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**COMPARISON OF FREEWAY SPACE DISTANCE OF WILLIS METHOD WITH
DIGITAL PHOTO ANALYSIS METHOD IN BANJAR TRIBE**

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ABSTRACT

Background: The face's vertical dimension or vertical height is the distance between two anatomical points, namely the points on the maxilla and mandible. In measuring the vertical dimension, vertical dimensions of rest (DVR) and vertical dimensions of occlusion (DVO) must be measured. The difference between the vertical dimension of rest (DVR) and the vertical dimension of occlusion (DVO) is called the freeway space (FWS) or interocclusal distance. Freeway space is a key requirement for optimal comfort and function of a partial or complete denture. Each individual's freeway space distance is the movement of muscle function, which can be measured by direct methods such as the Willis method using calipers and the digital photo analysis method using computer software. Two measurement methods can be used to measure freeway space distance direct and indirect. **Purpose:** To analyze the difference between freeway space distance measured by the Willis method and by digital photo analysis of Adobe Photoshop and Corel Draw graphic design software in the Banjar tribe (a review of students at the Faculty of Dentistry, Universitas Lambung Mangkurat Banjarmasin). **Methods:** This study is a quantitative study with an analytic observational method and a cross-sectional approach. This study was conducted by collecting data simultaneously at one time by comparing three different methods on the same sample without being given any treatment. **Results:** One Way ANOVA test is 0.296 ($P > 0.05$) which means there is no significant difference. **Conclusion:** There is no significant difference between the results of measuring freeway space distance using the Willis method with a digital caliper and digital photo analysis with Adobe Photoshop and Corel Draw software.

Keywords: Digital Photos, Freeway Space, Vertical Dimension of Occlusion (DVO), Vertical Dimension of Rest (DVR), Willis Method.

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INTRODUCTION

Tooth loss is something that can disrupt many activities in the oral cavity.¹ According to basic health research data (RISKESDAS) of South Kalimantan in 2018, the percentage of people in Banjarmasin city who experienced tooth loss was 14.10% and the percentage in South Kalimantan was 17.84%. The percentage of people in Banjarmasin city who installed dentures was 1.42% and the percentage in South Kalimantan was 3.28%.²

When making a denture, missing teeth can be replaced. Vertical dimensions that are too large can cause the denture to be unstable and cause disruption of the temporomandibular joint, while vertical dimensions that are too small can cause disruption of masticatory function.³

The vertical dimension must be considered. The

face's vertical dimension or height is the distance between two anatomical points. Namely, points on the maxilla and mandible.^{1,3} In measuring the vertical dimension, it is divided into two measurements: the vertical dimension of rest (DVR) when relaxed or when saying the letter "m" and the vertical dimension of occlusion (DVO) when in occlusion.³ The difference in distance between the vertical dimension of rest (DVR) minus the vertical dimension of occlusion (DVO) is called the freeway space (FWS) or interocclusal distance.^{4,5,6}

Freeway space is a crucial requirement for comfort and optimal function of a partial or complete denture. Freeway space is a vital requirement for the comfort and optimal function of a partial or complete denture.⁶ The distance of each individual's freeway space is a movement of muscle function, which can be

measured by direct methods such as the Willis method using a calliper. The advantages of this method are that the results are more accurate, stable, and easy to do, while the disadvantages of this method are that if the measurement is not careful, the tool can injure the patient's facial skin surface.^{7,8,9}

The distance of a person's freeway space can also be measured by indirect methods from the media of digital photos of the patient's face, which can be measured by analyzing using some digital software from computers such as Adobe Photoshop and Corel Draw.^{10,11}

Adobe Photoshop is software that is generally used to edit bitmap-based photos, which are photos formed by several points and if the photo or image is enlarged it will look broken.¹⁰ Corel Draw is also software that can be used to measure the vertical dimensions of digital photos. This software is generally used to edit images or photos, but this software can also measure certain points on the face with vector-based, which is an image formed by lines and curves, if the photo or image is enlarged it will not look broken.^{11,12}

The measurement method of the vertical dimension of occlusion (DVO) and the vertical dimension of rest (DVR) has been carried out by Chintami et al. (2016) to get different results, namely for the measurement results of the vertical dimension of occlusion (DVO) and the vertical dimension of rest (DVR) there is a difference in the distance of freeway space between direct measurement methods and digital photo analysis with a distance of 56 cm taking photos analyzed using Corel Draw digital software. There is a significant difference between the freeway space value of the direct measurement method and the Willis method, which is greater than that of the digital photo analysis.⁹ In a study conducted by Wirahadikusumah et al. (2011), the results of the study stated different results from previous researchers, namely, there was no significant difference between direct measurements on the face and on digital photos with a distance in taking profile photos as far as 56 cm which were analyzed using only Adobe Photoshop digital software.¹⁰

Research conducted by Wirahadikusumah et al. (2011) stated that there were no measurements regarding the distance of the vertical dimension of rest (DVR) and the vertical dimension of occlusion (DVO) specifically categorizing the measurement results based on race or ethnicity, gender and face shape.¹⁰ Measurement of vertical dimensions based on ethnicity is proper as data from differences or variations in a group, race or tribe, which includes physical shape and morphology of the shape and size of the jaw.^{11,12}

Race or ethnicity is something that can affect the morphology of a person's jaw shape and size.¹³

The head shape of each race is also different, the Caucasoid race tends to have a dolyccephalic head shape, while the Mongoloid race tends to be brahisefalik and dolyccephalic.¹⁴ The Mongoloid race is a Malay-Indonesian sub-race that is spread across most of Indonesia, especially those located in the western and southern parts, including Sumatra, Java, Bali and Lombok.¹⁵ The Indonesian population consists of various races which are divided into three groups, namely the Proto Malay sub-race and the Deutro Malay sub-race which belongs to the Malayan Mongoloid sub-race.¹⁶ The Banjar tribe and the Dayak tribe (Proto Malay race) have a very close genetic relationship so that the physical characteristics in the form of dentocraniofacial patterns in the Banjar tribe may have similarities with other ethnic groups of the Proto Malay race and even the Deutro Malay race, unless the genetic identity is differentiated due to a uniquely formed expression where for the Banjar people the expression is accentuated by the Banjar language, river culture, and Islam.^{17,18}

This study aims to analyze the difference in freeway space distance measured by the Willis method and by digital photo analysis of Adobe Photoshop and Corel Draw graphic design software in the Banjar tribe (a review of students at the Faculty of Dentistry, Lambung Mangkurat University Banjarmasin).

METHODS

This quantitative study uses the analytic observational method and *cross sectional* approach. The Ethics Commission of the Faculty of Dentistry, Lambung Mangkurat University, declared this research ethically sound with No.117/KEPKG-FKGULM/EC/XI/2023.

This study was conducted by collecting data simultaneously by comparing three different measurement methods on the same sample without being given any treatment. This study aims to determine the comparison of freeway space distance using the Willis method and digital photo analysis using two digital software, namely Adobe Photoshop and Corel Draw, which Banjar tribe students review at the Faculty of Dentistry, Lambung Mangkurat University Banjarmasin. A sample of 36 people was obtained by the inclusion and exclusion criteria by the research criteria. The inclusion criteria in this study were complete teeth in the upper jaw and lower jaw, no missing teeth, no or have never used fixed or removable ortho treatment, no history of jaw fractures and surgical operations on the face or temporomandibular joint, Faculty of Dentistry Lambung Mangkurat University Banjarmasin students aged 18-25 years old. The exclusion criteria in this study were FKG ULM students who were unable to become respondents. This study uses a This

study uses tools and materials in the form of : Informed consent sheet, Questionnaire sheet, Camera, Digital caliper, Tripod, Ruler, Ring light, Photo backdrop cloth, Laptop or computer, Adobe Photoshop digital software, Coreldraw digital software.digital push rod and computer software in Adobe Photoshop and Corel Draw to take photos using a full frame mirrorless type camera and tripod.

The stages in taking photos and measuring the vertical dimension distance were carried out twice. First, when the sample was instructed to occlude or bite to measure the vertical dimension of occlusion (DVO) with the Willis method using a digital calliper, followed immediately by taking digital photos using a camera so as not to change the DVO position of the sample. With a photo-taking distance of 56 cm from the tip of the nose to the camera lens, as high as the position of the sample's body while sitting. Second, the researcher instructed the sample to pronounce the letter "m" to measure the vertical dimension of rest (DVR) with the Willis method using a digital calliper, followed immediately by taking digital photos using a camera so as not to change the position of the DVR from the sample, with a picture taking distance of 56 cm from the tip of the nose to the camera lens, as high as the position of the sample's body while sitting.

Calculate the freeway space distance by subtracting the vertical dimension of rest (DVR) and vertical dimension of occlusion (DVO) from direct and indirect measurements using Adobe Photoshop and Corel Draw software. All results were recorded and then processed and analyzed using SPSS.

RESULTS

Univariate Analysis

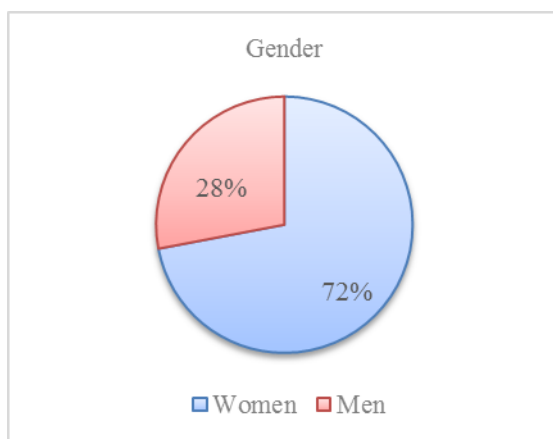


Figure 1. Characteristics of respondents based on gender

The characteristics of respondents based on the gender of FKG ULM students in this study were that the number of female respondents was more than men

with 26 female respondents (72%) and 10 male respondents (28%) with a total of 36 respondents.

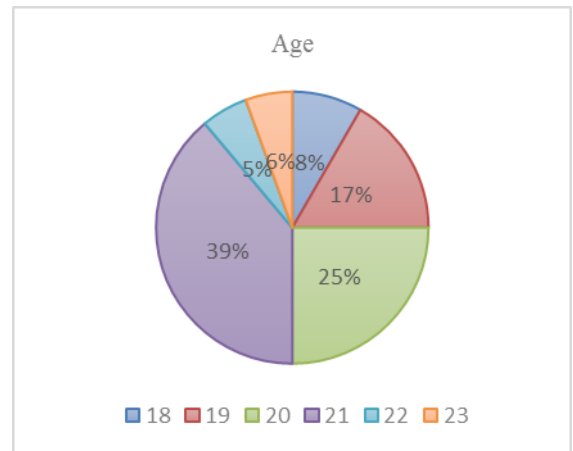


Figure 2. Characteristics of respondents based on age

The characteristics of respondents based on age from FKG ULM students in this study were aged from 18-23 years and most of the respondents in this study were 21 years old as many as 14 respondents, the youngest respondent was 18 years old as many as 3 respondents, and the oldest respondent was 23 years old as many as 3 respondents.

Bivariate Analysis

Table 1. Differences in mean freeway space distance by gender

Gender	Method		
	Willis	Adobe PhotoShop	Corel Draw
Male	2,61	2,52	2,52
Female	2,53	2,46	2,53

The mean difference in freeway space distance for males is more significant than that for females.

Table 2. The mean difference in freeway space distance by age type

Age	Method		
	Willis	Adobe Photoshop	Corel Draw
18	2,47	2,42	2,45
19	2,55	2,46	2,52
20	2,56	2,46	2,53
21	2,6	2,55	2,6
22	2,65	2,55	2,6
23	2,66	2,58	2,6

The mean difference in freeway space distance is highest at 23 years old and lowest at 18 years old.

Table 3. Table of One Way ANOVA test results of freeway space distance measurement results from direct and indirect measurement methods

Measurement Method	N	$\bar{x} \pm$ Standard Deviation	Significance Value
Willis Method	36	2,55 \pm 0,22	0,296
Adobe Photoshop	36	2,48 \pm 0,15	
Corel Draw	36	2,52 \pm 0,17	

The significance value of the One-Way ANOVA test is 0.296 ($P > 0.05$), which means that there is no significant difference in the results of measuring the distance of freeway space between direct measurement using the Willis method using a push rod and indirect measurement using the digital photo analysis method using Adobe Photoshop and Corel Draw applications.

DISCUSSION

The research results show no significant difference between the measurement of freeway space distance measured directly on the face and digital photos with a shooting distance of 56 cm. The distance of freeway space was measured directly by the Willis method using a digital calliper and indirectly by analyzing digital photos using Adobe Photoshop and Corel Draw applications. This statement is based on the research of Sari et al. (2021). The results of this study state that there is no significant difference between measuring the vertical dimensions of occlusion directly on the face and in digital photographs with a shooting distance of 56 cm, which are analyzed using Adobe Photoshop digital software.¹⁹

The freeway space distance is obtained from the reduction of the DVR value with DVO with a normal distance of 2-4 mm.¹³ In research conducted by Chintami, et al., (2016) obtained different results, namely for the measurement results of the vertical dimension of occlusion (DVO) and the vertical dimension of rest (DVR) there is a difference in the freeway space distance between the direct measurement method and digital photo analysis. The shooting distance of 56 cm was analyzed using digital Corel Draw software, with the result that there was a significant difference between the freeway space value of the direct measurement method and the Willis method which was greater than the digital photo analysis.⁹

The difference in the results of the 2 previous researchers was due to differences in taking digital photos. In the first study conducted by Chintami et al. (2016) took photos without using tools such as a cephalostat or ruler as a reference point so that the position of the sample when photographed remains the same and does not change.¹⁹ In the next study conducted by Sari et al. (2021) took photos using tools such as a cephalostat or ruler as a reference point so that the position of the sample when taking photos does not change.⁹ In this study, researchers also used tools such as a ruler as a reference and calibration so that the position of the sample did not change when taking photos. In taking photos, the shooting distance was 56 cm with the help of a tripod to reduce distortion from the shooting results.

The freeway space distance based on gender between men and women is greater than the male freeway space distance of 2.61 mm and the female freeway space distance of 2.53 mm. This is due to the physiological structure and muscle mass of men being greater than women and men having more activities than women, so they need more nutritional intake to produce energy. This happens because the chewing power in men is more significant than in women, which affects the difference in the distance between freeway space between men and women.²⁰ One of these differences comes from the characteristics of the skeleton, namely the shape of the bones and skull, which is more prominent in men than in women and is influenced by sexual dimorphism. Sexual dimorphism is a feature of post-pubertal sex-related physical differences influenced by androgenic hormones.²¹

The freeway space distance based on age obtained different results and continued to increase with the age of respondents from 18-23 years. This is because the jawbone will grow faster at the age of 18 to 21 years but will decrease at the age of 21 to 23 years. This jawbone growth will decrease so that the numerical difference is more minor, although there is still an increase in the distance of the freeway space, indicating that there is still jawbone growth.²²

Rapid mandibular growth is found in the 16 to 18 age range rather than the 18 to 20 age range. The overall growth of the lower jaw is twice as fast as the upper jaw. Growth hormones are one factor that affects bone growth; during adolescence, growth hormones are released in high amounts, and when entering adulthood, the amount of growth hormones released decreases.^{21,23} During growth, the upper and lower jaws rotate towards the anterior skull base when viewed from the side. This rotation occurs upward and forward and changes as the jaw grows, especially in the vertical plane. This growth results in more backward vertical growth than forward. This growth pattern suggests that ramus length, mandibular gonoid angle and erupted teeth affect the height or vertical

dimension of the anterior face.^{19,21}

The closest freeway space distance to direct measurement with the Willis method is indirect measurement with digital photos analyzed with the Corel Draw application. Corel Draw is a vector-based application with the advantage that the enlarged photo results will not experience rupture or blur.²⁴ The photo results are also of higher quality, making the measurements more accurate and closer to direct measurements.²⁵

The constraints of this study are that no grouping of the freeway space distance based on the type of malocclusion of the respondents has been carried out, and this research is limited to the age range of 18-25 years and only carried out on respondents who are Banjar tribe.

Based on the discussion above, it can be concluded that The average freeway space distance in the Banjar tribe reviewed by students at the Faculty of Dentistry, Lambung Mangkurat University Banjarmasin, with the direct measurement using the Willis method using a digital calliper showed a value of 2.55 mm. The average distance of freeway space in the Banjar tribe, as reviewed by students at the Faculty of Dentistry, Universitas Lambung Mangkurat Banjarmasin, with photo digital analysis using Adobe Photoshop digital software, shows a value of 2.48 mm. The average freeway space distance in the Banjar tribe, as reviewed by students at the Faculty of Dentistry, Lambung Mangkurat University Banjarmasin, with digital photo analysis using Corel Draw digital software, shows a value of 2.52 mm. There is no significant difference between measuring the distance of freeway space using the Willis method with a digital calliper and digital photo analysis with Adobe Photoshop and Corel Draw software.

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