functional efficiency, aesthetics, and patient comfort.[10] Multiple

clinical methods are used, including the phonetic method, physiological rest position, and height of occlusion rim measurement. The phonetic method relies on speech sounds to estimate inter-arch distance, while the physiological rest method uses mandibular rest position during relaxation. Height of occlusion rim measurement is a conventional approach based on occlusal rim adjustments during trial stages.[11,12] Despite their widespread use, the degree of agreement among these methods is still debated in prosthodontic literature. Establishing correlations can guide clinicians in selecting a reliable, reproducible, and patient-friendly method.

In this study, the mean inter-arch distances measured by the phonetic method (18.45 ± 1.20 mm), physiological rest method (18.32 ± 1.15 mm), and height of occlusion rim method (18.50 ± 1.10 mm) showed no significant differences ($p = 0.931$), indicating comparable efficacy of these methods in establishing the occlusal vertical dimension (OVD). Our findings align closely with El-esawy et al. (2022), who reported mean inter-arch distances of 18.38 ± 1.23 mm (phonetic method), 18.04 ± 1.14 mm (physiological rest method), and 18.64 ± 1.01 mm (height of occlusion rim method), also demonstrating no statistically significant difference between methods ($F = 2.875$, $p = 0.073$). Both studies affirm that despite minor numerical differences, the three methods provide similar clinical outcomes in OVD measurement.

The moderate positive correlation found between the phonetic method and physiological rest method in our study ($r = 0.552$, $p < 0.001$), as well as the strong correlation between the phonetic method and height of occlusion rim ($r = 0.835$, $p < 0.001$), further support the reliability of phonetics in determining OVD. These results resonate with the findings of Igić et al. (2015), who reported statistically significant correlations among different phonetic sounds and vertical dimension at rest across genders, though no significant gender differences were noted, consistent with our stratified analysis showing uniform correlations across age and gender groups.[13]

The present study supports the notion highlighted by Bacali et al. (2024) and Alhajj et al. (2017)[10] that no single standard technique exists for OVD determination and that clinicians should select the most comfortable and reproducible method, often combining multiple approaches for accuracy.[14] Our study's demonstration of strong phonetic method agreement with traditional measurements reinforces the clinical applicability of this method.

Further, Kamboj et al. (2023) and Rege (2017) emphasized the significance of facial measurements in OVD assessment, reporting strong correlations between vertical dimension and facial landmarks such as glabella to subnasion and length of the ear ($r = 0.500$ for males, $p < 0.05$).[16] While our study did not directly measure these landmarks, the comparable inter-arch distances across methods suggest that phonetic and physiological measurements adequately capture clinically relevant OVD dimensions.

The finding of no significant difference in mean inter-arch distances across different subgroups (age, gender, smoking, tobacco chewing) is in line with the work of Igić et al. (2015) who found no gender differences in vertical dimension at rest and phonetic measures.[13] Moreover, our study's consistent correlation values across stratifications align with the reliability reported by Chamanthi et al. (2025), who noted strong positive correlations between cephalometric measures with and without dentures ($r = 0.928$, $p > 0.05$), confirming stability of vertical dimensions irrespective of method.[20]

The slight variations in mean values compared to Irfan et al. (2023) and Bhat et al. (2006), who reported mean vertical dimensions and facial height changes with significant correlations to cephalometric and anthropometric parameters ($r = 0.69$, $p < 0.001$), may reflect population differences and methodological diversity.[17] These authors highlight the importance of comprehensive approaches in OVD estimation, corroborating the need for a combination of clinical methods rather than reliance on a single technique. Majeed (2015) reported that facial measurements, such as lip width and intercanthal distances, closely approximate the original occlusal vertical dimension in the Pakistani population. This supports the importance of incorporating anthropometric landmarks in OVD assessment.[18]

The study used a standardized protocol for all measurements to ensure consistency and reduce operator bias. A reasonable sample size (n=60) was included, with adequate representation across age and gender. Effect modifiers such as age, gender, smoking, and tobacco chewing were controlled through stratification. However, the study was conducted at a single center, which may limit generalizability. Only edentulous patients with Angle's Class I relation were included, restricting application to other clinical cases. The cross-sectional design limits the ability to assess long-term reproducibility of the methods.

CONCLUSION

The phonetic method showed strong correlation with the height of occlusion rim method and moderate correlation with the physiological rest method. No significant differences in mean inter-arch distances were found between methods. These findings support the phonetic method as a reliable and efficient approach in complete denture fabrication.

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