



EVALUATION OF THE PHONETIC METHOD FOR DETERMINING THE VERTICAL DIMENSION OF OCCLUSION IN COMPLETE DENTURE CONSTRUCTION

Mohamed H. El-esawy ^{1*}, Hafez I. Bahnassawi ², Yasser A. Baraka ³

ABSTRACT

Objectives: The purpose of the present study was to evaluate the phonetic method for determining the vertical dimension of occlusion in complete denture construction as compared to the rest vertical dimension method and the height of occlusal rim method. **Subjects and methods:** Fifteen completely edentulous patients were involved in the study, patients age ranged between 40-60 years with a mean age of 54.40 years. Vertical Dimension of Occlusion (VDO) was measured using three different methods, phonetic method, physiologic rest position and height of occlusal rim method. The upper cast was mounted on a semi-adjustable articulator using the maxillary face bow, after adjustment of upper occlusal rim height and orientation, followed by centric relation recording and mounting of the lower cast. The mean inter- arch distance (IAD) of the three methods were measured on the articulator. The results were tabulated and statistically analyzed. **Results:** There was statistically no significant difference in the mean Inter-arch distance measured by the three mentioned methods. As well as, significantly positive correlation was found between the methods. **Conclusion:** Phonetic method was more reliable method than the physiologic rest position method in measuring the OVD. The height of occlusal rim method considered encouraging but must be confirmed by further investigations on larger sample of patients.

KEYWORDS: Vertical dimension, rest position, phonetic method, occlusal plan.

INTRODUCTION

Determination of the occlusal vertical dimension (OVD) is an integral part of complete dentures 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 maintain aesthetics, for proper speech, to provide comfort to TMJ and to preserve residual ridge ⁽¹⁾.

Although recent 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 the establishing of OVD in the construction of dentures ⁽²⁾.

Several studies have spotted on different methods for assessment of OVD, which could be broadly

1. Masters Candidate, Department of Removable Prosthodontics, Faculty of Dental Medicine, Boys, Cairo, Al-Azhar University
2. Assistant Professor, Department of Removable Prosthodontics, Faculty of Dental Medicine, Boys, Cairo, Al-Azhar University
3. Assistant Professor, Department of Removable Prosthodontics, Faculty of Dentistry, Sinai University

• **Corresponding author:** elesawy1991.me@gmail.com

divided into: physiological and subjective methods that include physiological rest position, swallowing, phonetics, and esthetics, otherwise, mechanical and objective methods that include assessments of facial measurements, cephalometric, pre-extraction records and electromyograms⁽³⁻⁵⁾.

Various techniques of establishing vertical maxillary-mandibular jaw relations in completely edentulous patients have been spotted and evaluated, some of them are pre-extraction records, physiological rest position, measurement of closing biting forces, tactile sense, facial dimensions, post-extraction phonetics, deglutition, aesthetic and post-extraction cephalometric⁽⁶⁾. When selecting the best method to use, accuracy and reliability of measurement, adaptability of technique, type and complexity of the equipment needed, cost and length of time required to make measurement criteria should be considered. Various techniques have been advocated in determining vertical maxillary-mandibular jaw relations in completely edentulous patients⁽⁷⁾.

A recent method has been studied, by determining the physiological rest position of the mandible using the contact position of the lip when the mouth is closed and compared with others which was obtained by using conventional techniques of positioning the mandible in the physiological rest position⁽⁸⁾. The so-called "neuromuscular dentistry" concept to establish, OVD, by utilizing jaw tracking and electrical muscle stimulation, has been advocated scientifically to be inferior the traditional techniques⁽⁹⁾.

The swallowing method has been studied by using cephalometric radiographs to establish the vertical maxillary-mandibular jaw relation before extraction of teeth and after construction and delivery of dentures⁽¹⁰⁾. another method of assessing OVD is the interpupillary distance (IPD) method. However, there is no absolute method to determine an acceptable OVD. Each studied method has its limitation⁽¹¹⁾.

Physiological rest position has been used for recording OVD, although several studies, found physiological rest position is a static position and recommended this position for using to establish the OVD, many other studies, found it's a dynamic position and concluded against relying solely on physiological rest position to determine the maxillary-mandibular jaw relation⁽¹²⁾.

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 S sound places the incisal edge of the lower incisors about 1-2 mm inferior and lingual to incisal edge of the upper incisors⁽¹³⁾. The closest speaking space should not be confused with the free-way space of the physiological rest position. The free-way space establishes the vertical dimension when the muscles involved are at complete rest, closest speaking space determines the vertical jaw relation when the mandible and muscles involved are in the active full function of speech⁽⁶⁾. The selection of a technique for establishing vertical jaw relation for completely edentulous patients is still a controversial issue, so more studies are mandatory to compare the different methods⁽¹⁴⁾.

SUBJECTS AND METHODS

This study was carried out on a total number of fifteen patients from the out-patient clinic of Removable Prosthodontics Department, Faculty of Dental Medicine (Cairo-Boys), Al-Azhar University. According to previous study⁽¹⁵⁾, a total sample size of fifteen patients was sufficient to detect an effect size of 2.4 at a power (1- β error) of 0.8 and using a two-sided hypothesis test and a significance level α error) 0.05 for data.

Inclusion criteria: A completely edentulous male and female patient of 40-60 years with an average age of 54.40 years and patients with Angle's class I maxillomandibular relation.

Exclusion criteria: Patients with debilitating uncontrolled systemic disease, neuromuscular and psychological disorders preventing the neuromuscular control, patients with old dentures, uncooperative patients and presence of abused soft tissue.

Ethical Considerations: this study was approved by the ethical committee, Faculty of Dental Medicine, Al-Azhar University, ethical code number 165/100. The objectives of the study were discussed with the patients and informed consent form and a copy of the instructions for the patients were signed before treatment.

Intervention:

An accurate primary impression was made, to get the primary cast for custom made tray construction. Then, final impression was made with proper border tracing and pouring it to get the master cast and record blocks were constructed to record the vertical maxillary-mandibular jaw relation by three different methods; the phonetic method (group I), the physiological rest position method (control group, group II) and the height of the mandibular occlusal rim method (group III).

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

Vertical dimension of occlusion was established by using the phonetic method by asking the patient to say "yes" and continues the s sound like yesssss, while the patient is pronouncing the s sound, for confirming, the patient will be asked to count from 60 to 66. The wax rims were not allowed to touch

each other during pronunciation and 1-2 mm of clearance (closest speaking position) should be observed between the upper and lower wax rims, if occlusal rims contacted early when the patient said those S sounds, then more wax removed until clearance obtained. Otherwise, adding wax until reaching proper height when there is too much clearance. The upper incisal edge should come right back to the closest speaking position with the pronunciation of the sibilant s sound. Then the vertical jaw relation will be closed 1-2 mm from the closest speaking position.

Physiological rest position was used to record OVD by subtracting 3 mm from RVD, which was recorded as follow, two small adhesive tapes were attached one on the tip of the nose and the other on the point of the chin. By asking the patient to relax his whole body with his lip slightly closed, then the distance between the apices of the tapes was recorded with a digital caliper. Repeating the measurements several times until at least three constant readings were obtained, which is considered as the vertical dimension of rest.

The height of mandibular occlusal rim method was done as follow: the height of the anterior portion of the occlusion block was adjusted to be at the level of the corner of the mouth, the posterior portion height of the occlusion block was adjusted to be at the level of the anterior two-thirds of the retromolar pad by marking it on the cast.

Recording centric relation (for each of the vertical jaw relation techniques) by using zinc oxide and eugenol as inter-occlusal registration material and both wax rims were sealed together and mounted on the semi-adjustable articulator.

The inter-arch distance (IAD) of the mentioned methods were recorded on the articulator. Three reference points were marked on the upper and lower casts by using an indelible marker, Figure 1. The mean inter-arch distance was calculated according to this equation:

$$IAD = (AA' + BB' + CC') / 3.$$

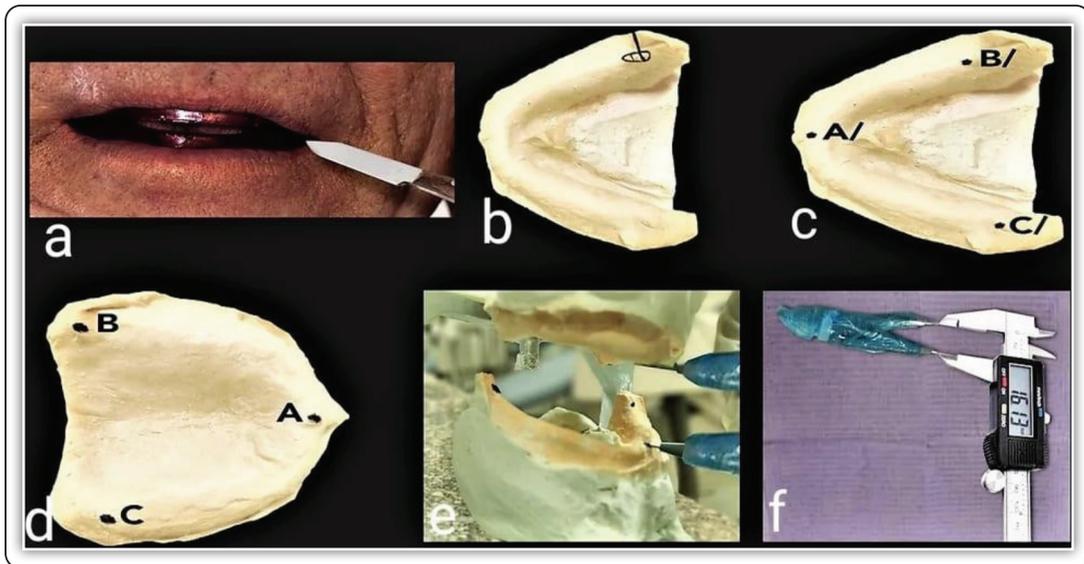


FIG (1) a) the determination of anterior wax rim height, b) determination of posterior wax rim height, c) mandibular reference points, d) maxillary reference points, e) using divider to measure the inter-arch distance f) using digital calipers to determine the inter-arch distance.

The mean inter-arch distances of each method were recorded and the result was tabulated and statistically analyzed.

Statistical analysis of the data was done by using IBM SPSS software package version 20.0, data were fed to the computer and analyzed. (Armonk, NY: IBM Corp) Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum), mean, standard deviation and median. The significance of the recorded results was judged at the 5% level. The used tests were: ANOVA with repeated measures for normally distributed quantitative variables, to compare between more than two periods or stages, and Post Hoc test (Bonferroni adjusted) for pairwise comparisons. Pearson coefficient to correlate between two normally distributed quantitative variables.

RESULTS

The informative statistical analysis which

shows mean values and standard deviation (SD) of the mean inter-arch distance (IAD) for all tested methods is summarized in table (1).

The statistical analysis of IAD for all tested methods showed that statistically no significant difference between the three groups, as indicated by one-way ANOVA test ($F=2.875$, $P=0.073$). Where; the highest (mean \pm SD) of inter-arch distance was recorded for the height of the occlusal rim (18.64 ± 1.01), followed by phonetic method (18.38 ± 1.23). The lowest (mean \pm SD) of inter-arch distance was recorded with physiological rest position (18.04 ± 1.14).

Table (2) summarizes the correlation between different methods. Inter-arch distance (IAD) of Phonetics was showed a significantly positive correlation with Physiologic rest position and Height of occlusal rim as well as Physiologic rest position showed a significantly positive correlation with Height of occlusal rim.

TABLE (1): Comparison between the three studied methods according to Inter-arch distance (IAD) (n = 15)

	Phonetics	Physiologic rest position	Height of occlusal rim	F-value	P-value
Inter-arch distance (IAD) (mm)					
Mean ± SD.	18.38 ± 1.23	18.04 ± 1.14	18.64 ± 1.01	2.875	0.073
Diff. with phonetics		↓ 0.34	↑ 0.26		
Diff. with physiologic			↑ 0.60		

F: F test (ANOVA) with repeated measures

p: p value for comparing between the studied methods

TABLE (2): Correlation between different methods

		Phonetics	Physiologic rest position	Height of occlusal rim
	r	1.000	0.550	0.833
Phonetics	p		0.034*	<0.001*
	r		1.000	0.521
Physiologic rest position	p			0.047*
	r			1.000
Height of occlusal rim	p			

r: Pearson coefficient

**: Statistically significant at p ≤ 0.05*

DISCUSSION

In the present study, healthy patients with no debilitating diseases were selected with normal jaw relationships and normal temporomandibular joints to avoid muscle atrophy which may influence the readings of vertical dimension⁽¹⁶⁾. Patients with abused soft tissue were excluded as it could affect

the stability and retention of the bite blocks during establishing proper vertical dimension. Patients with old dentures also were excluded to avoid any detrimental habits that might affect the jaw relation record⁽¹⁷⁾. All selected patients were Angle’s class I maxillomandibular relation for proper placement and centralization of the biting load on the record bases as instability of record bases with prognathic and retrognathic patients was reported⁽¹⁸⁾.

Available inter- arch space was also selected because excessive restoration of decreased vertical dimension will lead to destruction of supporting structure. In addition, this patient needs to increase the interocclusal distance up to 5-10 mm due to the physiologic changes in the facial musculature, alveolar bone, skin and sensory perception⁽¹⁹⁾. The time lapsed from the last extraction was approximately one year to obtain a firm ridge foundation. Hence it was stated that after two months following tooth extraction the fundic part of the bony socket is filled with connective tissue which is replaced by coarse fibrillar bone, then replaced by organized lamellar bone resembling the alveolar bone⁽²⁰⁾.

In the current study, the same maxillary and mandibular record bases were used for the tested

techniques to eliminate any other variables that would affect the jaw relation record. Wax rim was the only variable which is adjusted according to the used technique ⁽²¹⁾.

Zinc oxide and eugenol (ZnOE) material was attributed to be the interocclusal centric relation registration material, as it's an accurate material with high dimensionally stable proprieties and a high degree of flow⁽²²⁾.

Three reference points were marked on the upper and lower casts for measuring the inter-arch distance, one anteriorly and two bilateral posteriorly to obtain three- dimensional IAD which may compensate any errors during mounting⁽¹⁵⁾.

In this study, the phonetic method was evaluated and compared with the physiological rest position method as the two methods are physiologic subjective methods.

The results of the present study revealed statistically no significant differences of mean inter-arch distance (IAD) between phonetics method, physiological rest position and height of the occlusal rim method ($p=0.073$). The phonetic method produced a higher IAD 18.38 mm compared to that obtained by the physiological rest position method 18.04mm and lower IAD attributed to the height of occlusal rim 18.64mm.

The height of the occlusal rim method produced a higher OVD compared with that produced by the two other methods, this might be due to early posterior touch of the wax rim of the height of occlusal rim method which was observed in five patients. This early touch attributed to some difficulty to outline the position of the retro-molar bad. Another indirect cause of a higher value of height of occlusal rim method is the lower value of the physiological rest position method which result from subtraction of 3 mm of the rest vertical dimension RVD other than 2 mm to get the vertical dimension of occlusion, which give us a shorter mean inter-arch distance recorded by the divider.

CONCLUSION

Within the limitation of this investigation, the results revealed that: phonetic method was a reliable, repeatable and consistent method but combination of more than method to establish the OVD was highly recommended. The height of the occlusal rim method is considered an encouraging method but must be confirmed by further investigations on a larger number of patients.

REFERENCES

1. Abduo J, Lyons KJAdj. Clinical considerations for increasing occlusal vertical dimension: a review. Australian dental journal, 2012;57(1):2-10.
2. Mouhibi A, Chafii A, Andoh A. The means of determining the Vertical Occlusion Dimention. Journal of Oral and Dental Health Research, 2020;2(3).
3. Bajunaid SO, Baras B, Alhathlol N, Ghamdi A. Evaluating the reliability of facial and hand measurements in determining the vertical dimension of occlusion. International Journal of Medicine and Pharmacy, 2017;5(1):1-11.
4. Ahmed M, Helal M. Evaluation of lower facial heights as related to different anthropometric measurements in dentate and completely edentulous subjects. Quintessence international, 2016;47(1).
5. Harby, N. Relationship of Facial Measurement for Determining the Vertical Dimension in Young Adult Saudi Students. Al-Azhar Dental Journal for Girls, 2017;4(2), 157-160.
6. Sun J, Lin Y-C, Lee JD, Lee SJ. Effect of increasing occlusal vertical dimension on lower facial form and perceived facial esthetics: A digital evaluation. The Journal of Prosthetic Dentistry, 2020.
7. Khajuria R, Sudan S, Sudan T, Choudhary P, Sodhi G. Research DS. Evaluation of effect of complete dentures on respiratory performance: A clinical study. Journal of Advanced Medical and Dental Sciences Research, 2017;5(12):119-21.
8. Watarai Y, Mizuhashi F, Sato T, Koide K. Highly producible method for determination of occlusal vertical dimension: relationship between measurement of lip contact position with the closed mouth and area of upper prolabium. Journal of prosthodontic research. Journal of prosthodontic research, 2018;62(4):485-9.

9. Jariyavithayakul P, Charoemratrote C. Relationship between dentofacial morphology and mandibular movement from rest position to maximum intercuspation in Class II division 1 malocclusion patients. *International Journal of Health & Allied Sciences*, 2019;8(4):255 .
10. Shen Y-F, Wei M-C, Li H-P, Pan Y-H, Hong H-H, Chen C-C, et al. Vertical dimension of occlusion related to mandibular movement during swallowing. *biomedical journal*, 2021;44(2):217-22.
11. Ladda R, Kasat VO, Bhandari A. A new technique to determine vertical dimension of occlusion from anthropometric measurement of interpupillary distance. *Journal of clinical and experimental dentistry*, 2014;6(4):e395.
12. Alhaji MN, Khalifa N, Abduo J, Amran AG, Ismail IA. Determination of occlusal vertical dimension for complete dentures patients: an updated review. *Journal of oral rehabilitation*. 2017;44(11):896-907.
13. Silverman MM. The speaking method in measuring vertical dimension. *Journal of Prosthetic Dentistry*, 2001;85(5):427-31.
14. Pattanaik SB, Bhule SR, Gill AK, Jaybhay. Prosthetic planes of interest for establishing the occlusal plane-a review. *Indian Journal of Comprehensive Dental Care*, 2015;5(2).
15. Fouad M. New Method Determining the Vertical Dimension of Rest for Completely Edentulous Patient -Using the letter. *Egyptian dental journal*, 2007.
16. Marangoni AF, de Godoy CHL, Biasotto-Gonzalez DA, Alfaya TA, Fernandes KPS, Mesquita-Ferrari RA, et al. Assessment of type of bite and vertical dimension of occlusion in children and adolescents with temporomandibular disorder. *Journal of bodywork and movement therapies*, 2014;18(3):435-40.
17. Mattoo KA, Kumar L, Rehman, research c. Flabby ridge management using paint on technique—meticulous review. *Journal of medical sciences and clinical research*, 2019;7(10):518-21.
18. El Aouame A, Daoui A, El Quars. Nasal breathing and the vertical dimension: A cephalometric study. *International orthodontics*, 2016;14(4):491-502
19. Jain AR, Nallaswamy D, Ariga P, Philip. Full mouth rehabilitation of a patient with reduced vertical dimension using multiple metal ceramic restorations. *Contemporary clinical dentistry*, 2013;4(4):531.
20. Hassumi JS, Mulinari-Santos G, FABRIS ALdS, Jacob RGM, Goncalves A, Rossi AC, et al. Alveolar bone healing in rats: micro-CT, immunohistochemical and molecular analysis. *Journal of Applied Oral Science*, 2018;26.
21. Batra R, Kalra S, Bansal A, Nerula S, Dang R. Estimation of Vertical Dimension of Occlusion in Edentulous Patients Using Cephalometric Analysis. *Dental Journal of Advance Studies*. *Dental Journal of Advance Studies*, 2017;5(01):030-8
22. Tejo SK, Kumar AG, Kattimani VS, Desai PD, Nalla SJH. A comparative evaluation of dimensional stability of three types of interocclusal recording materials-an in-vitro multi-centre study. *Head & face medicine*, 2012;8(1):1-9.