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Correlation Between Length of Digitus Minimus, Thumb, Length of Ear, Eye, and The Vertical Dimension of Occlusion

Research Article

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Abstract

Introduction: The vertical dimension of occlusion plays a very important role in the fabrication of complete dentures. Turrell has suggested various methods of determining and measuring the vertical dimension of occlusion. It is suggested by many authors that the determination of the vertical dimension of occlusion is unreliable, while others suggest that it must be determined with the use if clinical judgment. Currently, there may be ways to determine the VDO using various radiographic methods like lateral cephalograms or electromyographs. But it is not feasible for various dental facilities to be equipped with such machines. This study aims to determine the vertical dimension of occlusion using non-invasive and anthropological methods.
Aim: To find the correlation between the length of the little finger, thumb, ear, and eye with the vertical dimension of occlusion.
Materials and Methods: 110 dental subjects were chosen from Saveetha Dental College. Inclusion criteria include subjects ranging from 18 to 25 years. The exclusion criteria for the study was anyone with any pathology in their fingers and face. Digital Vernier calipers were used to measure the length of the little finger, thumb, the length of the ear, the length of the eye from the inner to the outer canthus. The results were tabulated and interpreted.
Results: The results suggest that there is a stronger correlation among the VDO with the ear, eye, thumb, and little finger for females as compared to males. the results obtained in this study indicate that the most reliable measurement we can depend on for the estimation of the vertical dimension of occlusion for both male and female subjects is the length of the ear.
Conclusion: This is a strong correlation with all the measurements to the vertical dimension of occlusion. This means that we can predict the vertical dimension of occlusion of an edentulous patient using either of the above measurements. This can greatly improve the success of complete denture prosthesis.
Clinical Significance: The use of anthropometric measurements such as the length of the ear, eye, thumb or little finger can be used for determining the vertical dimension of occlusion in clinical settings.

Keywords: Vertical Dimension of Occlusion; Digital Minimus; Anthropology.

Introduction

The vertical jaw relation plays the most important role in determining the success of a complete denture prosthesis. It can be defined as "The length of the face as determined by the amount of separation of the jaws."- GPT.The vertical jaw relation includes the vertical dimension at rest and the vertical dimension at occlusion. The vertical dimension at rest can be defined as "The length of the face when the mandible is in the rest position." The vertical dimension at occlusion can be defined as "the distance between two selected anatomic or marked points (usually one on the tip of the nose and the other on the chin) when in the maximal intercuspal position."- GPT [1].

There are numerous - up to 29 such ways of obtaining the verti-

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cal dimension measurements as suggested by Turrell [2]. It has been established that there is obvious and seizable importance of vertical dimension of occlusion in the success of a complete denture [3, 4]. Till the current day, there are no specific methods to obtain the vertical dimension of occlusion and the methods vary among different professionals, although some of the methods are considered undependable by some investigators. The current problem is the availability and employment of so many methods to determine the vertical dimension of occlusion. It has been advocated that the various factors are accountable for the vagueness of these measurements and calculations; some of them being the rage of differences observed in the physiologic and pathologic conditions of the patient and estimating the distance based on the thickness of skin present [5]. It has been established in the book Grey's Anatomy that the interlocking of the teeth during occlusion determines the relationship between the maxilla and mandible. It is also suggested that there is a reduction in the vertical dimension of occlusion due to severe abrasion or loss of the tooth or teeth [6, 7].

As established previously, one of the most important factors that play a role in the success of a complete denture is measuring the correct vertical dimension of occlusion. According to Naveen Raj et al, the clinical judgment by the dentist will play a major role in measuring the vertical dimension of occlusion. Based on the separation between the maxilla and mandible under specific conditions, the vertical dimension is classified into the vertical dimension of rest and vertical dimension of occlusion. The vertical dimension of occlusion will depend on the vertical height of the pair of dentures when the teeth are contacting and at occlusion [8]. Another study conducted by a group of prosthodontists from India tried to find a relation of the vertical dimension of occlusion with the cephalometric landmarks and its link with such traits obtained through heredity. They found that there is a significant trait of inheritance of traits from the father to the daughter and from mother to daughter [9].

The main goal of providing a complete denture is to restore the superlative and comfortable function and help in the habituation of the dentures to the masticatory system. To satisfy the goal, accurate vertical dimension measurements have to be made. The final facial aesthetic and stomatognathic function of the complete dentures will depend on the evaluation of the vertical dimension [10, 11].

The current literature available to us on the various methods to determine the vertical dimension of occlusion is boundless. Despite the lack of so many options available, the most commonly used methods by the clinical practitioners are the physiologic method, aesthetic method, and phonetics methods [12].

More than seven decades ago anthropometry was the only technique available for quantifying body size and proportions as early as 1921, equations for predicting body fat were developed from measurements of body length, width, circumference, and skinfold thickness. The distinct advantages of this technique are that it is portable, non-invasive, inexpensive, and useful in field studies and there is substantial literature available [13].

Materials and Methods

111 subjects from the OP department of Saveetha Dental College. The subjects are of two groups- 55 females and 56 males. The main inclusion criteria for this study are the subjects of the age 18-25 years and without any skeletal or any facial pathology. The exclusion criteria include anyone above 30 years and those with some pathology in the head and neck region and in the fingers. The digital Verniercaliper was used to measure the length of the little finger, thumb, the length of the ear, the length of the eye from the inner to the outer canthus. The results were tabulated and interpreted. IBM SPSS Statistics 23 was used for the descriptive statistics which includes the Pearson correlation coefficient, p values, and the scatterplots.

Results

The results in Table 1 show the mean and standard deviation of the VDO, length of the thumb, ear, eye, and little finger of the male and female subjects. the results suggest that the average values of all 5 categories were higher among males relative to the female subjects. Table 2 represents the Pearson's correlation coefficients and the p-value for the male and female subjects comparing the VDO with the thumb, eye, ear, and little finger individually. from the table, it is understood that the correlation coefficients

Figure 1. Depicting the measurements made on the subject using Vernier calipers, a. measurement of Vertical Dimension of Occlusion, b. measurement of the length of the eye, c. measurement of length of the ear, d. measurement of the length of the thumb, e. measurement of the length of the little finger.

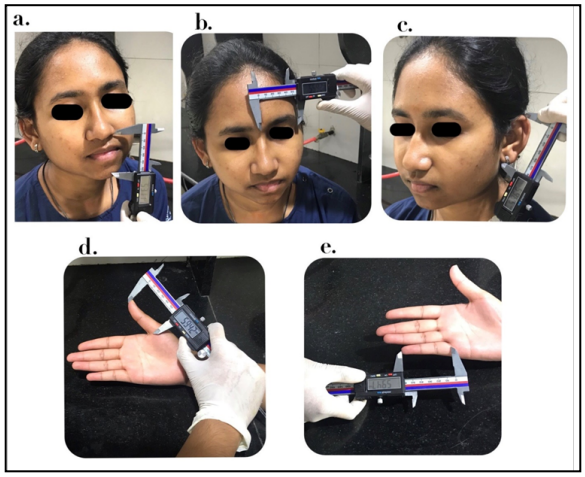


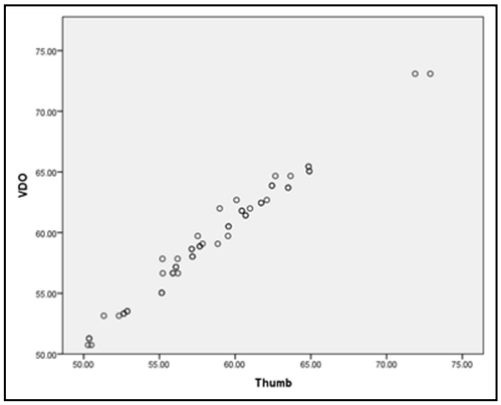
Table 1. Table representing the Mean and Standard Deviation of the VDO, length of the little finger, thumb, ear, and eye (in mm) for male and female subjects.

	FEMALE					MALE				
	VDO	Little finger	Thumb	Ear	Eye	VDO	Little finger	Thumb	Ear	Eye
MEAN	59.49	56.6	58.52	58.64	41.23	67.63	64.54	77.93	62.37	42.02
SD	4.97	5.27	4.97	4.84	4.2	4.02	3.37	3.34	2.04	1.78

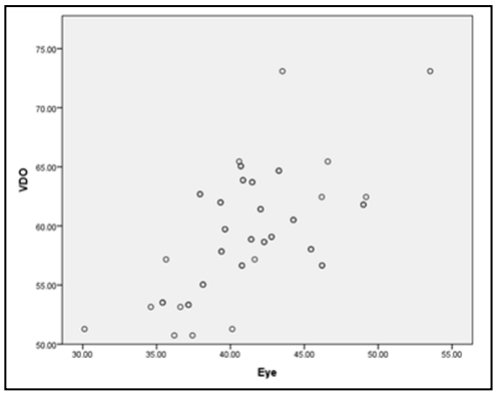
Table 2. Table representing the Pearson correlation coefficient and p-values for the correlation between the VDO and thumb, VDO and Eye, VDO and Ear, VDO, and little finger for the male and female subjects. The data is found to be significant when the p-value is <0.05. The correlation is positive when the coefficient is greater than 0 and negative when the coefficient is lesser than 0.
(*denotes significant results)

Correlation	FEMALE		MALE	
	Pearson's coefficient	p-value	Pearson's coefficient	p-value
VDO / Thumb	0.991	0.001*	-0.084	0.536
VDO / Eye	0.6	0.001*	0.286	0.032*
VDO / Ear	0.991	0.001*	0.704	0.001*
VDO / Little finger	0.969	0.001*	0.083	0.545

Graph 1. Scatter plot representing the correlation between VDO and thumb measurements for female subjects.

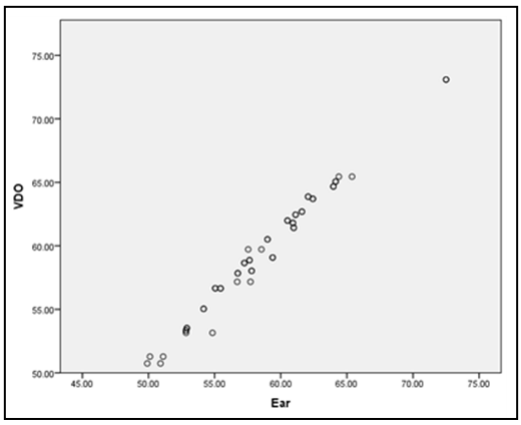


Graph 2. Scatter plot representing the correlation between VDO and eye measurements for female subjects.

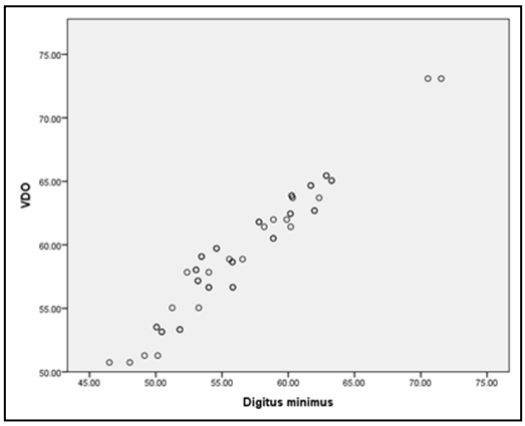


obtained for the female subjects are all statistically significant. the values of the correlation coefficient also signify a strong positive correlation. whereas, for the male subjects, the correlation between VDO and thumb; and VDO and little finger is not statistically significant. the correlation between the VDO and eye and VDO and ear is statistically significant. the Pearson correlation coefficient for the results obtained for males is relatively weak compared to that among female subjects. the correlation for the VDO with the thumb is negative for males. The strongest positive correlation among the male subjects is the VDO and the length of the ear. Graph 1 represents the scatter plot showing a strong positive, linear association between the VDO and the length of the thumb among the female subjects. There doesn't seem to be any outliners in data. Graph 2 represents the scatter plot showing a strong positive, linear association between the VDO and the length of the eye among the female subjects. There seem to be any outliners in data. Graph 3 represents the scatter plot showing a moderate positive, linear association between the VDO and the length of the ear among the female subjects. There doesn't seem to be any outliners in data. Graph 4 repre-

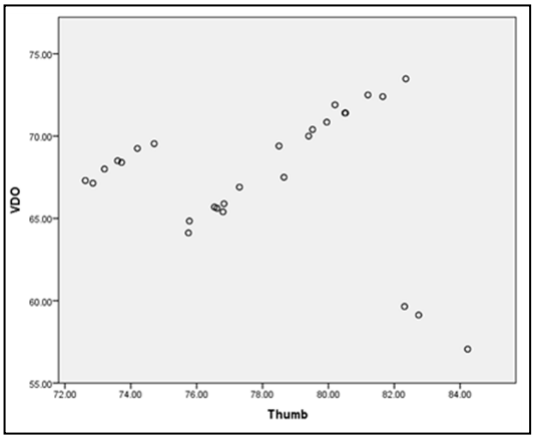
Graph 3. Scatter plot representing the correlation between VDO and ear measurements for female subjects.



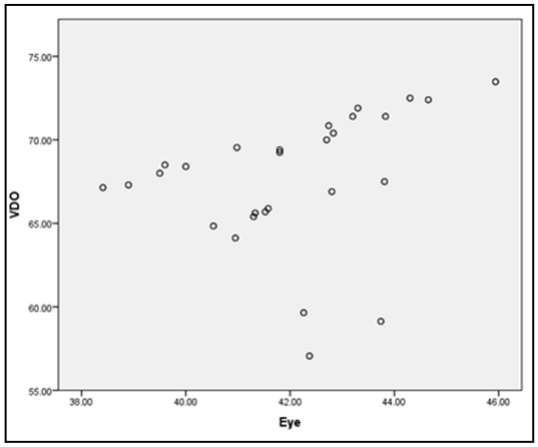
Graph 4. Scatter plot representing the correlation between VDO and little finger (digitusminimus) measurements for female subjects.



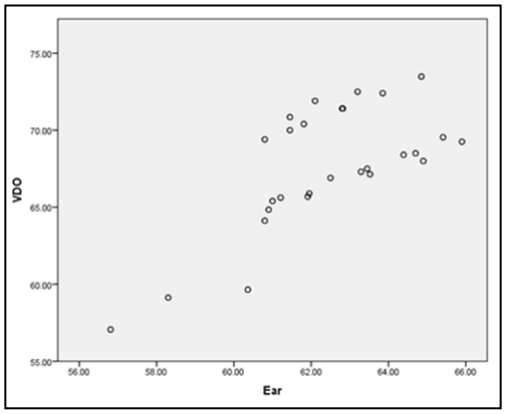
Graph 5. Scatter plot representing the correlation between VDO and thumb measurements for male subjects.



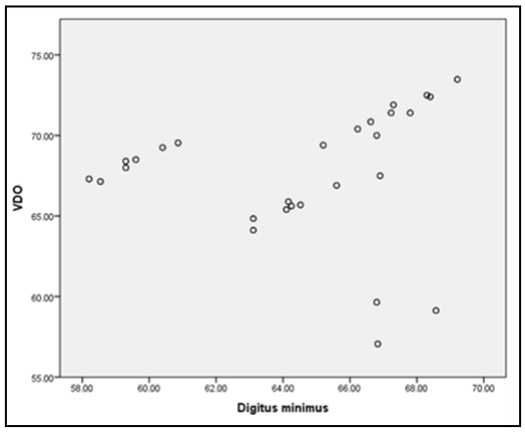
Graph 6. Scatter plot representing the correlation between VDO and eye measurements for male subjects.



Graph 7. Scatter plot representing the correlation between VDO and ear measurements for male subjects.



Graph 8. Scatter plot representing the correlation between VDO and little finger (digitusminimus) measurements for male subjects.



sents the scatter plot showing a strong positive, linear association between the VDO and the length of the little finger among the female subjects. There doesn't seem to be any outliners in data. Graph 5 represents the scatter plot showing a weak negative association between the VDO and the length of the thumb among the male subjects. There seem to be a few outliners in data. Graph 6 represents the scatter plot showing a weak positive, linear association between the VDO and the length of the eye among the male subjects. There seem to be a few outliners in data. Graph 7 represents the scatter plot showing a strong positive, linear association between the VDO and the length of the ear among the male subjects. There seem to be a few outliners in data. Graph 8 represents the scatter plot showing a weak positive, linear association between the VDO and the length of the little finger among the male subjects. There seem to be few outliners in data.

Discussion

For this study, a total of 54 female subjects and 56 male subjects were measured for their VDO, length of the eye, ear, thumb, and little finger using verniercalipers. It was identified that the mean or average length of VDO among the female subjects is 59.49mm. The average length of the little finger among the female subjects is 56.60mm. The average length of the thumb among female subjects is 58.52mm. The average length of the ear among female subjects is 58.64mm. The average length of the eye among female subjects is 41.23mm. The mean values of the VDO among the male subjects is 67.63. The mean values of the little finger among the male subjects is 64.54mm. The average length of the thumb among male subjects is 77.93mm. The average length of the ear among male subjects is 62.37mm. The average length of the eye among male subjects is 42.02mm [Table 1]. The results obtained from the test were also subject to correlation tests. The results collected from the female subjects were compared separately, independent of the results collected from the male subjects. The VDO measurements were compared with the measurements obtained for the little finger (digitusminimus), thumb, ear, and eye.

The correlation of the four anthropometric parameters was checked individually with the vertical dimension of occlusion for both, the male and female subjects. The significance and correlation of the values obtained from my study were calculated using Pearson's correlation coefficient. The correlation between the VDO and thumb is 0.991 [Graph 1]. The correlation between the VDO and the eye is 0.6 which is a strong positive correlation [Graph 2]. Similarly, the correlation between VDO and the ear is 0.991 which is also a very strong positive correlation [Graph 3]. The correlation between VDO and the little finger is 0.96 [Graph 4]. The p values for all the correlations are less than 0.05, thus the results obtained are statistically significant. The correlation coefficients suggest that there is a very strong correlation between the VDO and the length of the thumb, ear, little finger, and the eye in descending order of strengths of correlation among the female subjects [Table 2].

Similar correlation tests were performed among the male subjects where the correlation between the VDO and the thumb is -0.08 which is a mild negative correlation [Graph 5]. The correlation between the VDO and the eye is 0.286 [Graph 6]. The correlation of VDO and the ear is 0.704 which is a strong positive correlation

[Graph 7]. The correlation of VDO and the little finger is 0.083, representing a weak positive correlation [Graph 8]. The p values for the correlation between VDO and the thumb; and VDO and the little finger is greater than 0.05, thus the results are statically insignificant. Whereas, the p values for the correlation of VDO and eye; and VDO and ear is less than 0.05, thus the results obtained are statistically significant [Table 2].

The results obtained in Table 1 suggest that the mean values of all the 5 measurements were greater among males than compared to the mean values of the same 5 measurements in females. The results obtained from the correlation tests [Table 2 and Graphs 1-8] suggest that, among the males, there is a stronger correlation of the VDO with the length of the ear and eye, with a stronger correlation with the former. Among females, it is found that the strongest positive correlation with the thumb and ear. The results from my study prove that the most accurate measurements of the VDO can be made and estimated with comparison to the length of the ear, for both male and female subjects. Measurements can be taken from the tip of the ear superiorly to the junction of the ear inferiorly. This study can have a larger subject population, further studies with increased subject size might help in the future for increased accuracy.

The relation of the physiological rest position of the mandible, during occlusion, and the interocclusal space between the teeth helps in defining the vertical dimension of occlusion [14, 15]. Three different possible processes can explain the physiologic rest of the mandible-myotatic reflexes, tone of the muscle depends on its posture and gravity elasticity. They can individually influence the vertical dimension or can work in unison [16]. The current methods employed to determine the VDO include the use of measuring devices in the mouth and head. Some other methods include the swallowing method, bite force methods, the use of telemetry, cephalometry, and other magnetic methods that are used to determine the VDO of the patient. The problem faced by all dentists is mainly the availability of so many methods to determine VDO, but none of them allow for accurate measurements and results among partially or fully edentulous patients [17, 18]. Many dentists while trying to achieve the correct and most accurate VDO, try to alter the values. The factors they consider while making these alterations include esthetics, restoration space allowance, occlusal relationship corrections, prosthetic convenience. The difficulty faced at this time is the likelihood of instability of the prosthesis due to an increase or decrease of VDO [19, 20]. With such imbalance, there is a modified state of closure and sufficiency. This can cause various changes and consequences including angular cheilitis, altered phonetics, decreased masticatory function, and pain in the edentulous ridges [21].

Anthropometry is a branch of science relating to the measurements of the human body. It is used to study and understand the nutritional status of children and adults. The anthropometric measurements in children reflect their health status, growth and development, and dietary adequacy over time. In adults, these measurements can be used to analyze the health and the dietary status, body composition, risk of disease.

The results obtained in our study regarding the mean values of the 5 anthropometric measurements are justified by the results obtained in other craniometric studies focussing on sexual dimorphism among Indian populations. The study conducted by Raghavan et al suggests that the mean values of the measurements obtained from males will be greater than the mean values of the females in the Indian population [22].

A similar study conducted in Loni, India by Ladda et al., [23] suggested similar results obtained in my study, supporting the fact that the VDO is higher in males than in females. This suggests that there is sexual dimorphism in the measurements of VDO. But their study compared only the measurements of the fingers, excluding the measurement of any facial features. Their results will not be applicable for double-amputee patients. A study conducted by Singh et al, [24] involved finding the correlation of the VDO with facial features alone among the Indian population.The results obtained in this study are justified by very similar studies comparing the correlation of the VDO with another facial and hand measurements done by Miran et al. [24]. their study was conducted in Iraq.This study combines the correlation of the facial and finger measurements with the VDO for Indian population.

Conclusion

The science of anthropometry is a very precise science of measurements of the parts of the body. These measurements can be used and compared with the VDO. Since there are various methods of measuring the VDO with no specific and accurate method for measurement, such correlations can be very useful. The VDO that is measured can be correlated to any of the above anthropometric measurements to arrive at a satisfactory result.

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