

# Facial height proportion based on Angle's malocclusion in Deutero-Malayids

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## ABSTRACT

**Background:** Facial aesthetics are closely related to the harmonious proportions of the facial components. One of the components is facial height. The reference of facial height proportion of certain racial groups needs to be known by orthodontists and surgeons to create treatment outcomes that can be specifically designed for these particular demographics. One of the factors that can affect facial height proportion is malocclusion. **Purpose:** This study aimed to determine facial height proportion based on Angle's classification of malocclusion in Deutero-Malayids. **Methods:** This study used a descriptive cross-sectional method, which was conducted on 116 Deutero-Malayid subjects. The subjects' malocclusion was first examined using Angle's classification of malocclusion. Upper and lower facial height were then measured to determine the proportion of these dimensions. The results were then grouped based on each malocclusion class. **Results:** It was found that the upper and lower facial height proportions in the class I malocclusion group were 46.74% and 53.26% in males and 47.52% and 52.48% in females, respectively. The upper and lower facial height proportions in the class II malocclusion group were 48.46% and 51.54% in females. Upper and lower facial height proportions in the class III malocclusion group were 45.31% and 54.69% in males and 46.29% and 53.71% in females, respectively. **Conclusion:** The largest proportion of upper facial height in Deutero-Malayids was seen in the class II malocclusion group, followed by class I and class III. The largest proportion of lower facial height in Deutero-Malayids was seen in the class III malocclusion group, followed by class I and class II.

**Keywords:** Angle's classification of malocclusion; anthropometry; Deutero-Malayid; facial height proportion

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## INTRODUCTION

Malocclusion is defined as the malrelation of molars or teeth between the dental arches beyond the range of what is accepted as normal.<sup>1</sup> According to the World Health Organization, the incidence of malocclusion is third largest after caries and periodontal disease, and has rather high prevalence, ranging from 20% to 100% in different populations in the world.<sup>2-4</sup> Although malocclusion is not life-threatening, it has a negative impact on quality of life,<sup>3,5-7</sup> and for those who experience the greatest negative impact, it can result in physical pain and psychological discomfort.<sup>7</sup> Psychological discomfort is often linked with lowered self-esteem and the dissatisfaction of psychosocial well-being.<sup>8,9</sup>

Physical appearance plays a key role in self-esteem, and according to a previous study, malocclusion can affect that.<sup>8</sup>

Facial aesthetics are closely related to the harmonious proportioning of the facial components.<sup>10,11</sup> Orthodontists and surgeons have emphasised the importance of seeing the face in proportion, and this includes facial height.<sup>10,12</sup> The assessment of facial height is a part of clinical evaluation, and it is important in diagnosis and treatment planning in orthodontics.<sup>5,13,14</sup> The quantitative evaluation of soft tissue by using the anthropometric method is essential and has come to prominence currently because the evaluation of hard tissue alone often does not bring satisfactory results, and as seen clinically, soft tissue determines facial appearance.<sup>11,12,15</sup>

According to facial anthropometry, there are two types of facial height. The first one, physiognomic facial height, divides the face into the upper face (trichion-glabella), middle face (glabella-subnasale), and lower face (subnasale-gnathion). The second type, morphological facial height, divides the face into the upper face (nasion-subnasale) and lower face (subnasale-gnathion).<sup>12,16</sup> Facial height proportion has been studied and used as a guideline for treatment planning in many fields.<sup>12</sup> It can also be used to distinguish a wide variety of races or ethnic groups among populations since these groups will have different norms and facial features.<sup>14,17,18</sup>

Malocclusion can alter facial height; hence, it can affect facial proportion. For instance, a deep bite resulting from malocclusion class II division 2 will create the appearance of a short face.<sup>10</sup> In this study, the researchers seek to investigate facial height proportion in every type of malocclusion. Angle's classification of malocclusion is used since this is still widely used to determine malocclusion because of its simplicity and practicality.<sup>19,20</sup> Angle divided malocclusion into three classes based on the relationship between the maxillary and mandibular first molar. Class I describes a normal relationship between the molars, class II describes a lower molar that is distally positioned relative to the upper molar, and class III describes a lower molar that is mesially positioned relative to the upper molar.<sup>5</sup>

Ethnicity is an interesting concept in studying human variations, as different race and ethnic groups will have different gene pools that exhibit different characteristics. According to the two layers theory, there were two racial migrations to Indonesia through Asia, namely Mongoloid and Austromelanesoid. The fusion between Mongoloid and Australomelanesoid produced Proto-Malayid and the fusion between Proto-Malayid and Mongoloid produced Deutero-Malayid, which now inhabits most of Indonesia.<sup>21–23</sup> This includes ethnic groups such as the Aceh, Minangkabau, Bugis, Makassar, Sasak, Bali, Malay, Jawa, Betawi, Sunda, Madura, and Manado communities.<sup>24,25</sup>

It is important to know the reference of facial proportion of a certain ethnic group as a guideline for treatment planning.<sup>12</sup> Orthodontists and surgeons need to adjust the treatment planning based on the facial pattern that is endemic to where the individual lives to help create a natural and aesthetically acceptable facial appearance relative to the their demographic's standard.<sup>14</sup> Unfortunately, to date, there have been no available data of facial height proportion for the Deutero-Malayids. Therefore, this study was carried out to determine facial height proportion based on Angle's classification of malocclusion in Deutero-Malayids. It is hoped that the findings in this study can give an overview of facial height proportion based on Angle's classification of malocclusion and provide a reference for treatment planning in achieving the ideal facial height proportion for Deutero-Malayids.

## MATERIALS AND METHODS

This study was descriptive research with a cross-sectional design. Samples were sourced using a total sampling technique that included all the undergraduate students of the Faculty of Dentistry, Universitas Padjadjaran, specifically those who were of Deutero-Malayid descent in the 2016–2019 cohort. The number in the sample that met the criteria of this study was 116 subjects. Ethical exemption was obtained from the Research Ethics Committee of the Faculty of Medicine, Universitas Padjadjaran. The reference number is 1466/UN6.KEP/EC/2019.

The study procedure began with the collection of data by questionnaire from all dental students in order to select subjects according to the inclusion criteria, which were as follows: eligible subjects (1) were of Deutero-Malayid descent within the past two generations, (2) had Angle's malocclusion class I, II, or III, (3) had complete permanent teeth except for their third molars, (4) were 18 years or older, and (5) were willing to participate in this study. Exclusion criteria were (1) having abnormal tooth shape or size; (2) having a previous history of facial trauma and/or fracture; (3) currently undergoing (or with a history of) previous orthodontic treatment, orthognathic surgery, or dentocraniofacial surgery; (4) having a previous history of syndromic disorders' and (5) having a previous history of germinectomy.

Intra-observer and inter-observer measurements were performed on 23 students prior to measurements on all subjects to ensure the reliability of the measurement. Intra-observer measurements were carried out by an observer on 23 subjects once each day for a total of two days. Inter-observer measurements were carried out by three observers on 23 subjects once on the same day. All eligible subjects were given oral and written information regarding this research and then asked to sign an informed consent prior to the procedure, thereby confirming their agreement.

The intraclass correlation coefficient (ICC) of all data obtained was subsequently tested using IBM SPSS Statistics. The results of intra-observer measurement for the ICC with regard to the upper face and lower face measurements were 0.917 and 0.896, respectively. The results of inter-observer measurement for the ICC regarding upper face and lower face measurements were 0.982 and 0.936, respectively. Both of the tests showed excellent reliability.

Angle's classification of malocclusion was used to determine the type of the subject's malocclusion in this study. The landmarks for this study were defined as follows: (1) nasion, the sagittal midline point of the nasal root at the nasofrontal suture; (2) subnasale, the midpoint of the columella base at the apex of the angle where the lower border of the nasal septum and the upper lip meet; and (3) gnathion, the lowest median landmark on the lower border of the mandible, which is identified by palpation and is identical to the bony gnathion.<sup>11</sup>

The subject was instructed to sit in an upright relaxed position with their teeth making contact in centric occlusion. Malocclusion of the subject was determined by assessing the relationship between the maxillary and mandibular first molar. The subject was asked to keep their head straight and parallel to the ground so that the researcher could palpate and identify facial landmarks. Prior to taking the standard measurements, surface landmarks were marked on the face with a non-toxic marker. Upper and lower face height were then measured using a digital vernier caliper while the

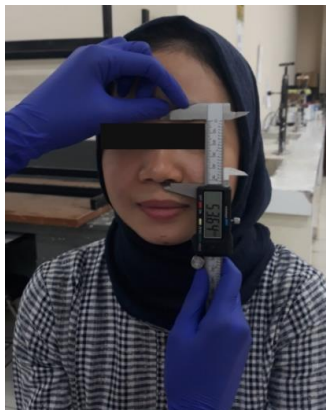


Figure 1. Measurement of upper facial height.

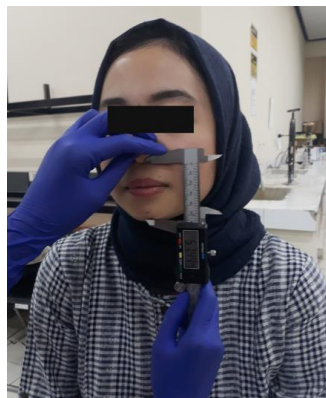


Figure 2. Measurement of lower facial height.

subject was in centric occlusion. Upper face height (UFH) was determined by measuring the distance between the nasion to the subnasale (Figure 1), and lower face height (LFH) was determined by measuring the distance between the subnasale to the gnathion (Figure 2). The sum of upper facial height and lower facial height is the total facial height. The data were subsequently computed to determine the proportion of upper facial height and lower facial height using following formula.<sup>26</sup>

$$\text{Upper face proportion} = \frac{\text{Upper facial height (UFH)} \times 100\%}{\text{Total facial height (TFH)}}$$

$$\text{Lower face proportion} = \frac{\text{Lower facial height (LFH)} \times 100\%}{\text{Total facial height (TFH)}}$$

Both facial height and facial height proportion were then grouped into class I, II, and III of Angle’s classification of malocclusion and differentiated based on sex. Data is expressed as mean ± SD. The result provided an overview of facial height proportion.

## RESULTS

Of the 626 undergraduate students in the Faculty of Dentistry, Universitas Padjadjaran, 116 met our inclusion criteria: 17 males (14.66%) and 99 females (85.34%) aged 18–23 years with an average age of 20. Table 1 shows the distribution of malocclusion in both sexes, and it was found class I malocclusion was the most common among all subjects, followed by class III, and class II malocclusion respectively.

Table 2 provides the average of facial height based on Angle’s classification of malocclusion among males

Table 1. Distribution of malocclusion in both sexes (n=116)

Molar relation	Male		Female		Total
	n	%	n	%	
Class I	13	11.21	92	79.31	90.52%
Class II	0	0	3	2.59	2.59%
Class III	4	3.45	4	3.45	6.9%
Total	17	14.66	99	85.34	100%

Table 2. Distribution of facial height based on Angle’s classification of malocclusion in both sexes (n=116)

Angle’s classification of malocclusion	Upper facial height				Lower facial height			
	Male		Female		Male		Female	
	n	mm	n	mm	n	mm	n	mm
Class I	13	57.23 ± 4.05	92	53.47 ± 3.86	13	65.22 ± 4.08	92	59.08 ± 4.23
Class II	0	-	3	54.52 ± 4.94	0	-	3	57.97 ± 4.78
Class III	4	54.92 ± 1	4	51.48 ± 2.15	4	66.38 ± 3.71	4	59.80 ± 3.94

Table 3. Distribution of upper and lower facial height proportion based on Angle’s classification of malocclusion in both sexes (n=116)

Angle’s classification of malocclusion	Upper facial height proportion				Lower facial height proportion			
	Male		Female		Male		Female	
	n	%	n	%	n	%	n	%
Class I	13	46.74 ± 2.20	92	47.52 ± 2.20	13	53.26 ± 2.20	92	52.48 ± 2.20
Class II	0	-	3	48.46 ± 3.99	0	-	3	51.54 ± 3.99
Class III	4	45.31 ± 1.56	4	46.29 ± 1.42	4	54.69 ± 1.56	4	53.71 ± 1.42

and females who were Deutero-Malayids. It was found that upper and lower facial height in all malocclusion groups were greater in Deutero-Malayid males compared to female Deutero-Malayids. Upper facial height in Deutero-Malayid males with class I malocclusion was greater than those with class III malocclusion. On the other hand, lower facial height in Deutero-Malayid males with class III malocclusion was greater than those with class I malocclusion. Deutero-Malayid females with class II malocclusion had the greatest upper facial height, followed by class I and class III malocclusion groups. Meanwhile, Deutero-Malayid females with class III malocclusion had the greatest lower facial height, followed by class I and class II malocclusion. The linear measurements from Table 2 were then used to calculate upper and lower facial height proportion and the result is shown in Table 3.

## DISCUSSION

Observing that the human face is in proportion has been emphasised as it creates a harmonious appearance.<sup>10,12</sup> Anthropometric measurement of facial height itself is an essential part of clinical evaluation and it is important in diagnosis as well as treatment planning in orthodontics.<sup>5,13,14</sup> The facial height proportion for Deutero-Malayids needs to be known as a reference. This study aimed to determine the facial height proportion in Deutero-Malayids based on Angle's classification of malocclusion and the study was done by assessing malocclusion as well as measuring the upper facial height and lower facial height of the subjects.

This study found that the lower facial height proportion in Deutero-Malayids was greater than the upper facial height proportion in all types of malocclusion class in both sexes. Given that class I malocclusion is the most common and the molar relation is considered as normal, it was found that in Deutero-Malayids, the ideal upper facial height proportion was 47.13% (46.74% in males and 47.52% in females), and the ideal lower facial height proportion was 52.87% (53.26% in males and 52.48% in females), which is slightly different to what we used to believe was the ideal proportion (45% for UFH and 55% for LFH).<sup>12,27</sup> The ideal proportion of facial height in class II and class III malocclusion has not been discussed in the previous studies. However, in this study, it was found that upper and lower facial height proportion were respectively 48.46% and 51.54% in class II malocclusion and 45.8% and 54.2% in class III malocclusion.

Previous studies have also conducted similar research on different populations. In the study that was conducted by Farkas et al.<sup>18</sup> on various ethnic groups and races, it was found that facial height proportion in Hungarian males (46.50% for UFH and 53.50% for LFH) almost resembled that of the Deutero-Malayids. However, this was very different from the African American male population, where the proportion of lower facial height (62.66%) far

exceeded the proportion of upper facial height (37.33%). The proportion of facial height in Deutero-Malayid females showed similarities to the research conducted by Farkas et al.<sup>18</sup> on Portuguese females (the proportion of UFH was 46.86% and the proportion of LFH was 53.13%) and Russian females (the proportion of UFH was 46.23% and the proportion of LFH was 53.76%), whereas this was very different from African American females, where the proportion of lower facial height (61.37%) far exceeded the proportion of upper facial height (38.62%). Another study of facial height proportion was also done by Sheikh et al.<sup>12</sup> in Bangladesh and it was found that the facial proportion of Bangladeshi males (45.32% for UFH and 54.68% for LFH) almost resembled Deutero-Malayid males. However, the facial proportion of Bangladeshi females (44.27% for UFH and 55.73% for LFH) was slightly different from Deutero-Malayid females because Bangladeshi females had an upper facial height proportion that was less than 45% and a lower facial height proportion that was more than 55%.<sup>12</sup> This result also corroborates findings by Baral et al.<sup>26</sup> regarding the Rai population in Nepal where the upper facial height proportion was smaller (43.2% in males and 43.1% in females) than Deutero-Malayids, and the lower facial height proportion (56.8% in males and 56.9% in females) was greater than Deutero-Malayids.<sup>26</sup>

Research conducted by Farkas et al.,<sup>18</sup> Baral et al.,<sup>26</sup> and Sheikh et al.<sup>12</sup> had similarities with the present study in terms of landmark points and the inclusion criteria that were used. The difference, however, was in the number of samples. Farkas et al.<sup>18</sup> had 60 subjects consisting of 30 males and 30 females, Baral et al.<sup>26</sup> had 208 subjects, and Sheikh et al.<sup>12</sup> had 500 subjects. Another difference is that these studies did not specify as a requirement the subjects' type of malocclusion.<sup>12,18,26</sup> The similarities and differences in facial height proportion between Deutero-Malayids and other populations may also be influenced by the diversification of ethnicity and genetics.<sup>10,12</sup>

The calculation of facial height proportion based on the Angle's classification of malocclusion in Table 3 shows that the proportion of upper facial height in the class II malocclusion group (48.46%) was greater than that of the class I malocclusion group (47.52%). It was also found that the proportion of upper facial height in the class III malocclusion group (45.31% in males and 46.29% in females) was smaller than the class I malocclusion group (46.74% in males and 47.52% in females). In contrast, the proportion of lower facial height in the class II malocclusion group (51.54%) was smaller than the class I malocclusion group (52.48%) and the proportion of lower facial height in the class III malocclusion group (54.69% in males and 53.71% in females) was greater than the class I malocclusion group (53.26% in males and 52.48% in females).

In the present study, the result of facial height proportion and its correlation with malocclusion are in line with the study that was conducted by Ifwandi et al. with the Aceh ethnic group. His study showed that the lower facial height proportion in class I malocclusion (52.97%) was greater

than the lower facial height proportion in class II, division 2 malocclusion (51.84%). The difference from this present study was that Ifwandi did not have Deutero-Malayid descent and a class III malocclusion group as inclusion criteria.

The difference of facial height proportion in different malocclusion groups can be a result of jaw rotation growth. Individuals with a short face who are characterised by a significantly smaller lower facial height experienced an increased internal rotation during growth, resulting in forward rotation in which the posterior growth is greater than anterior growth. This type of rotation is usually accompanied by a deep bite malocclusion, which can be seen in class II division 2 malocclusion. Individuals with a long face who are characterised by greater lower facial height have a palatal plane that rotates posteriorly downward, creating a negative inclination. This results in a backward rotation in which the anterior growth will be greater than the posterior growth. This type of rotation is usually associated with an anterior open bite malocclusion.<sup>5</sup> The association between malocclusion and facial morphology was also examined in the study conducted by Siriwat and Jarabak.<sup>28</sup> These authors conducted a cephalometric analysis on 500 cephalographs and suggested that class II malocclusion is the dominant malocclusion group in the hypodivergent growth pattern where the face tends to grow horizontally resulting in smaller lower facial height, while class III malocclusion is the dominant malocclusion in the hyperdivergent growth pattern where the face experiences downward rotation resulting in an increased lower facial height.

This study was conducted to determine the proportion of facial height based on Angle's malocclusion classification. The limitations of this study lie in the application of Angle's classification of malocclusion as a classification system. Even though it is one of the classifications that is frequently used, it still has some drawbacks. Angle only considered malocclusion in the anteroposterior plane, and there is no differentiation between dental and skeletal malocclusions. The proportion of facial height involves the dimension of the face in a vertical plane; therefore, it is necessary to examine and consider the subject's skeletal relationship. Another limitation in this study is the absence of a male sample in class II malocclusion, which meant that we were unable to identify and compare facial height proportion from that specific class. It can be concluded that the largest proportion of upper facial height in Deutero-Malayids was seen in the class II, class I, and class III malocclusion groups, respectively. The largest proportion of lower facial height in Deutero-Malayids was seen in the class III, class I and class II malocclusion groups, respectively.

## REFERENCES

- Bhullar MK, Nirola A. Malocclusion pattern in orthodontic patients. *Indian J Dent Sci.* 2012; 4(4): 20–3.
- Haralur SB, Addas MK, Othman HI, Shah FK, El-Malki AI, Al-Qahtani MA. Prevalence of malocclusion, its association with occlusal interferences and temporomandibular disorders among the Saudi sub-population. *Oral Health Dent Manag.* 2014; 13(2): 164–9.
- Tak M, Nagarajappa R, Sharda AJ, Asawa K, Tak A, Jalihal S, Kakatkar G. Prevalence of malocclusion and orthodontic treatment needs among 12-15 years old school children of Udaipur, India. *Eur J Dent.* 2013; 7(Suppl 1): S045–53.
- Zou J, Meng M, Law CS, Rao Y, Zhou X. Common dental diseases in children and malocclusion. *Int J Oral Sci.* 2018; 10(1): 7.
- Proffit WR, Fields HW, Sarver DM. *Contemporary orthodontics.* 5th ed. St. Louis: Mosby Elsevier; 2013. p. 3–114.
- Scapini A, Feldens CA, Ardenghi TM, Kramer PF. Malocclusion impacts adolescents' oral health-related quality of life. *Angle Orthod.* 2013; 83(3): 512–8.
- Neto AFC, Pinho RCM, de Sousa RV, Vajgel B de CF, Cimões R. The impact of malocclusion on quality of life and life satisfaction. *Int Med Soc.* 2017; 10(222): 1–10.
- Taibah SM, Al-Hummayani FM. Effect of malocclusion on the self-esteem of adolescents. *J Orthod Sci.* 2017; 6(4): 123–8.
- Perillo L, Esposito M, Caprioglio A, Attanasio S, Santini AC, Carotenuto M. Orthodontic treatment need for adolescents in the Campania region: the malocclusion impact on self-concept. *Patient Prefer Adherence.* 2014; 8: 353–9.
- Ifwandi, Rahmayani L, Maylanda A. Proporsi tinggi wajah pada relasi molar klas I dan klas II divisi 2 Angle mahasiswa Fakultas Kedokteran Gigi Universitas Syiah Kuala. *J Syiah Kuala Dent Soc.* 2016; 1(2): 153–60.
- Jagadish Chandra H, Ravi MS, Sharma SM, Rajendra Prasad B. Standards of facial esthetics: an anthropometric study. *J Maxillofac Oral Surg.* 2012; 11(4): 384–9.
- Sheikh MA, Chowdhury GM, Jolly F, Zaman M. An anthropometric evaluation of morphological facial height in Bangladeshi young adult. *J Armed Forces Med Coll Bangladesh.* 2014; 10(2): 33–8.
- Al-jassim NH, Fathallah ZF, Abdullah NM. Anthropometric measurements of human face in Basrah. *Basrah J Surg.* 2014; 20(2): 29–40.
- Zacharopoulos G V, Manios A, Kau CH, Velagrakis G, Tzanakakis GN, de Bree E. Anthropometric analysis of the face. *J Craniofac Surg.* 2016; 27(1): e71-5.
- Costa MCC, e Barbosa M de C, Bittencourt MAV. Evaluation of facial proportions in the vertical plane to investigate the relationship between skeletal and soft tissue dimensions. *Dental Press J Orthod.* 2011; 16(1): 99–106.
- Hall JG, Allenson JE, Gripp KW, Slavotinek AM. *Handbook of physical measurements.* 2nd ed. New York: Oxford University Press; 2006. p. 100–5.
- Ajami S, Zarif Najafi H, Mahdavi S. Angular photogrammetric analysis of the soft tissue facial profile of Iranian young adults. *Iran J Orthod.* 2015; 10(2): 1–8.
- Farkas LG, Katic MJ, Forrest CR, Alt KW, Bagic I, Baltadjiev G, Cunha E, Cvicelová M, Davies S, Erasmus I, Gillett-Netting R, Hajnis K, Kemkes-Grottenthaler A, Khomyakova I, Kumi A, Kgamphe JS, Kayo-daigo N, Le T, Malinowski A, Negasheva M, Manolis S, Ogetürk M, Parvizrad R, Rösing F, Sahu P, Sforza C, Sivkov S, Sultanova N, Tomazo-Ravnik T, Tóth G, Uzun A, Yahia E. International anthropometric study of facial morphology in various ethnic groups/races. *J Craniofac Surg.* 2005; 16(4): 615–46.
- Villada-Castro M, Rueda ZV, Botero-Mariaca PM. Level of knowledge on classification systems of malocclusions among dentists and orthodontists. *J Educ Ethics Dent.* 2017; 7(2): 37–43.
- Bugaighis I, Karanth D. The prevalence of malocclusion in urban Libyan schoolchildren. *J Orthod Sci.* 2013; 2(1): 1–6.
- Primasari A, Angelia V, Agara D. Differences in head size and shape during the growth of Deutero Malay children. *Padjadjaran J Dent.* 2019; 31(1): 53–9.
- Irsa R, Syaifullah TD. Variasi kefalometri pada beberapa suku di Sumatera Barat. *J Biol Univ Andalas.* 2013; 2(2): 130–7.
- Rieuwpassa IE, Hamrun N, Riksavianti F. Ukuran mesiodistal dan servikoinisial gigi insisivus sentralis suku Bugis, Makassar,

- dan Toraja tidak menunjukkan perbedaan yang bermakna. *J Dentomaxillofacial Sci.* 2013; 12(1): 1–4.
24. Chairani CN, Rahmi E. Korelasi antara dimensi vertikal oklusi dengan panjang jari kelingking pada sub-ras Deutro Melayu. *Maj Kedokt Gigi Indones.* 2016; 2(3): 155–63.
  25. Harahap MN. Hubungan sudut interinsisal dengan profil jaringan lunak wajah menurut analisis Holdaway pada mahasiswa FKG USU ras campuran Proto dan Deutro Melayu. *Dentika Dent J.* 2013; 17(4): 314–8.
  26. Baral P, Lobo SW, Menezes RG, Kanchan T, Krishan K, Bhattacharya S, Hiremath SS. An anthropometric study of facial height among four endogamous communities in the Sunsari district of Nepal. *Singapore Med J.* 2010; 51(3): 212–5.
  27. Rakosi T. An atlas and manual of cephalometric radiography. Great Britain: Wolfe Medical Publications; 1982. p. 71.
  28. Siriwat PP, Jarabak JR. Malocclusion and facial morphology is there a relationship? An epidemiologic study. *Angle Orthod.* 1985; 55(2): 127–38.