

International Journal of Dental Science and Innovative Research (IJDSIR) **IJDSIR** : Dental Publication Service Available Online at: www.ijdsir.com Volume – 3, Issue – 1, January - 2020, Page No. : 14 - 23 A correlative evaluation between occlusal vertical dimension and the length of thumb and index finger: An Anthropometrical study. ¹Dr. Ranjana Balla, Assistant Professor, Department of Prosthodontics, Adesh Institute of Dental Sciences and Research, Bathinda ²Dr. Davinderjit Kaur Shergill, Assistant Professor, Department of Prosthodontics, Maharaja Ganga Singh Dental College and Research Centre, Sri Ganganagar ³Dr. Anita Mehta, Professor, Department of Periodontology & Implantology, Dasmesh institute of Research & Dental Sciences, Faridkot, Punjab, India ⁴Dr. Nitin Khuller, Prof and HOD, Department of Periodontology & Implantology, Dasmesh institute of Research & Dental Sciences, Faridkot, Punjab, India ⁵Dr. Preetinder Singh, Professor, Department of Periodontology & Implantology, Swami Devi Dyal hospital and Dental College, Barwala, Panchkula, Haryana Corresponding Author: Dr. Anita Mehta, Professor, Department of Periodontology & Implantology, Dasmesh institute of Research & Dental Sciences, Faridkot, Punjab, India. Citation of this Article: Dr. Ranjana Balla, Dr. Davinderjit Kaur Shergill, Dr. Anita Mehta, Dr. Nitin Khuller, Dr. Preetinder Singh," A correlative evaluation between occlusal vertical dimension and the length of thumb and index

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Abstract

Hands are specialized appendages at the distal end of the upper limbs and are designed for grasping and moving precisely. The anthropometric measurements of the hand, thumb, and other digits are utilized in constructing gloves, design and sizing of hand tools, controls, knobs, and other applications in various kinds of precision and power grips. This study was designed to assess the possibility of a simple and precise method for estimating vertical dimension of occlusion from the length of index finger and thumb. **Keywords:** Tissuegraphic, Vertical Dimension, Thumb and Index Finger.

Introduction

Occlusal vertical dimension is very critical record because errors in this record produce the first sign of discomfort in the denture. Establishing the correct vertical dimension of the edentulous mouth is one of the major concern in treating edentulous patients. In addition to functional importance, the lower third of the face affects one's facial expressions and appearance. The restoration of a pleasing appearance is one of the primary goals of aesthetic

dentures. The vertical dimension that is appropriate, stable occlusal contacts that are harmonious with the existing temporomandibular joints and masticatory muscles, and consistent contours with the surrounding facial musculature will help to adapt the complete dentures to the rest of the masticatory system.

Although Prosthodontics as a whole has progressed leaps and bounds with variety of techniques being proposed and practiced for the evaluation of vertical dimension of occlusion, none of them is scientifically more accurate than other. Each method advocated has its own limitations. These are either tedious, time consuming, require special instrument/equipment, or expose patients to radiations.¹ Studies have also been done to record the vertical dimension of occlusion using anthropometrical measurements. Anthropometry which deals with the measurements of the human body, is very important in dentistry e.g measurement of weight, height, mid-upper arm circumference and hip circumference to assess the occurrence of dental caries, to measure eye-ear distance and interpupillary distance to measure occlusal vertical dimension, to evaluate the facial esthetics using facial measurements, to use facial measurements in forensic odontology, to assess the width and height of human teeth etc.

This study is designed to assess the possibility of a simple yet precise method for estimating vertical dimension of occlusion from length of index finger and length of thumb. The research hypothesis is that there should be a significant relationship between the vertical dimension of occlusion with the length of index finger and thumb by using tissuegraphic and radiographic method.

Aim

The aim of the study is to evaluate the correlation between the length of thumb and index finger with the occlusal vertical dimension.

Objectives

1. To compare the relationship of length of thumb and index finger with the occlusal vertical dimension recorded by the tissuegraphic method.

2. To compare the relationship of length of thumb and index finger with the occlusal vertical dimension recorded by the radiographic method.

3. To compare the occlusion vertical dimension recorded by the tissuegraphic method and the radiographic method.

Material and methods

The present study was conducted in the Department of Prosthodontics & Crown and Bridge, Maharaja Ganga Singh Dental College and Research Centre, Sriganganagar. The subjects were the local residents of Rajasthan. The purpose of this study was to evaluate the correlation between occlusal vertical dimension with the length of thumb and index finger recorded by the tissuegraphic method and by the radiographic method. The comparison between the occlusal vertical dimension recorded by the tissuegraphic method and radiographic method was also assessed.

The study was conducted on 20 subjects (10 males and 10 females) with the age group of 20- 35 years belonging to Rajasthan.

Inclusion Criteria

Physically healthy patients and having eugnathic jaw relationship of age range 20 to 35 years, with no deformity of thumb and fingers and presence of at least 28 fully erupted periodontally sound teeth and a definite centric stop were included in this study.

Exclusions Criteria

Patients with open bite, teeth anomalies, attrition, extensive prosthesis in the oral cavity, TMJ disorders, hormonal abnormalities (Gigantism, Acromegaly etc.), large carious lesions, abnormality in thumb, any pathology in the maxillofacial region, history of trauma, orthodontic or orthognathic surgery were excluded from the study.

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A written informed consent was obtained from each subject and the measurement of occlusal vertical dimension and length of thumb and index finger was obtained by tissuegraphic and radiographic methods.

Tissuegraphic Method

Measurement of thumb and index finger: Each subject were asked to place his/her hand on a graph paper with the palm facing downwards, keeping the fingers separated and the thumb lying comfortable. Then outline of hand was marked with the help of marking pen. Two points, one at the tip of thumb and index finger and other at the base of the same respectively, were marked on the graph paper. The distance from the tip to the root of both index finger and thumb were measured and recorded. This measurement was done with digital vernier caliper (Measuring Digital Caliper, range 0-150 mm /6 inch calibrated upto $10^{(-4)}$ mm in inches.







Measurement of occlusal vertical dimension: Each subject were asked to sit comfortably on the dental chair in a fully upright position with the Ala-tragus line in a horizontal position which was maintained throughout the measurements. A headrest was used to support the head and each of the subjects were instructed to bite lightly on the posterior teeth with lips in repose. Then the two markings were placed; one at the tip of the nose and other on the most prominent point on the chin (Pogonion) with the help of a marking pen. Then with digital vernier caliper (Precision Measuring Digital Caliper, range 0-150 mm /6 inch calibrated upto 10^{-4} mm), the distance between the two markings were measured in inches.



Radiographic Method

Measurement of thumb and index finger: Radiograph of hand of each subject was taken. While taking the radiograph of the hand, each subject was instructed to place his/her hand on the table with the palm facing downwards and fingers widely separated. Tracing of each hand radiograph was done on the tracing paper. Then two points were marked on the tracing paper for each finger:

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one at the tip of the finger and another at the root of the finger. The length of thumb and index finger was calculated by measuring the distance between these two points by using the digital vernier caliper in inches





Measurement of occlusal vertical dimension: Lateral cephalogram of face of each subject were taken. While taking the lateral cephalogram, patients were instructed to stand straight with the left side towards the image receptor which is positioned parallel to the patient's midsaggital plane. Each of them was instructed to bite lightly on the posterior teeth. After that the tracing of each lateral cephalogram was done on the tracing paper. ANS (Anterior nasal spine) and Me (Menton) were the two hard tissue reference points which were marked on the tracing paper. The distance between these two points was measured in inches using digital vernier caliper.

This distance gave the value of vertical occlusion dimension



Observation and Result

All the measurements, thus obtained, were then interpreted and conclusions were drawn. For the purpose of documentation of records, a chart was made. The mean, standard deviation maximum and standard error mean were calculated for both the groups. "P value" was calculated for the comparison between the length of index finger & thumb and vertical occlusion dimension. Pearson correlation test was done to estimate the correlation between all the variables. P<0 .05 was considered to be significant correlation and P<0.001 was considered highly significant correlation. The measurement of vertical dimension of occlusion, length of index finger and thumb were recorded using Tissuegraphic and Radiographic methods. The readings were divided into two groups -Group T (Tissuegraphic) and Group R (Radiographic), hence Group T indicates the measurements done by tissuegraphic method using digital vernier caliper and Group R indicates the measurements done by radiographic method using digital vernier caliper.

		t	df	Sig. (2-
				tailed)
In	Equal variances	-	38	.001
	assumed	3.515		
Th	Equal variances	1.639	38	.109
	assumed			
VDO	Equal variances	4.056	38	.000
	assumed			

In=Index finger, Th=Thumb, VDO=Vertical dimension of occlusion, t=T value

Graph 1: Graphical representation of the T test value and sig. value of index finger, thumb and VDO



In=Index finger, Th=Thumb, VDO=Vertical dimension of occlusion

T test for the equality of means of Group T and Group R reveals that there was a significant difference between measurement of index finger in Group T and Group R.(t=-3.515, p=0.001)(Table IV)

T test for the equality of means of Group T and Group R reveals that there was not any significant difference between measurement of thumb in Group T and Group R.(t=1.639, p=0.109)(Table IV)

T test for the equality of means of Group T and Group R reveals that there was significant difference between measurement of vertical occlusion dimension in Group T and Group R.(t=4.056, p=0.000)(Table IV)

Table 2: Correlation between vertical occlusiondimension, length of index finger and length of thumb inGroup T.

In=Index finger, Th=Thumb, VDO= vertical dimension of occlusion

Correlations(GroupT)				
		VDO		
In	Pearson Correlation	.817**		
	Sig. (2-tailed)	.000		
	Ν	20		
Th	Pearson Correlation	.826**		
	Sig. (2-tailed)	.000		
	Ν	20		

Correlation by Spearman's method, P<0.05 is considered to be significant correlation. P<0.001 highly significant correlation.

The coefficient of correlation by Spearman's method between the length of index finger and thumb and vertical occlusion dimension in Group T, at the probability level of 95% is presented in Table III. From Table III, it was observed that the vertical occlusion dimension is significantly and positively correlated with the length of index finger and thumb in Group T

Table 3: Correlation between vertical occlusion dimension, length of index finger and length of thumb in Group R.

Correlations(Group R)				
		VDO		
Index	Pearson Correlation	0.712		
finger	Sig. (2-tailed)	0.002		
	Ν	20		
Thumb	Pearson Correlation	0.721		
	Sig. (2-tailed)	0.001		
	Ν	20		

The coefficient of correlation by Spearman's method between the length of index finger and thumb and vertical occlusion dimension in Group R, at the probability level of 95% is presented in Table IV. From Table IV, it was observed that Vertical occlusion dimension is significantly and positively correlated with the length of index finger and thumb in Group R.

Graph 2: Graphical representation of the Sig. value of index finger, thumb and VDO in Group T and Group R.



In=Index finger, Th=Thumb

Graph 3: Scatter diagram along with the regression lines of length of index finger versus vertical occlusion dimension in Group T



Graph 4: Scatter diagram along with the regression lines of length of thumb versus vertical occlusion dimension in Group T



Graph 5: Scatter diagram along with the regression lines of length of index finger versus vertical occlusion dimension in Group R



Graph 6: Scatter diagram along with the regression lines of length of thumb versus vertical occlusion dimension in Group R.



Regression analysis was performed for the prediction of vertical dimension of occlusion using all the parameters (Graph VI-Graph IX).

The following regression equations were reliable to determine vertical dimension of occlusion:

By tissuegraphic method

- 1. $VDO = 3.3 + 2.26 \times \text{length of index finger (Graph VI)}$
- 2. $VDO = 0.92 + 1.94 \times \text{length of thumb}$ (Graph VII)

By radiographic method:

1. VDO = 3.11 + 0.28 × length of index finger (Graph VIII)

 $VDO = 0.9 + 0.79 \times length of thumb (Graph IX)$

Discussion

Length of index finger of right hand measured in the present study by tissuegraphic method showed a mean of 67.8mm, of thumb was 47.9mm and of vertical dimension of occlusion was 69.6mm. In the present study the average difference between the length of index finger and vertical dimension of occlusion was 5.7mm and between the length of thumb and vertical dimension of occlusion was 21.7mm. This is in accordance with the study done by Ladda R et al¹ which showed a mean of 71.6mm in males and 65.9mm in females of index finger, 61.5mm in males and 56.3mm in females of little finger and 61.4mm in males and 56.7mm in females of vertical dimension of occlusion in case of males and little finger can be used to measure vertical dimension of occlusion in case of males and little finger can be used to measure

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vertical dimension of occlusion in case of females. They found that the average difference between the length of index finger and vertical dimension of occlusion in males was 6.5mm and in females it was 5.2mm.

A similar study done by Alhajj MN, Mussad NJ and Ismail IA^3 showed a mean of 68.98mm of index finger and 79.74mm of vertical occlusion dimension and they reported that the index finger can be used to predict the value of occlusion vertical dimension. They found that the average difference between the length of index finger and vertical dimension of occlusion was 5.05mm.

An anthropometric study done by **Basneet BB et al⁴** that showed a mean of 59.32+-4.58mm of the thumb and 66.26+- 5.04mm of vertical dimension of occlusion. In their study they concluded that the thumb length can be used as an adjunct for establishing occlusal vertical dimension in the edentulous patients. Similarly **Miran FA et al⁵, Regge JJ et al⁶,** and **Kalra D et al⁷** through their studies also concluded that the anthropometric measurements of fingers can be used to predict the value of vertical occlusion dimension in edentulous patients.

A study introduced by **Rege JJ Gosavi SS, Gosavi SY et al**⁶ showed a significant difference between measurement of vertical dimension of occlusion for males and females (t=7.419, p-value=<0.001) and also between the measurement of length of little finger for males and females (t=9.026, p-value<0.001). Similarly in the present study, T test was done to check the equality of means by the tissuegraphic method. T test revealed that there was a significant difference between the measurement of index finger and that of vertical occlusion dimension by tissue method (t=-3.515, p-value=0.001) but there was no significant difference between measurement of thumb by tissue method (t=1.639, p-value>0.001).

Spearman correlation was also done between the index finger and thumb and vertical occlusion dimension.

Significant value that is P value was calculated. P value <0.05 is considered significant and if it is <0.0001, it is considered highly significant. In this study vertical occlusion dimension showed a significant and positive correlation with the length of index finger and thumb by tissuegraphic method. Ladda R, Bhandari AJ, Kasat VO¹ reported that the vertical occlusion dimension is significantly and positively correlated with the length of fingers.

In the present study, the length of index finger, thumb and vertical dimension of occlusion was also determined radiographically. Hand radiographs was used to measure the length of index finger and that of thumb and lateral cephalogram was used to measure the vertical dimension of occlusion. The hard tissue reference points, Nasion and Menton were used to measure the vertical dimension of occlusion by using lateral cephalogram. This is in accordance with the study done by Qamar K, Munir U and Naeem S^8 in which they used the skeletal landmarks (N-ANS/ANS-Me) to evaluate the proportion between middle and the lower third through lateral cephalographs. Similarly Brzoza, Barrera, Contasti and Hernández⁹ had also used the same references and the soft tissue proportion i.e. G-Sn/ Sn-Me. The results of their study showed that it was possible to predict the vertical dimension through lateral cephalometric landmarks. This method was also simple and inexpensive method that is complementary to the conventional methods used to evaluate the vertical dimension.

So far now, there is no study done to find the correlation of length of index finger and that of thumb with the vertical occlusion dimension radiographically. In the present study, the mean of the length of index finger of right hand measured by radiographic method showed a mean of 71.6mm, of thumb was 46.3mm, of vertical occlusion dimension was 59.2mm and the average

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difference between the length of index finger and vertical dimension of occlusion was 5.7mm and between the length of thumb and vertical dimension of occlusion was 21.7mm. An anthropometric study done by **Ng PK, Satari A, Fauzi AM et al²** found that the average length of index finger is 64.8mm and the average length of thumb is 57.9 mm. Pearson correlation was done which revealed that there was significant correlation between vertical occlusion dimension and length of index finger and thumb by radiographic method.

So from the present study, it is concluded that the length of index finger and length of thumb can be used to determine the value of vertical occlusion dimension by using the tissuegraphic method and radiographic method. Nevertheless the results indicated that the anthropometric measurements like the length of index finger and length of thumb can serve as a basic guide in estimating the lower facial height and offer significant prosthetic advantages. As there are objective measurements rather than subjective criteria (such as resting jaw position, swallowing, etc), the guesswork in vertical dimension of occlusion is eliminated.¹. Moreover the vertical dimension of occlusion estimated using this method is within the range of 2-4mm which is significantly less compared to other methods where a range of 0-14mm is given.^{10,11} These methods are attractive and practical because they are simple, economical, non-invasive and they do not require any sophisticated measuring devices. These methods do not require a great amount of time and experience to master which is another advantage they enjoy over previous methods.

From the results of the present study, it can also be concluded that there is insignificant difference between the measurements of occlusion vertical dimension recorded by tissuegraphic method and radiographic method. But radiographic method is more reliable because the soft tissue reference points are not stable and changes with time. Also if the patient has a round facial profile with soft tissue bulk under the chin, the measurement of vertical dimension of occlusion through soft tissue method is very difficult to record. In this study measurements of only right hand finger were recorded. This will not create any bias because it is a known fact that physiologically human body maintains symmetry¹. **Danbornoet al**¹² did a study to estimate the height and weight from the length of second and fourth digits in Nigerians and they found no differences in the length of fingers of both hands.

The limitation of this study was that it did not include the subjects with any skeletal and dental malocclusion, open bite, abnormalities in thumb and index finger, etc. Further the subjects were not categorized based on facial forms. To authenticate these findings further studies should be carried out comprising of a broad clinical research program that would include the similar analysis for dentulous population in other ethnic groups and then appropriate regression equations may be constructed which can be accepted universally. However, the operator should keep in mind that vertical dimension of occlusion is the result of a musculoskeletal balance. The correct vertical dimension of occlusion can be better described as a range instead of as a fixed point. Therefore, in order to evaluate the vertical dimension of occlusion, a pluralistic method should be adopted at all the stages of rehabilitation to maximize the benefits and minimize damage to the stomatognathic system.

Conclusion

The best parameter to predict the vertical dimension of occlusion was found to be index finger and thumb by using the tissuegraphic method and the radiographic method. The variation between the index finger and vertical occlusion dimension is in the range of 5-7mm and variation between the thumb and vertical occlusion

dimension is in the range of 18-22mm. The same vertical dimension may also be used for future prosthetic reconstruction. Occlusion vertical dimension measurement through these methods is reliable and reproducible. Further studies can be conducted with larger sample size and in different ethnic groups to study the correlation of vertical occlusion dimension and anthropometric measurement of index finger and thumb.

Reference

- Ladda R, Bhandari AJ, Kasat VO et al. A new technique to determine vertical dimension of occlusal from anthropometrical measurements of fingers. J Dent Res 2013;24:316-20.
- Ng PK, Saptari A and Fauzi AM. Hand Anthropometry: A Descriptive Analysis on Elderly Malaysians. 2013;2(1)2302-3368.
- Alhajj MN, Mussad NJ and Ismail IA. Corrrelation between finger length and occlusal vertical dimension in adult Sudanese women. Bull Tokyo Dent Coll2016;57(4):215-21.
- Basnet BB, Parajuli PK, Singh RK et al. An Anthropometrical study to evaluate the correlation between occlusal vertical dimension and length of thumb. International Journal of Dental Sciences and Research 2015;7:33-9.
- Miran FA and Mahmood KA. The Correlation between the Right Little Finger, Eye - Ear Distance and Vertical Dimension of Occlusion among Students of Faculty of Medical Sciences in University of Sulaymani. IOSR-JDMS 2015;14(12):69-73.
- Rege JJ, Gosavi SS, Gosavi SY et al. Evaluation of the correlation between the vertical dimension of occlusion and the length of the ear, nose and little finger: An anthropometric study. Int J Prosthodont Restor Dent 2017;7(1):1-7.

- Kalra D, kalra A and Goel S. Determination of vertical dimension of occlusion from anthropometric measurements of fingers- An in vitro study. International Journal of Enhanced Research in Medicines & Dental care 2015;2(2):10-5.
- Qamar K, Munir U and Naeem S. Role of Cephalometry in evaluation of vertical dimension. Pakistan Oral and Dental Journal 2013;33(1):183-6.
- Barzoza D, Barrera N, Contadti G et al. Predicting vertical dimension with cephalograms for edentulous patients. Gerodontology 2005;22:98-103.
- Silverman MM. Accurate measurement of vertical dimension by phonetics and the speaking centric space- Part I. Dent Dig 1951;57:261-5.
- Benediktsson E. Variation in tongue and jaw position in S sound production in relation to front teeth occlusion. Acta Odontol Scand 1958;15:275-303.
- 12. Danborno B, Adebisi S, AdelaiyeA et al. Estimation of height and weight from the lengths of second and fourth digit in Nigerians. The Internet Journal of Forensic Science 2009;3(2):1-4.
- Ciftçi Y, Kocadereli I, Canay S et al. Cephalometric evaluation of maxillo mandibular relationships in patients wearing complete dentures: a pilot study. Angle Orthod 2005;75:821-25.
- 14. Zeng JY, Yuan YS and Ma LA. Pilot study on jaw relation of edentulous patients with digital cephalometric system. Zhonghua kou Qiang Yi Xue Za Zhi 2003;38:113-15.
- 15. Pinto AS, Mollo FA, Melo ACM et al. Use of cephalometric cephalograms in the evaluation of prosthetic treatment. Ortodontiae Ortopedia Facial 2000;5 (abstract).
- Tallgren A. The continuing reduction of the residual alveolar ridges in complete denture wearers. J Prosthet Dent 1972;27:120-32.

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- Orthlieb JD, Laurent M and Laplanche O. Cephalometric estimation of vertical dimension of occlusion. J Oral Rehabil 2000;27:802-7.
- Bhat VS and Gopinathan M. Reliability of determining vertical dimension of occlusion in complete dentures. JIPS 2006;6:38-42.
- Glossary of Prosthodontics terms (8thed). J Prosthet Dent 2005;94:10-85.