

DENTIN
JURNAL KEDOKTERAN GIGI
Vol VII. No 1. April 2023

**CORRELATION BETWEEN VERTICAL DIMENSION OF OCCLUSION AND
 ANTHROPOMETRY OF FINGER LENGTH
 (Literature Review)**

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ABSTRACT

Background: Determining the Vertical Dimension of Occlusion (VDO) was one of the procedures required to create a complete denture. VDO was the height of the lower third of the face that connected the distance between the subnation point found in the craniofacial and the gnation point on the mandible. The methods in determining VDO were very diverse, but there were no methods that considered as highly accurate presently. Hence, several methods of determining VDO were needed to obtain more accurate results. The finger length anthropometry method was a method that has been widely used as an alternative method in determining VDO because it was considered accurate, not invasive, cheap, and easy to implement.

Objective: This study aimed to determine the correlation between the vertical dimensions of occlusion and the anthropometric length of fingers. **Material and Method:** The study was conducted by using the literature review method with the narrative review procedure. Research using Google Scholar, Science Direct, PubMed, and Semantic Scholar. **Results:** The results of the study of 22 articles reviewed had a positive correlation between VDO and all lengths of the fingers of the hand. The finger that had the strongest correlation with VDO in males was the index finger ($r=0.804$) and in females was the little finger ($r=0.937$). **Conclusion:** All fingers could be used as an alternative method in determining the Vertical Dimension of Occlusion.

Keywords: Anthropometry, Finger length, Vertical Dimension of Occlusion

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INTRODUCTION

Teeth loss is a dental and oral problem that often occurs mainly due to age.^{1,2} Loss of teeth caused discomfort that could interfere in various daily life aspects such as talking, eating, socialization and self-confidence.³ According to Basic Health Research (Riskesmas/ Riset Kesehatan Dasar) of the Ministry of Health of Indonesia in 2018, the prevalence of the Indonesian population who experienced the loss of all their teeth was 1.3%.⁴ The loss of all teeth can be corrected by using prosthodontic treatment of making complete dentures to restore the function of the oral cavity and the level of confidence in daily activities.^{2,5,6}

The success of the complete denture treatment must be preceded by several procedures, one of them is determining the Vertical Dimension of

Occlusion (VDO). VDO is the vertical relation between the maxilla and the mandible at centric occlusion. The determination of VDO is very important in making a complete denture. VDO can be determined using conventional methods which are divided into mechanical and physiological methods. The mechanical method is a method which measurement does not require functional movement and uses simple mechanical measuring instruments, while the physiological method is a method that measures when the jaw is doing a biting movement.^{7,8}

While the mechanical method includes facial, previous denture, and pre-extraction record measurements, the physiological method uses bite rim, physiological rest positioning, and perception of patient comfort. The mechanical method by

using facial measurement measures VDO from the subnasion point to the gnathion. In addition to that, it is a method which widely used in clinical practice. The facial measurement method still has the disadvantage of determining landmark points on the skin of the face. Hence, it allows errors to occur in determining VDO.^{7,8,9}

Determining VDO is not easy because there are still often various measurement errors found. For example, the vertical dimensions of VDO are too high or too low due to the difficulty of determining the point to be used in measurement; resulting the denture becoming uncomfortable. To get an accurate result, it is recommended to use several VDO measurement methods. Therefore, an anthropometric method using human body measurements can be used as an alternative method in determining VDO.^{7,8,9}

Anthropometric methods are used as an alternative method in determining VDO including anthropometry of the length of fingers, the landmark points of the face, and the length of the auricle. The anthropometric method uses the length of fingers as a method that currently most developed in research as an alternative to determining VDO. It is relatively easier to do and easier to determine the reference point, therefore it helps if there are difficulties in measuring VDO using facial measurements. Wrist radiograph has also been widely used for the examination of the growth of dentofacial structures as an indicator of bone skeletal maturity and ossification of carpal, metacarpal, and phalangeal bones. Examination of bone maturity is usually based on the degree of unification of the epiphysis of the ulna and radius bone.^{7,8}

Research conducted by Bhandari, et al (2012), has revealed a strong correlation between VDO and the length of the little finger in both males and females. Similar results have been found in a study conducted by Ladda, et al (2013), which stated that there is a strong correlation between VDO and the length of the male's index finger and the little finger of females.^{10,11} Furthermore, previous studies have found that there is a correlation between VDO and anthropometric length of the fingers, but each study uses different fingers. Therefore, researchers are interested in conducting this literature study because there are no literature studies that summarize which finger has the strongest correlation with the vertical dimension of occlusion.

MATERIAL AND METHODS

Literature review used as the research method of this study, which was a search or research to produce writings about a certain topic or issue with a narrative review procedure. This data collection technique was carried out using secondary data.

This method was carried out by reviewing, analyzing, evaluating, and summarizing scientific material on a particular topic that had been written based on the arguments of experts.^{12,13}

Literature searches were conducted using Google Scholar, PubMed, ScienceDirect, and Semantic Scholar with keywords: dimensi vertikal oklusi, *occlusal vertical dimension*, antropometri, panjang jari tangan, and "*finger length*" as well as those related to these keywords. The age of the subjects used was around eighteen years old to sixty years old. The inclusion criteria of this study are sources in Indonesian and English languages which were published between 2012-2021 that could be accessed in full text. The independent variable in this literature study was the anthropometry of the finger length, while the dependent was the vertical dimension of occlusion.

As a result, 22 articles were obtained that matched the inclusion criteria. The analysis was carried out by comparing the value of the correlation coefficient in each article and taking the highest value.

RESULT

The results of the Pearson and Spearman correlation test showed that there was a correlation between VDO and anthropometric of finger length. The following table is the results of the finger that correlates with VDO:

Table 1. Male finger correlation with VDO

Fingers	p-value	r-value
Thumb	0,001*	0,687
Index Finger	0,05*	0,804
Middle Finger	0,05*	0,363
Ring Finger	0,086	0,319
Little Finger	0,05*	0,788

*Statistically significant

Table 1 showed that the thumb, index finger, middle finger, and little finger had a significant correlation with VDO, while the ring finger has no correlation with VDO. The finger that had the strongest correlation with VDO in males was the index finger with a value of $r=0,804$.

Table 2. Female finger correlation with VDO

Fingers	p-value	r-value
Thumb	0,001*	0,538
Index Finger	0,05*	0,819
Middle Finger	0,412	0,155
Ring Finger	0,05*	0,320
Little Finger	0,05*	0,937

*Statistically significant

Table 2 showed that the thumb, index finger, ring finger, and little finger had a significant correlation with VDO, while the middle finger had no correlation with VDO in females. The finger that had the strongest correlation with VDO in females was the little finger with a value of $r=0,937$.

The results of a review showed that there was a significant correlation between VDO and anthropometric length of the fingers. Five articles stated that the finger that had the strongest correlation with VDO in males was the index finger. Six articles stated that the finger that had the strongest correlation with VDO in females was the little finger.

DISCUSSION

The results of the review stated that the fingers had a positive correlation with VDO. The conclusion of the 22 articles was obtained by the researcher's way of looking at the value of the correlation coefficient from the correlation test. The results of the conducted correlation test stated that the finger that had the strongest correlation with VDO in males was the index finger ($r= 0.804$) which meant it was sturdy and was carried out in the Indian population. The finger that had the strongest correlation with VDO in females was the little finger ($r= 0.937$) which meant it was sturdy and was carried out in the Pakistan population.

The conducted research proved that the results obtained were also influenced by gender and race in a population. This is related to the research conducted by Ladda et al (2013), that sex could affect body anthropometry based on the sexual theory of dimorphism which was a characteristic of physical differences that was influenced by post-puberty androgen hormones.¹¹ The results of those studies influenced by population are related to the

result by Abeysekera and Shahnava which different populations would produce different anthropometry.¹⁴

Some of the reviewed articles stated that VDO was the height of the lower third of the face that connected the distance between the subnasal point found in craniofacial and the gnathion point on the mandible.⁷ The success of making complete dentures was strongly influenced by the vertical dimension of occlusion. It was explained in a study by Bajracharya et al (2017), that VDO can be affected by mandibular ramus length, gonial angle, and teeth eruption. These factors can be influenced by race, gender, nutritional intake, and the type of food consumed during the period of growth and development.¹⁵

The size of VDO was also influenced by the length of the ramus, the gonial angle of the mandible, and the eruption of the teeth. Mandibular ramus continued to grow when the growth process was still ongoing. Changes in ramus length affect the height of the anterior face and VDO. The eruption of the teeth was also a factor that could affect VDO because it served to maintain occlusal contact. Variations in tooth eruptions can affect the height of the lower face.⁷

That being said, VDO could be determined using several methods. It was explained in a study by Ladda et al (2013), that no method has been considered the most appropriate for determining VDO. Research by Chairani & Rahmi (2016), explained that there were several difficult factors in determining VDO, which was difficult to determine facial landmark points because there were changes caused by psychological and pathological factors. Therefore several measurement methods were needed to obtain more accurate VDO measurement results.^{7,11} The finger length anthropometry method is a method that is widely used to determine VDO presently. Measurements of the length of fingers were measured on the palmar aspect from the fingertip to the farthest point on the digital palmar fold with the hand being supination. Based on research conducted by Ladda et al (2013) and Chotimah et al (2020), the use of finger length anthropometry as a method of determining VDO was also based on the theory popularized by Leonardo da Vinci that the growth of human body parts occurs in proportion to each other. The length of the fingers could be influenced by several factors, including gender, age, and race.^{11,16}

The difference in outcomes between the male and female sexes was due to a characteristic, namely sexual dimorphism. Research by Ladda et al (2013), stated that sexual dimorphism was characterized by the dimensional changes in the part of the tissues caused by sex differences and the level of exposure to post-puberty androgen hormones.

This dimensional change results in systemic differences such as size, shape, color, height, and appearance between males and females. Research by Chairani & Rahmi (2016), stated that dimensional changes can be found due to sexual dimorphism, which was characteristic of the bone, where the skull of males was found to be more prominent than females. The dimensional changes could also affect the acceleration of hand bone growth (adolescent growth spurt). Hand bone growth in males lasted longer than in females so the length of the fingers in males tended to be longer and greater than in females.^{7,11}

The length of the fingers was also affected by a person's age because the ossification of the hand bone continued to change during the growth period. Research by Chairani & Rahmi (2016), explained that the post-puberty phase in females occurs around 15-17 years while in males around 16-19 years. Examination of bone maturity in this phase is based on the degree of unification of the epiphysis of the ulna and radius bone. All carpal, metacarpal, and phalangeal bones had been perfectly developed. Therefore, previous studies about the correlation between VDO and fingers were carried out on people over 18 years who completed the growth and development period.^{7,11} The most carried out samples of the research were mostly around 18-30 years, so the use of finger length anthropometry as an alternative method in determining VDO at that age could be used. People with elderly could also be used, this had been proven in a study by Helal & Hasan (2016), that there was a correlation between VDO and index finger in subjects with complete teeth loss around 52-60 years. It was stronger compared to the correlation between VDO and index finger in subjects with complete teeth around 19-21 years.¹⁷

Variations in the dimensions of the human body could also occur due to the influence of race and ethnic groups because they had different gene pools. The study conducted by 22 articles that were reviewed used samples taken from 7 different populations, including the populations of India, Indonesia, Iran, Pakistan, Arabia, Peru, and Africa. The results which were shown from the study were different depending on the population taken. The results of a study by Saxena (2019), conducted on the Indian population found that the correlation between VDO and index finger length in males had a value of $r = 0.194$ which meant weak. While the research that was conducted on the population of Pakistan by Hussain & Yazdanie (2019), stated that the correlation between VDO and index finger in males had a value of $r = 0.745$ which meant strong.^{18,19}

Research conducted on one population did not rule out the possibility of producing different

results. This could be seen in the differences found in the research conducted by Munshi et al (2020) and Hussain & Yazdanie (2019) on the Pakistan Population. The study conducted by Munshi et al (2020), stated that the correlation between VDO and index fingers in males had a value of $r = 0.234$ which meant weak, while a study conducted by Hussain & Yazdanie (2019), stated that the correlation between VDO and index fingers in males had a value of $r = 0.745$ which meant sturdy. These differences could occur due to differences in race, habits, nutrition, economy, and marriages that had been carried out.^{19,20}

The correlation between VDO and anthropometry of finger length could be proven from the results of previously conducted studies. Research by Nazir S et al (2015), showed that there was a correlation between VDO and thumb with $r = 0.536$ in males and $r = 0.126$ in females.⁸ Research by Vare SS et al (2021), conducted on Coastal Andhra population India, had also conducted a study on the correlation between VDO and thumb which stated that there was a strong correlation between thumb and VDO with a correlation coefficient of 0.662.²¹ Research conducted by Khanehzad M et al (2018) on Iranian population also stated that there was a correlation between VDO and thumb length with a correlation coefficient value 0.291.²² The value in the previous studies could show a correlation between VDO and the thumb. Therefore the thumb could be used as an alternative method for determining VDO.

Research conducted by Hussain & Yazdanie (2019), showed that there was a correlation between VDO and index finger length with a value of $r = 0.745$ in males and $r = 0.819$ in females in the Pakistan population.¹⁹ In addition, Research conducted by Sambath K et al (2019) in India also stated that there was a strong correlation between VDO and index finger with a value of $r = 0.682$.²³ Both studies stated that there was a correlation between VDO and the length of the index finger. Therefore, the index finger could be used as an alternative method for determining VDO.

Research conducted by Torres et al (2020) in the Peruvian population regarding the correlation between VDO and the length of the fingers, obtained the result that there was a correlation between VDO and the length of the middle finger with a correlation coefficient value of 0.31.²⁴ Research by Nazir S et al (2015) also obtained results of a correlation between VDO and the length of the middle finger in males with a value of $r = 0.363$.⁸ Both studies stated that there was a correlation between VDO and the length of the middle finger. Therefore, the middle finger could be used as an alternative method for determining VDO.

Research which was conducted by Alhajj NM et al (2016), showed that there was a correlation between VDO and the length of the ring finger with a value of $r = 0.320$.²⁵ The study proved that there was a correlation between VDO and the length of the ring finger. Therefore, the ring finger could be used as an alternative method for determining VDO.

Research by Nazir S et al (2015), showed that there was a correlation between VDO and little fingers with $r = 0.569$ in males and $r = 0.895$ in females.⁸ Research conducted by Rahmi E (2020) in the Indonesian Chinese population stated that there was a very strong correlation between VDO and the length of the little finger with a correlation coefficient value of 0.852.²⁶ Research conducted by Shah R et al (2017) in the Indian population also stated that there was a correlation between VDO and the length of the little finger with the value of r in males 0.375 and in females 0.550.²⁷ The studies had proven that the length of the little finger could be used as an alternative method of determining VDO because it correlated with VDO.

Based on the research that has been carried out, it can be concluded that there was a positive correlation between VDO and anthropometry of finger length. Therefore, anthropometry of finger length can be used as an alternative method in determining VDO.

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