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THE ANALYSIS OF INTERINCISAL AND VERTICAL ANGLES ON CONVEX FACIAL PROFILE ACCORDING TO STEINER (STUDY OF JAVANESE ORTHODONTIC PATIENTS IN BANYUMAS REGENCY)

ANALISIS SUDUT INTERINSISAL DAN SUDUT VERTIKAL PADA PROFIL WAJAH CEMBUNG MENURUT STEINER (PENELITIAN PADA PASIEN ORTODONTIK SUKU JAWA DI KABUPATEN BANYUMAS)

Research Report
Penelitian

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A B S T R A C T

Background: *Orthodontic treatment focuses on correcting abnormal teeth and jaw positions for better facial esthetics. Abnormal teeth can be corrected by interincisal angle, while vertical angle can determine the facial growth pattern.* ***Purpose:*** *Analyze the interincisal and vertical angles on convex facial profiles of Javanese orthodontic patients in the Banyumas Regency.* ***Method:*** *Analytical descriptive research was conducted with a cross-sectional design. A purposive sampling technique was used to obtain lateral cephalograms totaling 33 based on inclusion and exclusion criteria from three locations. The lateral cephalogram was traced using tracing paper, while the interincisal and vertical angles were measured based on Steiner's analysis. Two operators carried out measurements, starting with tracing validation and the Kappa test. Furthermore, the results were from the average measurement of the two operators.* ***Result:*** *The mean interincisal and vertical angles were 115.30° and 37.04° with a protrusive inclination and hyperdivergent face, respectively. The correlation test showed a p-value of 0.432 (p > 0.05), meaning there was no relationship between the interincisal and vertical angles in Javanese orthodontic patients.* ***Conclusion:*** *There is no relationship between the interincisal and vertical angles in the convex facial profile of Javanese orthodontic patients in the Banyumas Regency.*

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A B S T R A K

Latar belakang: Perawatan ortodonti adalah perawatan yang memiliki fokus pada perbaikan posisi gigi dan rahang yang tidak normal sehingga dapat menghasilkan estetika wajah yang lebih baik. Koreksi gigi yang tidak normal dapat dilakukan dengan memperbaiki sudut interinsisal. Pola pertumbuhan wajah dalam arah vertikal dapat ditentukan melalui besarnya sudut vertikal. **Tujuan:** Menganalisis sudut interinsisal dan sudut vertikal pada profil wajah cembung pasien ortodonti suku Jawa di Kabupaten Banyumas. **Metode:** Penelitian deskriptif analitik dengan rancangan penelitian *cross-sectional*. Sampel berupa sefalogram lateral berjumlah 33 yang diambil menggunakan teknik *purposive* sampling berdasarkan kriteria inklusi dan eksklusi dari tiga lokasi penelitian. Sefalogram lateral ditapak menggunakan kertas kalkir selanjutnya dilakukan pengukuran sudut interinsisal dan sudut vertikal berdasarkan analisis Steiner. Pengukuran dilakukan oleh dua operator dimulai dengan validasi *tracing* dan uji *Kappa* terlebih dahulu. Hasil pengukuran berasal dari rerata pengukuran kedua operator. **Hasil:** Rerata sudut interinsisal adalah 115,30° dan merupakan inklinasi protrusif. Rerata sudut vertikal adalah 37,04° dan merupakan tipe wajah hiperdivergen. Uji korelasi menunjukkan bahwa nilai *p-value* yaitu 0,432 (*p-value* >0,05) yang artinya tidak terdapat hubungan antara sudut interinsisal dengan sudut vertikal pada pasien ortodonti suku Jawa. **Kesimpulan:** Tidak terdapat hubungan sudut interinsisal dengan sudut vertikal pada profil wajah cembung pasien ortodonti suku Jawa di Kabupaten Banyumas.

Kata kunci:
Profil cembung, Suku Jawa, Sudut interinsisal, Sudut vertikal

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INTRODUCTION

Orthodontics is a dentistry science with the scope of jaw growth and development, tooth position, and complex orofacial functions (Rahardjo, 2019). This treatment aims to improve the position of teeth and jaws that are not normal, producing better facial esthetics (Rahardjo, 2019). It begins with a clinical examination and treatment plan preparation, including diagnosis and orthodontic analysis. Determining the diagnosis requires several pieces of data, such as the patient's medical history, extraoral and intraoral examinations, analysis of dental impressions, panoramic and cephalometric radiographs, and facial photographs. Data analysis used in diagnosing consists of general, local, functional, model, and cephalogram (Rahardjo, 2011).

Lateral cephalogram analysis can obtain information regarding dental, skeletal, and soft tissue characteristics (Brahmanta, 2017). It can be analyzed with various types, including Steiner, Tweed, Ricketts, Mc Namara, and other analyses. Clinicians widely use Steiner analysis in diagnosing and planning treatment because of its easy process. Steiner analysis includes dental, skeletal, and soft tissue parameters hence providing information on the relationship between the position of the jaws to the base of the cranium, the lower and upper jaws, and the inclination of the teeth in the jaws (Gayatri *et al*., 2016; Premkumar, 2015).

Orthodontic treatment consists of modification at the age of growth and development (Fields Jr *et al*., 2018). This treatment in adult patients focuses on tooth correction because the skeletal shape and pattern have not changed (Khatoon *et al*., 2018; Rahardjo, 2019) and can be carried out by correcting the interincisal angle. The intersection of the line between the long axes of the mandibular incisors measured the interincisal angle. According to Steiner, this angle's normal value is $131^{o} \pm 2^{o}$ (Premkumar, 2015). Moreover, it is one of the parameters that can affect the vertical height of the face, which is measured through the line connecting the *nasion* (N) to the *gnathion point* (Gn). Another parameter that can be used to determine changes in vertical facial height is the angle (Fields Jr *et al*., 2018; Khatoon *et al*., 2018). Vertical angles can be measured through the lateral cephalogram with Steiner analysis between the points of the *gonion* (Go), *gnathion* (Gn), *sella* (S), and *nasion* (N). The GoGn-SN angle can be used to determine facial growth patterns (Graber *et al*., 2017).

The pattern of facial growth in the vertical direction consists of hypodivergent or short faces, hyperdivergent or long faces, and neurodivergent. According to Steiner, the normal value of the GoGn-SN angle is $32^{o} \pm 2^{o}$. A GoGn-SN angle $<30^{o}$ indicates a hypodivergent face, while a GoGn-SN angle $>34^{o}$ shows a hyperdivergent face (Graber *et al*., 2017; Prasad *et al*., 2013; Yemitan, 2018). Samreen khatoon *et al*. (2018) stated that the interincisal angle could affect the vertical height of the face.

Orthodontic treatment in the form of interincisal angle correction can affect the position of the lips, nasolabial angle, and labiomental, affecting the facial profile (Agha *et al*., 2011; Lubis and Nurbayati, 2012). The protrusive inclination will occupy a larger space than the retrusive type, which causes crowded teeth (Premkumar, 2015). The facial profile is determined using the S-line, with the position of the lips in front of the line considered to have a convex profile, while the position behind is concave (Premkumar, 2015).

The *Deutro* or *Young Malay sub-race* includes the Javanese. Banyumas Regency is one of the Java lands where most of the population is Javanese (Syabira and Sahelangi, 2019). The unique physical characteristics of the *Javanese race* include having thick lips, brown skin, a nose, a chin that does not protrude, and a convex profile (Brahmanta and Revianti, 2017; Farchani, 2018). Vijan (2017) stated that inter-incisor relationships could affect vertical angles in the *Deutro Malay sub-race* in North Sumatra. The research on the relationship between the vertical and interincisal angles on the *Javaenese race* has not been carried out, therefore we would like to examine whether the interincisal relationship affects vertical angles on the convex facial profile of Javanese orthodontic patients in the Banyumas Regency.

MATERIAL AND METHOD

This is a descriptive-analytic with a cross-sectional design from March to May 2022 performed in 3 locations, namely the Prof. Dr. Margono Soekarjo, Regional General Hospital, Oral and Dental Hospital, Jenderal Soedirman University, Purwokerto Regency, and Main Clinic for Outpatient *Indonesian Red Cross* (PMI), Banyumas Regency. Furthermore, 33 lateral cephalograms of orthodontic patients in Banyumas Regency, Java, were collected using the purposive sampling method. The sample criteria included a lateral cephalogram of good quality, patients aged 20 - 40 years and the Javanese population with a convex facial profile. The patient had not undergone orthodontic treatment and a lateral cephalogram, which was taken in the 2017 - 2021 time frame.

The research started with submitting ethical clearance to the *Health Research Ethics Commission* (KEPK) Faculty of Medicine, Jenderal Soedirman University, and permits to the location to borrow orthodontic patient's lateral cephalogram archives. Two operators carried it out by validating tracing to experts (Figure 1). Tracing is performed by drawing anatomical structures, which include soft tissue, floor of the orbit, external auditory meatus, outer contour of the cranium, sella turcica, frontonasal suture, anterior and posterior nasal spines, pterygomaxillary fissures, nasal bones, and maxillary first molars as well as lower, maxillary and mandibular central incisors, occlusal surfaces, symphysis, inferior margins, and mandibular condylar process. The results are landmark points of S, N, Or, Po, A, B, PNS, ANS, Pog, and Go (Hlongwa, 2019).

The facial profile is determined through the S-line, obtained by drawing a line from the *Pog' point* to the midpoint of the lower nose border and then looking at the upper and lower lips against the line. The intersection of the maxillary and mandibular incisor axes measured the interincisal angle. Meanwhile, the vertical angle is measured through the intersection of the MP and SN lines. The MP line is drawn from point Go to Mt, while SN is from S to N (Al–Saleem, 2013; Premkumar, 2015).

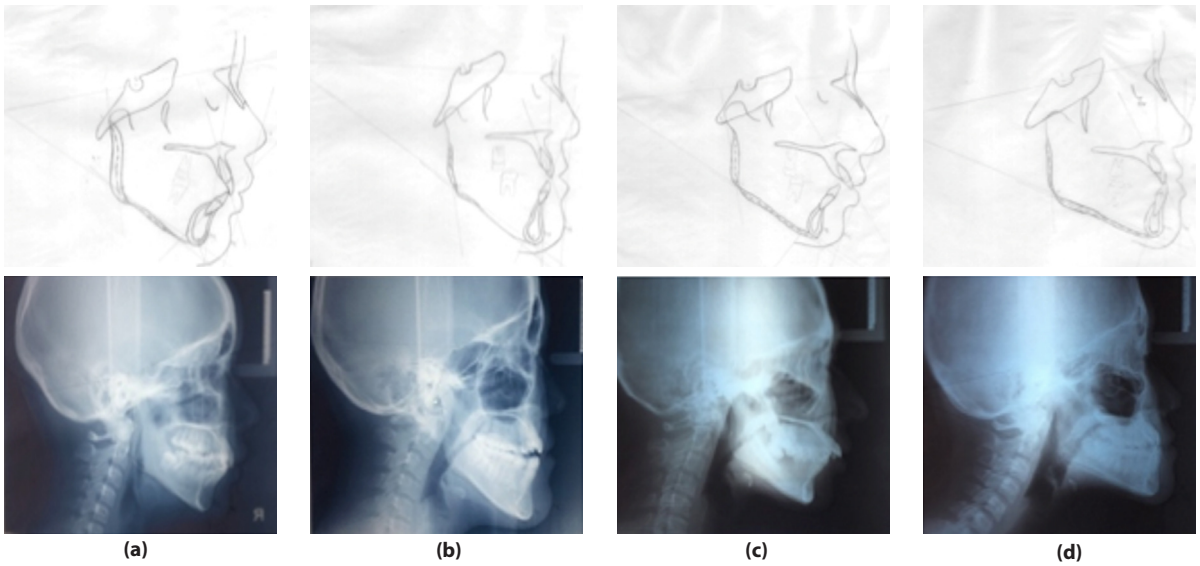

Figure 1. Tracing and cephalogram results for several validations, namely (a) First, (b) Second, (c) Third, (d) Fourth

RESULT

The *Kappa test* between the two operators showed that the measurement of the intrinsical angle was 0.748 with moderate agreement and vertical angle was 0.841 with strong agreement can be seen in Table 1.

Table 1. The results of the *Kappa test* are 2 variables

No	Variables	Score	Deal
1.	Interincisal angle	0.748	Enough
2.	Vertical angle	0.841	Strong

Source: Primary data, 2022

The frequency of patients with normal, protrusive, and retrusive inclination was 2.28 and 3 people at 6.06%, 84.85%, and 9.09%. Meanwhile, the frequency of patients with normodivergent, hypodivergent, and hyperdivergent facial types was 8.5 and 20 people at 24.25%, 15.15%, and 60.6%, respectively (Table 2). The mean value of the interincisal angle was 115.30° with minimum and maximum angle values of 92.5° and 146.5°. The average vertical angle value is 37.04° with a minimum and maximum value of 18° and 54° (Table 3).

Data from the measurement of the interincisal and vertical angles were subjected to the *Shapiro-Wilk Normality test* (n < 50). The *p-scores* for the *Normality test* and vertical angle were 0.741 and 0.914 at *p-value* >0.05 , meaning the data are normally distributed. *Pearson's* bivariate correlation test found that the *p-score* was 0.432 (*p-value* >0.05) in the relationship between the interincisal and the vertical angles. The calculated *R-score* is -0.141, which means it is smaller than the R_{table} score of 0.344 (-0.141 < 0.344). The *p-score* and *R-score* show the absence of a relationship between the interincisal and the vertical angles (Table 4).

Table 2. The results of the frequency distribution of the interincisal and vertical angles

No	Category	Interincisal angle	Vertical angle
1.	Normal	2 (6.06%)	-
2.	Protrusive	28 (84.85%)	-
3.	Retrusive	3 (9.09%)	-
4.	Normodivergent	-	8 (24.25%)
5.	Hypodivergent	-	5 (15.15%)
6.	Hyperdivergent	-	20 (60.6%)

Source: Primary data, 2022

Table 3. Results of the interincisal and vertical angles analysis

No	Variables	The mean ± SD	Min.	Max.
1.	Interincisal angles	$115.30^0 \pm 13.51^0$	92.5^0	146.5^0
2.	Vertical angles	$37.04^0 \pm 8.03^0$	18^0	54^0

Source: Primary data, 2022

Table 4. Results of the interincisal and vertical angles analysis

	Interincisal angles	
	p	R (*Pearson's*)
Vertical angles	0.432	- 0.141

Source: Primary data, 2022

DISCUSSION

Protrusive inclination, the average interincisal angle of Javanese orthodontic patients in Banyumas Regency is 115.30°. It corresponds to the physical characteristics of the Javanese, namely dental protrusion, which can cause the lips to protrude more and appear to have a convex facial profile. The Javanese come from the *Mongoloid race* with more protrusive maxillary incisors (Brahmanta and Revianti, 2017; Safitri *et al*., 2015). Research on Javanese orthodontic patients is in line with (Syabira and Sahelangi, 2019), who reported that the average interincisal angle at the Oral and Dental Hospital, Faculty of Dentistry, Trisakti University, Jakarta is 116.89°. Analysis of the Javanese is in line with the research of Syabira and Sahelangi (2019), which shows that the Javanese and the Betawi belong to the *Mongoloid race*.

Darwis and Editiawarni (2018) stated that orthodontic patients at Dustira Hospital had proclination of the upper and lower jaw teeth and a protruded lip profile. Research on Javanese orthodontic patients in Banyumas Regency aligns with Darwis and Editiawarni (2018) results. This can be caused because the Javanese and Sundanese come from the *Deutro-Malay sub-race*, with almost the same physical characteristics.

The average vertical angle of Javanese orthodontic patients in Banyumas Regency is 37.04°, a long or hyperdivergent face type. The type of face is influenced by several factors, one of which is the rotation of the mandible or the direction of growth (Fields Jr *et al*., 2018; Lall R. *et al*., 2018). There are two types of mandibular rotation, namely clockwise and counterclockwise. The rotation of the mandible clockwise is the downward and backward growth direction, which can increase the proportion of anterior facial height. Furthermore, the counterclockwise rotation is the direction of mandibular growth upwards and forwards, which can result in a reduced proportion of anterior facial height; hence, the appearance of a short face or hypodivergent facial type (Jeelani *et al*., 2016; Littlewood and Mitchell, 2020). The direction strongly correlates with anterior facial height, showing a difference in vertical facial height with clockwise and anticlockwise rotation. This causes the mandible to be one of the factors in determining the type of face (Bahrou, 2014).

Lubis and Fulvian (2021) stated that most orthodontic patients of the *Deutro Malay sub-race* at the Dental and Oral Hospital of the University of North Sumatra Medan had the majority of hyperdivergent facial types. Research on Javanese orthodontic patients in Banyumas Regency aligns with Lubis and Fulvian (2021) results. This can be caused by the Javanese and the *Deutro Malay sub-race* having the same physical characteristics, namely a hyperdivergent facial type or a long face shape.

The correlation test showed no relationship between the vertical and interincisal angles in the convex facial profile of the Javanese orthodontic patient. Tooth inclination is related to the shape of the mandibular dental arch of the lower jaw affected by the apical length of the mandibular base (Arvianti, 2015). The base is one of the factors causing crowding of the mandibular incisors and affects the size of the interincisal angle (Singh and Shivaprakash, 2017). The vertical angle of the Javanese is one of the factors that determine the type of hyperdivergent face. The magnitude is related to the mandible's downward and backward growth direction. Furthermore, the growth direction can affect the soft tissue of the chin, which tends not to stand out with a convex facial profile (Arvianti, 2015).

Plaza *et al*. (2019) stated that there was a correlation between the interincisal and the vertical angles in the *Caucasoid race*. This research shows that patients with protrusive inclinations have hyperdivergent facial types. The difference in results between Plaza *et al.* (2019) and our results can be influenced by the population used in the research. The *Caucasian race* has a flat facial profile which can be influenced by several factors, including a decrease in facial convexity. The direction of mandibular growth can influence the decrease in facial convexity.

The correlation test results between the vertical and interincisal angles align with the research of (Singh and Shivaprakash, 2017), where there is no correlation. The interincisal angle is not related to the vertical angle. Meanwhile, the angle can be affected by the location of the mandibular incisors and their relation to the mandibular plane (Oktaviona *et al*., 2014). Several parameters can influence the vertical angle besides the interincisal, namely the U1-NF and the U6-NF distance, which correspond to the occlusal plane (Khatoon *et al*., 2018; Oktaviona et al., 2014)

Research on interincisal and vertical angles shows no correlation with a convex facial profile. Determination of the Javanese facial profile in Banyumas Regency uses Steiner analysis. The facial profile is determined using the S-line, which is seen based on the position of the lips (Premkumar, 2015). One of the physical characteristics of the Javanese is thick lips which can cause the lips to protrude more (Oktaviona *et al*., 2014). Convex facial profile tends to follow hard tissue contours and thickness variations. Steiner's analysis does not pay attention to the thickness of the soft tissue; hence, the convex profile is caused by the skeletal position, protrusion inclination, and different soft tissue thicknesses (Bahrou, 2014; Darwis and Editiawarni, 2018; Gayatri *et al*., 2016).

CONCLUSION

There is no relationship between the interincisal angle and the vertical profile of Javanese orthodontic patients in the Banyumas Regency. The average interincisal angle of orthodontic patients was 115.30° and included in the category of protrusive inclination. Meanwhile, the average vertical angle is 37.4° in the hyperdivergent facial type.

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