

Vertical Dimension of Occlusion and its Correlation with the Length of Thumb and Craniofacial Measurements: A Clinical Study

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ABSTRACT

Aim: The objective of the study was to determine the correlation between Vertical Dimension of Occlusion (VDO) with the length of thumb and craniofacial measurements to simplify and facilitate the prediction of reestablishment of the VDO in the fabrication of complete dentures.

Materials & Method: Sample size of 200 adults was taken in this study. Measurements were taken from various anthropometry parameters and subsequently correlated with VDO.

Results: The data so obtained was statistically analyzed using Pearson Correlation coefficient. A strong correlation was established between VDO and length of nose in females and between VDO and length of ear and thumb in males.

Conclusion: Vertical Dimension can be reliably correlated with the length of Nose in Females and in case of Males, the length of Ear & Thumb can be taken as guides for establishing the Vertical Dimension of Occlusion.

Keywords: Vertical Dimension, Anthropometric measurements, Occlusion.

INTRODUCTION

The Esthetics and functional capabilities of a complete denture depends upon specific vertical and horizontal relations of the mandible and maxilla. Vertical dimension can be defined as distance between the two selected anatomic points, one on a fixed point on the maxilla and another on the chin.¹ Various researchers have developed different methods to determine Vertical dimension. These can be broadly divided into physiological and mechanical methods that include the swallowing, phonetics, tactile sensations, aesthetic, facial measurements, pre-extraction records,

cephalometry, anthropometric etc.^{2,3} The accurate determination of the vertical jaw relation is very important in achieving successful prosthodontic rehabilitation for function, esthetics, and comfort to the edentulous patients. However there is no particular universally accepted method for determining vertical relation especially when no pre-extraction records exist. There seems to be no edge of one technique over the other, but factors like cost, time and armamentarium may be the determining factors.⁴ If the dentures are fabricated at increased occlusal vertical height, premature tooth contacts may result in trauma to the underlying tissues, muscle fatigue and fullness of

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the mouth. Decreased occlusal vertical dimension leads to reduce biting force, temporomandibular joint disorders.



Fig 1: Digital Vernier Caliper.

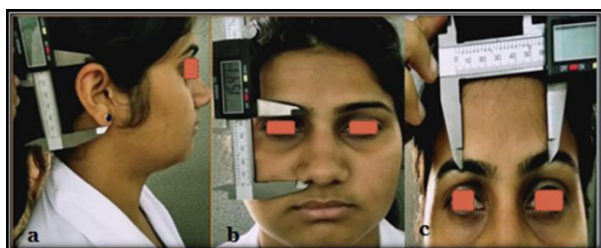


Fig 2: a) Superior to Inferior surface of Ear; b) Bridge of the Nose to the base of Ala of Nose; c) Inter-Pupillary Dimension.

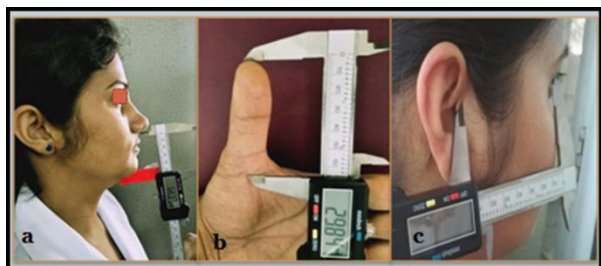


Fig 3: a) Lower border of the septum of the nose to under surface of the mandible ;b) Length of the right thumb; c) From external auditory meatus to outer canthus of eye.

Leonardo da Vinci demonstrated many observations and drawings on facial and other body proportions in relation to lower one- third of the face. He proposed that the chin-nose distance is equal to one third of the face, the height of the hand is almost equal to facial height and the length of thumb is similar to length of nose.⁵ Other researchers found that the upper facial height from the pupil of the eye to the rima oris and the lower facial height from the base of the nose to the lower border of the chin when teeth are in occlusion are equal measurements.⁶

If the anthropometric correlation is found between the VDO and certain parameters which are easily accessible to the clinician and are static, the time taken for accurate measurement of VDO could be significantly reduced. Also, the results would be objective for every practitioner. Since the readings are specific for the particular individual, it can be easily reproducible from time to time.

Accuracy and repeatability of the measurement are considered as ideal criteria in selecting the best method to use. The ease of making measurements, simplicity of the equipment needed and the time taken to document the measurement also should be considered. Hence, this clinical study was undertaken to ascertain a correlation between VDO and length of the thumb and other craniofacial measurements.

MATERIALS AND METHODS

The study was conducted among 200 adult volunteers (100 males and 100 females) in the age group of 18-25 years that include students of this institute after obtaining written consent from them. The approval from Institutional Ethical Committee was obtained to conduct the study. The inclusion and exclusion criteria are as following:

INCLUSION CRITERIA

1. Subjects with complete natural dentition(3rd molar not in consideration)
2. Intact upper and lower teeth without any artificial crowns
3. Straight profile on visual examination
4. Angle's class I maxillomandibular relationship.

EXCLUSION CRITERIA

1. Posterior bite collapse as a result of loss of teeth
2. History of prosthodontic/orthodontic/surgical treatment
3. Large carious lesions
4. Deformity or absence of thumb or any hormonal abnormality (gigantism, acromegaly)
5. Open bite or deep bite cases
6. Generalized attrition
7. Temporomandibular joint disorders

A digital Vernier caliper with an accuracy of 0.01 mm was used to determine the craniofacial

measurements and length of thumb and there correlation with the VDO.

The subject was made to sit comfortably , head unsupported in an upright position in a dental chair .The occlusal plane was ensured to be parallel to the floor. The instructions were given to close the back teeth lightly in centric occlusion. A modified digital Vernier caliper was used for measuring distance between various /craniofacial landmarks. The parameters used to record the required measurements are as follows:

- Right ear- superior surface to inferior surface (Fig : 2)
- Bridge of the nose to base of the right ala of the nose(Fig :3)
- Center of pupil of right eye to center of pupil of left eye. (Fig :4)
- Lower border of the septum of the nose to under surface of the mandible(Fig :5)
- Length of the right thumb. (Fig :6)
- From external auditory meatus to outer canthus of eye (right side) (Fig:7)

All the measurements in each parameter were taken three times by single operator (to rule out bias and error) and a mean of that was taken for consideration. These measurements were then compared and evaluated for their correlation with vertical dimension. The mean and standard deviations were determined for a descriptive analysis. The data so obtained was statistically analyzed using Pearson Correlation coefficient. The database of all the study sample was analysed using the Statistical Package for Social Science Software (SPSS V 20, IBM, Chicago, USA). A probability (p) value for each parameter was calculated and <0.05 value was considered significant.

RESULTS

The mean VDO in males was 73.800mm with the range varying from 66mm to 81mm and standard deviation of 4.310. The mean value of ear (males) was 71.583mm with a range varying from 65mm to 76mm and standard deviation of 2.871. The mean value of thumb (males) was 71.700 mm with a range varying from 67mm to 77mm and standard deviation of 4.403. In females, the mean value of VDO was 66.700mm with a range from 58mm to 77mm with the standard deviation of 4.413. The

Table 1: Gender specific co-relation between VDO and various parameters.

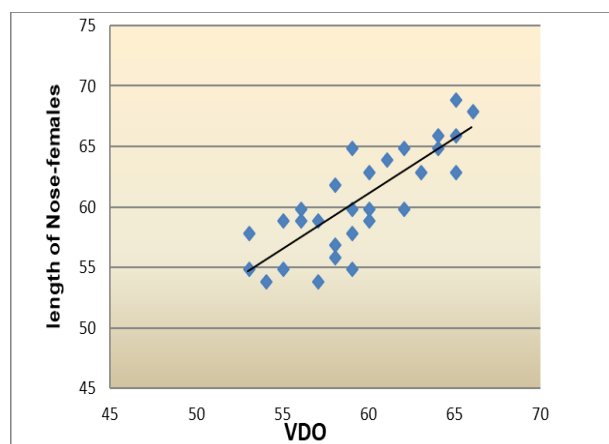
PARAMETERS		VDO	
		MALES	FEMALES
EAR	r-value	0.804	0.073
	p-value	0.010	0.702
IPD	r-value	0.363	0.155
	p-value	0.148	0.412
EYE-EAR	r-value	0.319	0.030
	p-value	0.086	0.876
NOSE	r-value	0.469	0.895
	p-value	0.061	0.018
THUMB	r-value	0.636	0.126
	p-value	0.020	0.509

r value- Pearson Correlation coefficient

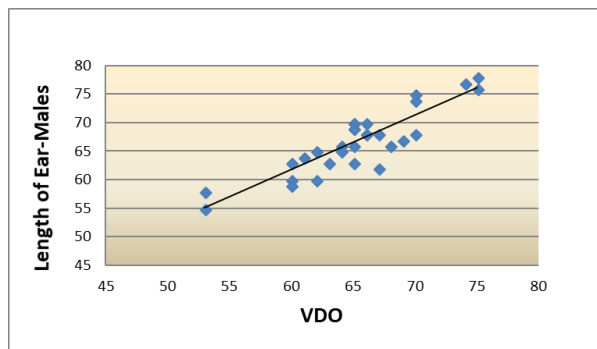
P value- ≤0.05 is considered to be significant correlation

Table 2: Descriptive statistics of VDO, Ear, Thumb and Nose.

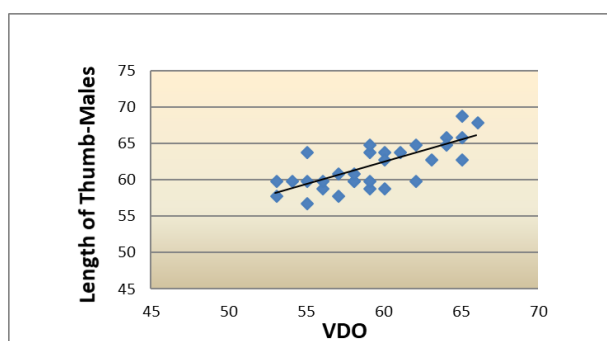
	Number	Measurement	Min (Mm)	Max (Mm)	Mean	Standard Deviation
MALES	100	VDO	66	81	73.800	4.310
		EAR	65	76	71.583	2.871
		THUMB	67	77	71.700	4.403
FEMALES	100	VDO	58	77	66.700	4.413
		NOSE	59	71	65.267	3.667



Graph 1: Graph showing relationship between Vertical Dimension of Occlusion and Length of Nose (Females).



Graph 2: Graph showing relationship between Vertical Dimension of Occlusion and Length of Ear (Males).



Graph 3: Graph showing relationship between Vertical Dimension of Occlusion and Length of Thumb (Males).

mean value of nose (females) was 65.267 with a range varying from 59mm to 71mm and standard deviation of 3.667. (Table 2) Table no. 1 indicates that in males, a significant p value exist between VDO and ear($p=0.010$) and between VDO and thumb($p=0.020$). Similarly in females, a significant p value exist between VDO and nose ($p=0.018$). However the results did not show any significant correlation between VDO and IPD / Eye -Ear distance.(p-value non significant in both groups) .

The statistical analysis concluded that there is strong correlation between VDO and length of nose in females (Graph 1) whereas in males, strong correlation exists between the VDO and length of ear and thumb.(Graph 2)

DISCUSSION

Vertical Dimension of Occlusion or VDO, also known as Occlusal Vertical Dimension (OVD) is a term used in dentistry to determine the superior - Inferior relationship of the maxilla to the mandible when the

teeth are made to occlude in maximum intercuspation. Vertical Dimension of Occlusion can be easily assessed in dentulous patients by asking the patient to close on the back teeth lightly. However, for completely edentulous patients, who must wear a denture prosthesis, the VDO is established by the vertical height of the two dentures when the artificial teeth are in contact. Thus the VDO must be established for edentulous [patients so that their denture teeth will come into contact at appropriate height. Determination of correct Vertical Dimension in edentulous patients has always been a major challenge to a dentist as it is one of the most crucial steps in the fabrication of complete denture. An excessively reduced Vertical dimension is likely to lead to post- insertion complaints like poor esthetics, cheek biting, drooling saliva at the corners of the mouth, reduced chewing efficiency etc. Similarly an increased Vertical Dimension can invite post operative complaints like soreness of the upper and lower ridges, ulcerations , fatigued jaw muscles, discomfort and pain in the temporomandibular joint, clicking of the teeth etc.

Many objective and subjective methods have been advocated for the establishment of VDO in the literature but none of them are universally accepted.⁷ Subjective methods such as phonetics, swallowing, esthetics, tactile sensation, patient comfort are non specific and non scientific, and hence are subject to operator bias. The objective methods such as electromyography, biting force are not practical as they require elaborate and specific devices which are not routinely used and kept in a dental operatory.^{8,9,10} The most reliable of all these methods are Pre-extraction records, which the patient may or may not present to the clinician and hence the advantages of these are limited to a select few patients only.¹¹ Considering the disadvantages of various techniques, it was decided to study the relationship between VDO and thumb and various other craniofacial measurements. Bowman and Chick advocated the use of Facial measurements to determine the Vertical Dimension in edentulous patients.¹² Ivy, Chou, Wright ,Goodfriend , Willis, also suggested the use of facial measurements to determine OVD.^{13,14,15} Though the literature mentions about using anthropometric techniques but there lack a clear consensus among them. In this study, only right side measurements were taken in

order to standardize the results as it is a proven fact that the human body growth occurs uniformly and maintains symmetry.¹⁶ In this study, the mean of OVD in males was found to be 73.800mm and in females 66.700mm. The mean OVD in males is found to be more in males than females. This gender difference in VDO can be attributed to growth pattern difference. Strong correlation was found between VDO and the length of nose in female. In agreement with the present study, Rege et al also demonstrated a strong correlation between the length of nose and the vertical dimension in females.¹⁷ In males strong correlation exists between VDO and the length of ear as well with length of thumb. Our study substantiated the similar results shown by Muhammad Irfan Majeed.¹⁸ Prajapati P also in his study stated that linear vertical length of ear is positively correlated to the vertical dimension of occlusion.¹⁹ Basnet et al also stated that the length of thumb can be used as a guide to assess VDO.²⁰ Our study reported a non-significant relation between VDO and Interpupillary distance in both males and female group (p-value 0.148 and 0.412). In contrast, studies done by Ruchi et al and Muhammad Irfan Majeed found a positive correlation between the two.²¹ Also, our study could not validate the relationship between VDO and Eye-Ear distance. Muhammad Irfan Majeed also shared the same results that were seen in our study. However, the studies done by Knebleman, Chawla found favourable relationship between VDO and Eye-Ear.^{22,23} One possible explanation for the different results that are seen can be attributed to the fact that Chawla et al did his study on edentulous subjects. Also the age group that was taken in his research was 40-60 years in contrast to our study which was conducted on dentulous subjects in the age group 18-25 years. The young age group was purposefully taken in our study as the chance of attrition of teeth is negligible.

The method used in this study is practical, simple, economic, non invasive, reliable and provide reproducible values for future reference. To some extent, small variations in all the measurements found in our study can be due to the difference in measuring techniques, age group, different ethnic group of the population and the sample size studied. The limitation of this study was that only subjects with class-1 occlusal relationship was studied.

Other skeletal and dental malocclusions were not considered. This study facilitated the determination of lower facial height by assessing correct Vertical Dimension for the aid of fabricating a successful prosthodontics rehabilitation.

CONCLUSION

We can conclude from this study that anthropometric measurement method can be successfully used to determine Vertical Dimension of Occlusion. The best method to predict the VDO in case of males was length of ear and thumb while in case of females it was length of nose. VDO prediction through this method is reproducible and reliable. Also, the method is simple, economic, and non invasive. Hence, it could be recommended for everyday practice. However, a further study can be done by taking a much larger sample size, different group of population and different age groups.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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