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RESEARCH ARTICLE

RELATIONSHIP OF THE VERTICAL DIMENSION OF OCCLUSION WITH ANTHROPOMETRIC MEASUREMENTS OF FINGER IN INDIVIDUALS OF KERALA POPULATION - A CROSS-SECTIONAL STUDY

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Abstract

Aim: The aim of this study was to find out the correlation of vertical dimension of occlusion with anthropometric measurements of finger in individuals of kerala population, which can be used as future reference of the vertical dimension of occlusion (VDO) and hence can be used to determine VDO in edentulous patients.

Materials and Methods: The study was conducted in the Department of Prosthodontics, Govt. Dental College, Kottayam, kerala, India. A total of 240 dentate subjects of age range 20 to 40 years were included for this study. Anthropometric measurements of VDO, length of index finger, length of little finger and distance from tip of thumb to tip of index finger of right hand was recorded clinically using modified digital vernier caliper with an accuracy of 0.01 mm. For all the parameters of this study mean, standard deviation and range was calculated. Correlation was studied using Pearson Correlation Coefficient method (when distribution was normal). Spearman correlation was used when distribution was not normal.

Results: In males, correlation of VDO was strongest for the parameter - length of index finger (r-0.659). In females; correlation of VDO was strongest for the parameter - length of little finger (r-0.723).

Conclusion: Within the limitations of the present study, the result shows that the index finger and little finger can be used as an adjunct for determining the VDO in edentulous male and female patients respectively.

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Introduction:-

Complete dentures are constructed to function in the mouth as an integral part of the masticatory apparatus, and therefore, they should be designed to conform to the patient's physiologic jaw relations.(1)

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Vertical dimension of occlusion is considered as the main factor in determination of an individual's ability to perform oral functions such as mastication, speaking and swallowing effectively.(2)Recording the correct vertical relation, is an important procedure and any error at this stage can result in dentures that are uncomfortable, or unwearable, and may even have the potential to produce lasting damage to many elements of the stomatognathic system.(3)

Vertical dimension (VD) should be determined correctly as its increase will increase the risk of trauma to the tissue underlying the denture, soreness of the muscles, clicking sound during speech, Temporomandibular disorders (TMD) etc. Vertical dimension of occlusion that is too far closed, does not allow the muscles of mastication to function at their normal length resulting in reduction of their efficiency, and less force is applied during mastication. This condition causes lack of support to muscles of facial expression, giving rise to premature wrinkles, deep nasolabial furrows, and folds at the angles of the mouth. This condition may permit saliva retention promoting angular cheilosis, and it is also conducive to temporomandibular joint dysfunction.(4)For an extensive prosthetic reconstruction, the choice of the vertical dimension of occlusion VDO is of paramount importance. Paradoxically, the changes of the VDO in both directions, increasing or decreasing are frequently argued.(5)

Many techniques have been used for measuring VD in dentulous and edentulous patients, like pre-extraction records, swallowing, functionally acquired jaw position associated phonetics and cephalometric radiographs.(6)Clinical judgment plays a major role in the assessment of this important component in the construction of dentures which should satisfy the dentist, patient and not induce any degenerative change in the tissue.(7)

The development of new investigative tools and better interpretation of the available methods for establishing the height of the face may eventually lead to the development of more accurate and practical methods.(8)

This study was conducted to assess the possibility of any correlation between VDO and length of fingers in Kerala population so that it can serve as a simple and precise method for estimating and predicting VDO. Four measurements are taken, 1) the length of index finger, 2) the length of little finger, 3) the difference between thumb and index finger and 4) the VDO.

Materials And Methods:-

This study was conducted in the Department of Prosthodontics, Government Dental College, Kottayam, Kerala, India. A total of 240 subjects were randomly taken for the study (90 males and 150 females) of the age group 20 to 40 years. The subjects were the patients reporting to the general OPD and the students of Government Dental College, Kottayam. Before the study an approval from the ethical committee was obtained and informed consent was signed by the subjects. Only the subjects meeting inclusion criteria were allowed to participate in this study. Inclusion criteria for the subjects were: they should have eugonathic jaw relationship, definite centric stop and at least 28 fully erupted, periodontally sound teeth in both jaws. And the subjects with following exclusion criteria were not allowed to participate in the study: subjects with open bite or deep bite cases, teeth anomalies, attrition, extensive prosthesis or restorations in the oral cavity, temporomandibular joint disorders, any other pathology in maxillofacial region, history of trauma and orthodontic treatment or orthognathic surgery.

Measurements:-

Digital verniercaliper (with an accuracy of 0.01 mm), metallic scale and marker pen were used for the measurement procedure.[Figure 1]Subjects were examined intraorally and extraorally using a probe and mirror. They had sufficient anterior and posterior teeth, which could maintain the occlusal vertical dimension. Subjects sat comfortably in the dental chair in an upright position with the head well supported, the occlusal plane parallel to the floor and eyes looking forward.

Vertical Dimension of Occlusion (VDO):

To record VDO, the subjects were instructed to bite lightly on the posterior teeth with lips in repose and head well controlled and stabilized. The tips of digital verniercaliper was modified for recording VDO to allow a precise positioning in vertical and horizontal planes without causing any discomfort to the subjects. The lower modified extended tip of caliper was placed firmly below the chin so that the soft tissues were compressed by pressure exerted

and thus caliper approximating to the lower border of mandible against the skin. Now the upper tip of caliper was raised until it lightly touches the base of nasal septum and the measurement was made.[Figure 2]



Figure 1:- Armamentarium.



Figure 2:-Measurement of vertical dimension of occlusion.

Finger Measurements :

For measurement firstly, subjects were told to place palmar aspect of the right hand in pronation against a flat surface with the fingers and thumb adducted. Length of the index finger of right hand was measured on palmar aspect (in supine position) from tip of finger to the near most point on palmar digital crease with help of digital caliper.[Figure 3] In the same way, length of little finger of right hand was measured from tip of finger to the farther most point on palmar digital crease.[Figure 4]

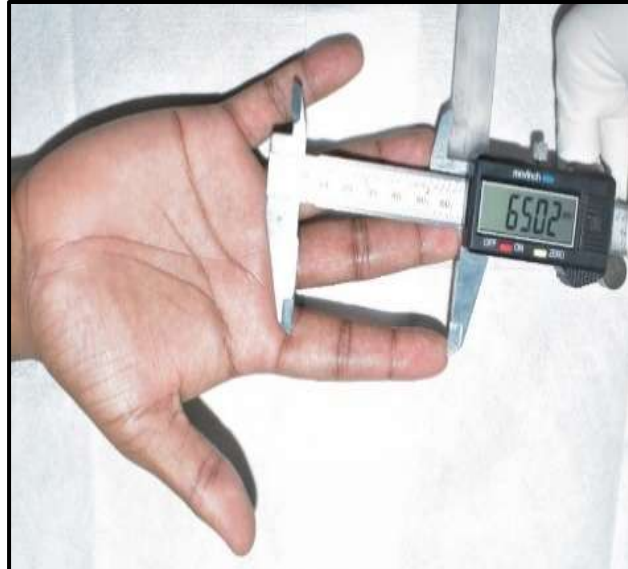


Figure 3:-Measurement of length of index finger.



Figure 4:- Measurement of length of little finger.



Figure 5:-a. Marking the distance for tip of the thumb with scale and black marker pen, b. Measurement of distance from tip of index finger to tip of thumb.

The measurements for distance between tip of index finger to tip of thumb were taken with the hand straight and flat. A point was marked on index finger with the help of metallic ruler and marker pen representing the tip of thumb. Then, with digital verniercaliper measure the distance from tip of thumb to tip of index finger, while taking all these finger measurements it was made sure that nails of the subjects were trimmed.[Figure 5-a, 5-b]

Statistical Analysis

For all the parameters of this study mean, standard deviation and range were calculated. Correlation was studied using Pearson Correlation Coefficient method when distribution was normal. And spearman correlation was used when distribution was not normal. To estimate VDO, Statistical Package for Social Sciences (SPSS) Software Version 16.0 was used.

Results:-

From Table 1(Descriptive statistics of vertical dimension of occlusion, length of index finger, length of little finger and distance from tip of index finger to tip of thumb), it was observed that, in males the mean value of VDO was 68.12 mm with the range from 56.2 mm to 75.6 mm whereas in females, the mean value was 57.24 mm with the range from 46.1 mm to 69.3 mm. Thus, VDO was more in males as compared to females.

In males, the mean value of length of index finger was 66.66 mm with the range from 54.8 mm to 72.2 mm whereas in females, it was 65.4 mm with the range from 55.3 mm to 75.3 mm. Therefore, males had longer index finger as compared to females.

In males, the mean value of length of little finger was 60.57 mm with the range from 52.6 mm to 68.5 mm whereas in females, the mean value was 56.68 mm with the range from 49.1 mm to 62.5 mm. Therefore, males had longer little finger as compared to females.

In males, the mean value of distance from the tip of thumb to the tip of index finger was 68.87 mm with the range from 53.1mm to 68.3 mm whereas in females, it was 58.96 mm with the range from 48.6 mm to 68.9 mm. Therefore, this distance was more in males than in females.

Table 1:- Descriptive statistics of vertical dimension of occlusion, length of index finger, length of little finger and distance from tip of index finger to tip of thumb.

Sex	Measurements (mm)	Mean (mm)	SD (mm)	Std. Error of Mean	Min (mm)	Max (mm)
Male	VDO	68.123	3.9104	0.4122	56.2	75.6
	Length of index finger	66.667	3.7777	0.3982	54.8	74.2
	Length of little finger	60.571	3.6994	0.3899	52.6	68.5
	Distance from tip of index finger to tip of thumb	60.874	6.8948	0.7268	6.9	70.0
Female	VDO	57.241	5.0572	0.4129	46.1	69.3
	Length of index finger	65.467	4.8843	0.3988	49.3	75.3
	Length of little finger	56.683	4.7981	0.3918	45.7	72.3
	Distance from tip of index finger to tip of thumb	58.967	4.6379	0.3787	47.5	69.3

VDO = Vertical Dimension of Occlusion, SD = Standard Deviation

Table 2:- Sex specific correlations between vertical dimension of occlusion and length of index finger, length of little finger, distance from tip of index finger to tip of thumb.

		Length of index finger	Length of little finger	Distance from tip of index finger to tip of thumb
Male VDO	r	0.659**	0.536**	0.245**
	P value	0.000	0.000	0.020
	N	90	90	90
	r	0.700**	0.723**	0.537**

Male VDO	P value	0.000	0.000	0.000
	N	150	150	150

Correlations (r) by Pearson product moment correlation method,
 **. Correlation is significant at the 0.01 level (2-tailed).

The coefficient of correlation (r) by Pearson’s correlation coefficient method between the measured variables and VDO, at the probability level of 95% is presented in Table 2 (Sex specific correlations between vertical dimension of occlusion and length of index finger, length of little finger, distance from tip of index finger to tip of thumb). From Table 2, it was observed that in males and females, VDO is significantly and positively correlated with the parameters studied. In males, correlation of VDO was strongest for the parameter -length of index finger (r=0.659). In females; correlation of VDO was strongest for the parameter - length of little finger (r=0.723).

Table 3:-Sex specific regression analysis.

Sex	Dependent Variable	Independent Variable	Regression Equation	R ² (%)	SE
Male	VDO	A	Y=22.65+.682xA	.434	2.95
		B	Y=33.79+.567XB	.288	3.31
		C	Y=59.59+.139XC	.060	3.81
Female	VDO	A	Y=8.20+.749xA	.523	3.50
		B	Y=15.40+.739XB	.490	3.62
		C	Y=22.72+.585XC	.288	4.28

(A=Length of index finger, B=Length of little finger, C=Distance from tip of index finger to tip of thumb, SE=Standard error, R2=coefficient of determination, VDO=Vertical dimension of occlusion)

Regression analysis was performed for prediction of VDO using all the parameters [Figure 6-8].From Table 3, it was observed that in males following regression equations were reliable to determine VDO:

- a. VDO = 22.65 + 0.682 × length of index finger
- b. VDO = 33.79 + 0.567 × length of little finger
- c. VDO = 59.59 + 0.139 × distance from tip of index finger to tip of thumb

In females following regression equations were reliable to determine VDO:

- a. VDO = 8.20 + 0.749 × length of index finger
- b. VDO = 15.40 + 0.739 × length of little finger
- c. VDO = 22.72 + 0.585 × distance from tip of index finger to tip of thumb

Determination of VDO using regression equation for length of index finger had a standard error of ±2.95 and ±3.50 in males and females respectively. Determination of VDO using regression equation for length of little finger had a standard error of ±3.31 and ±3.62 in males and females respectively. Determination of VDO using regression equation for distance from tip of index finger to tip of thumb had a standard error of ±3.81 and ±4.28 in males and females respectively.

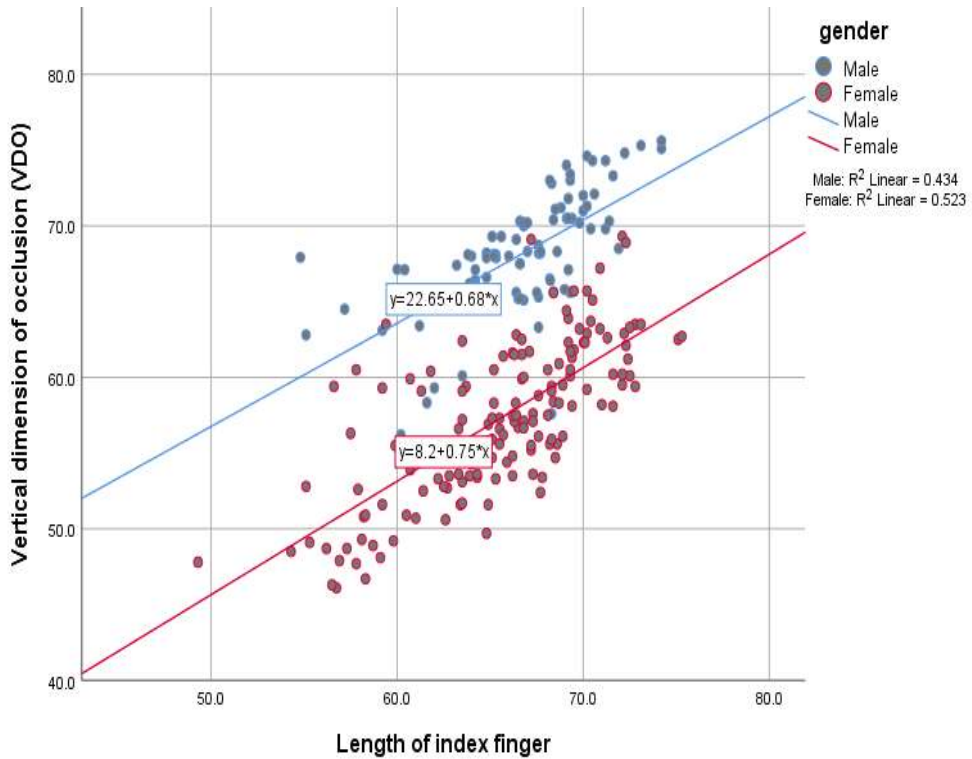


Figure 6:- Scatter diagram along with regression lines of length of index finger versus vertical dimension of occlusion.

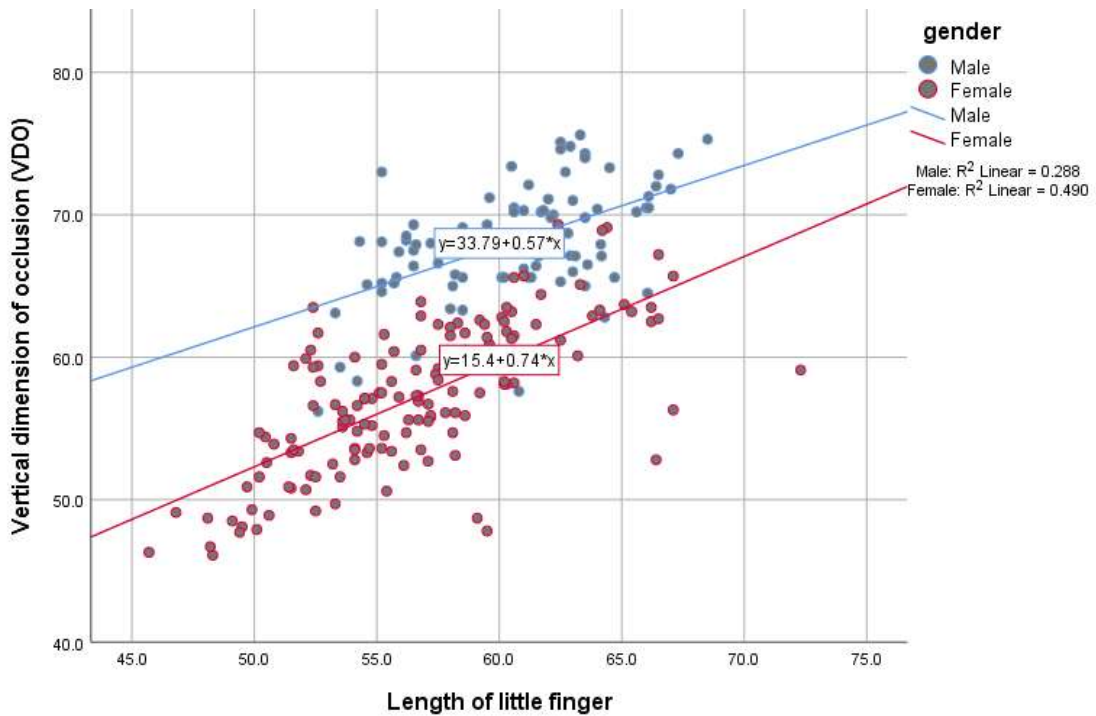


Figure 7:- Scatter diagram along with regression lines of length of little finger versus vertical dimension of occlusion.

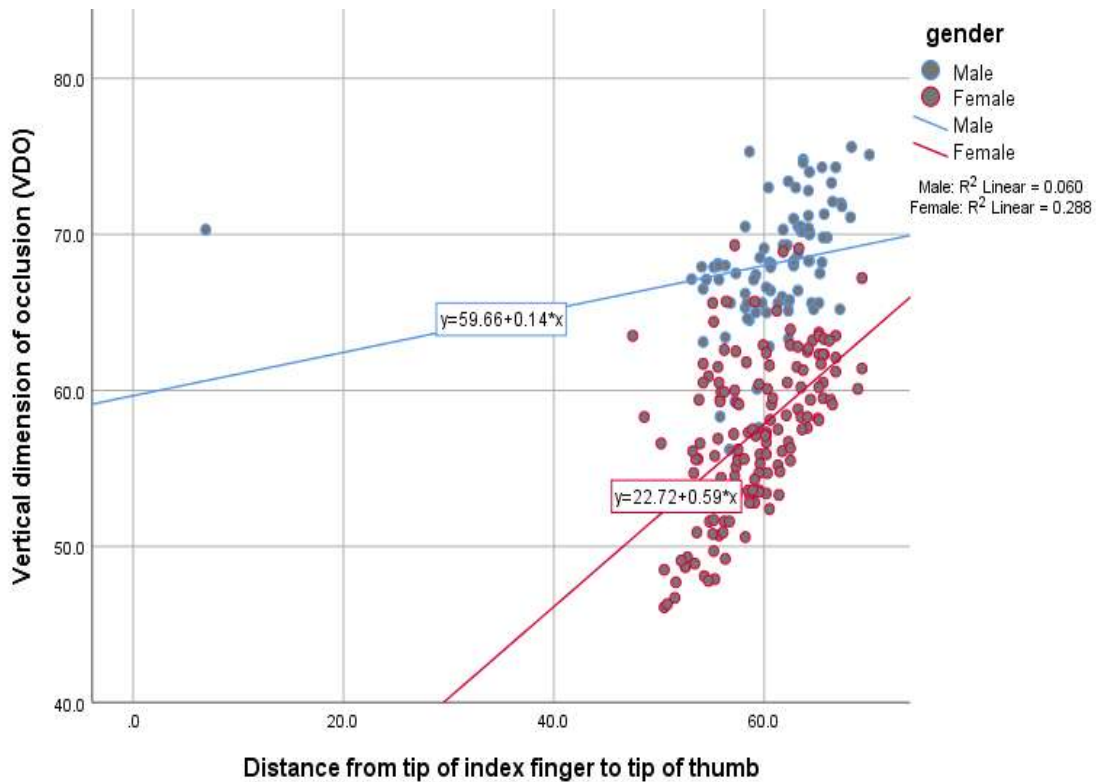


Figure 8:- Scatter diagram along with regression lines of distance from tip of index finger to tip of thumb versus vertical dimension of occlusion.

Discussion:-

The successful construction of a set of artificial dentures depends on the precision with which each step in the procedure is accomplished. Any step based on guesswork not only would be unscientific but also would be a potential cause of failure. An ideal method of obtaining vertical dimension is seldom included in the presentation of any denture technique. Therefore it becomes apparent that some exacting method must be used to establish the correct vertical dimension for each individual patient before recording centric relation.(9)

Although many methods have been proposed for determining the VDO, there is no universally accepted or completely accurate method. The conventional methods were found to be the most popular and convenient methods according to Swerdlow(8) and Turrell(4). This applies here in Kerala as well, where conventional methods are most commonly used by dental students and general practitioner alike, for they do not require a great amount of time, are easily mastered, practical and no sophisticated or expensive equipments are necessary.

This study evaluated the relation between vertical dimension of occlusion and length of fingers of each individual participated in this study in Kerala population.

The present study was conducted on a sample of Kerala population selected from general O.P.D. patients and dental students from Government College of Dentistry, Kottayam, Kerala. There were 240 subjects in all, 90 males and 140 females. Ages ranged between 20 – 40 years. All subjects were dentate with a minimum number of 28 teeth in their maxilla and mandible, to ensure preservation of the original VDO.

People with TMD, tooth wear, orthodontic appliances, Angle Class II, or III, were excluded, and only those with harmonious facial profile and good occlusion were selected for this study.

In this study all the values that is VDO and length of fingers were higher for the males as compared to females and that shows an evident sexual dimorphism. The sexual dimorphism in finger length is related to post-puberty levels of androgen exposure(10). Also in this study measurements of only right hand fingers were recorded for the sake of

uniformity. This will not create any bias because it is a known fact that physiologically human body maintains symmetry. Also many investigators like Danborn(11) found no differences in the length of fingers of both hands.

The mean VDO for males and females in present study showed 68.123 mm and 57.24 mm respectively. That is, mean VDO for males is greater than females in this study. Length of index finger of right hand measured in the present study showed a mean of 66.6 mm in males and 65.4 mm in females. The findings of Danborn(11) showed a mean value of 73.54 mm in males and 69.95 mm in females. Kanchanet al.(12) showed a mean value of 64.9 mm in males and 65.2 mm in females. Peters(13) showed a mean value of 72.9 mm in males and 66.9 mm in females. We found that length of index finger was a reliable parameter in determination of VDO with a standard error of ± 2.95 in males and ± 3.50 in females.

Length of little finger of right hand measured in the present study showed a mean of 60.5 mm in males and 56.6 mm in females. This is in accordance with the findings of Nag who showed a mean of 56.3 mm in females.(14) But no such comparative data of little finger measurements in males is available. The study revealed that little finger can also be used for determination of VDO with a standard error of ± 3.31 in males and ± 3.62 in females.

In this study, the mean value for distance from the tip of thumb to the tip of index finger was 60.8 mm in males and 58.9 mm in females. However, we could not trace any studies wherein this parameter was considered. But it was found that VDO can be estimated from this distance using regression equation with the standard error of ± 3.81 and ± 4.28 in males and females respectively.

The coefficient of correlation (r) for index finger in males, is 0.659 which is more significant than little finger ($r = 0.536$) and distance from tip of index finger to tip of thumb ($r = 0.245$). The coefficient of correlation (r) for little finger in females, is 0.723 which is more significant than 0.700 (index finger) and 0.537 (distance from tip of index finger to tip of thumb)

The results of current study indicated that anthropometric measurements like finger lengths can serve as a basic guide in estimating the lower facial height and offer significant prosthetic advantages. The VDO estimated using this method is within the range of 2-4 mm which is significantly less compared to other methods where a range of 0-14 mm is given. [15,16] The significance of this study lies in the fact that it is very simple, convenient, non invasive and yet convincing as it gives reproducible values and can be used for future references.

The limitation of the study was that it was confined to small group of subjects with class I malocclusion and other skeletal or dental malocclusions were not considered. Also, the measurement is difficult to record when a subject has a round facial profile with excessive soft tissue bulk under the chin as it can cause discrepancies in measurements. So it is recommended to carry out further studies on different ethnic population groups to construct proper regression equation acknowledged worldwide.

Conclusion:-

Within the limitation of this study it was concluded that there is positive and strong correlation between VDO and the length of fingers in individuals of Kerala population. In this study the best parameter to predict the VDO for males was found to be the index finger and for females it was little finger with Pearson's correlation coefficient (r) of 0.659 for males and 0.723 for females respectively. Hence, this simple, economic and time saving method can be used as an adjunct for the measurement of vertical dimension of occlusion.

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