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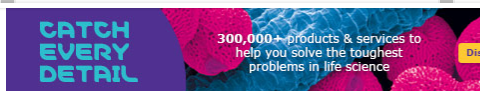
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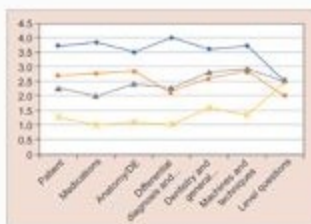
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Abstract





## ORIGINAL RESEARCH

*Eko Fibryanto, Rani R Tjin, Anastasia E Prahasti, Joko Kusnoto***Difference in Average Length of Maxillary Incisors between the Deuteromalayid and Protomalayid Sub-races**

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## Abstract

**Aim and objective:** The purpose of this study was to compare the differences in the average length of maxillary central and lateral incisors between the deuteromalayid and the protomalayid sub-race generally and differences between men and women in both sub-races. **Materials and methods:** The samples of this study were maxillary central and lateral incisors periapical radiographs of male and female patients from deuteromalayid and protomalayid sub-races in Universitas Trisakti Dental Hospital ( $n = 200$ ). Radiographic images were obtained from 50 men and 50 women in each of deuteromalayid and protomalayid aged 12–34 years, then the tooth length was measured using digital calipers (Nankai, Japan). The parallel technique of periapical radiograph was taken using the paralleling cone indicator device (Hanshin, Japan), digital dental X-ray devices (Dürr Dental Vitascan, England), and conventional dental X-ray (Veraview IX, Japan). **Results:** The average length of maxillary central and lateral incisors from the deuteromalayid and protomalayid sub-races was analyzed with an independent  $t$ -test and revealed that there were significant differences between the groups ( $p < 0.05$ ). The average length of maxillary central and lateral incisors for deuteromalayid was  $24.70 \pm 0.56$  and  $23.59 \pm 0.62$  mm, and the protomalayid was  $25.66 \pm 0.57$  and  $24.62 \pm 0.63$  mm, respectively. Based on gender, there were significant differences in the average length of maxillary central and lateral incisors between sub-races ( $p < 0.05$ ). The average length of maxillary central and lateral incisors for protomalayid men was  $26.05 \pm 0.39$  and  $25.09 \pm 0.44$  mm, and protomalayid women was  $25.27 \pm 0.42$  and  $24.15 \pm 0.41$  mm, respectively. The average length of maxillary central and lateral incisors for deuteromalayid men was  $25.06 \pm 0.39$  and  $24.04 \pm 0.44$  mm, and deuteromalayid women was  $24.33 \pm 0.47$  and  $23.14 \pm 0.42$  mm, respectively. The interclass correlation coefficients were 0.999 and 0.991 and the intra-examiner correlation were 0.75 and 0.71. **Conclusion:** The average length of the protomalayid maxillary central and lateral incisors is longer than the deuteromalayid sub-race. The men have a longer average length than women in both sub-races. **Clinical significance:** The clinical application of this study is to be used as a reference to determine the estimated working length in endodontic treatment and as a demographic data reference regarding the length of the deuteromalayid and protomalayid sub-racial teeth.



# Difference in Average Length of Maxillary Incisors between the Deuteromalayid and Protomalayid Sub-races

Eko Fibryanto<sup>1</sup>, Rani R Tjin<sup>2</sup>, Anastasia E Prahasti<sup>3</sup>, Joko Kusnoto<sup>4</sup>

## Abstract

**Aim and objective:** The purpose of this study was to compare the differences in the average length of maxillary central and lateral incisors between the deuteromalayid and the protomalayid sub-race generally and differences between men and women in both sub-races.

**Materials and methods:** The samples of this study were maxillary central and lateral incisors periapical radiographs of male and female patients from deuteromalayid and protomalayid sub-races in Universitas Trisakti Dental Hospital ( $n = 200$ ). Radiographic images were obtained from 50 men and 50 women in each of deuteromalayid and protomalayid aged 12-34 years, then the tooth length was measured using digital calipers (Nankai, Japan). The parallel technique of periapical radiograph was taken using the paralleling cone indicator device (Hanshin, Japan), digital dental X-ray devices (Dürr Dental Vitascan, England), and conventional dental X-ray (Veraview IX, Japan).

**Results:** The average length of maxillary central and lateral incisors from the deuteromalayid and protomalayid sub-races was analyzed with an independent  $t$ -test and revealed that there were significant differences between the groups ( $p < 0.05$ ). The average length of maxillary central and lateral incisors for deuteromalayid was  $24.70 \pm 0.56$  and  $23.59 \pm 0.62$  mm, and the protomalayid was  $25.66 \pm 0.57$  and  $24.62 \pm 0.63$  mm, respectively. Based on gender, there were significant differences in the average length of maxillary central and lateral incisors between sub-races ( $p < 0.05$ ). The average length of maxillary central and lateral incisors for protomalayid men was  $26.05 \pm 0.39$  and  $25.09 \pm 0.44$  mm, and protomalayid women was  $25.27 \pm 0.42$  and  $24.15 \pm 0.41$  mm, respectively. The average length of maxillary central and lateral incisors for deuteromalayid men was  $25.06 \pm 0.39$  and  $24.04 \pm 0.44$  mm, and deuteromalayid women was  $24.33 \pm 0.47$  and  $23.14 \pm 0.42$  mm, respectively. The interclass correlation coefficients were 0.999 and 0.991 and the intra-examiner correlation were 0.75 and 0.71.

**Conclusion:** The average length of the protomalayid maxillary central and lateral incisors is longer than the deuteromalayid sub-race. The men have a longer average length than women in both sub-races.

**Clinical significance:** The clinical application of this study is to be used as a reference to determine the estimated working length in endodontic treatment and as a demographic data reference regarding the length of the deuteromalayid and protomalayid sub-racial teeth.

**Keywords:** Central incisor, Deuteromalayid, Gender, Lateral incisor, Maxilla, Protomalayid, Tooth length.

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## Introduction

Knowledge of tooth length is very important to determine the working length in root canal treatment. Determination of the length of the instrument that enters the root canal during cleaning and shaping of the root canal is a crucial factor in endodontic treatment. The working length is defined as the distance from the reference point on the coronal to the final point of cleaning, shaping, and filling the root canal which is about 0.5–2 mm from the apex.<sup>1</sup> A reference about average tooth length will assist the endodontists in predicting working length before root canal treatment. Simultaneously, radiography is needed to diagnose hard tissue, determine the number, size, shape, and length of the root canal, evaluate obturation, and success of treatment.<sup>2</sup>

The references on tooth length are available previously for the Caucasian race. The average tooth length of the Caucasian race was numerous and varied. According to Ingle, the average maxillary central incisor length was 23.5 mm and the maxillary lateral incisor was 22 mm.<sup>3</sup> Grossman reported the average maxillary central incisor length of 22.8 mm and maxillary lateral incisor of 22.5 mm.<sup>4</sup> The average length of maxillary permanent central incisors in Batakese students at the Faculty of Dentistry, Sumatera Utara University, was 24.9 mm in female students and 26.3 mm in male students.<sup>5</sup> In Acehese students, the tooth length of maxillary

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permanent central incisors was 25.86 mm.<sup>6</sup> Since tooth length is influenced by races and sub-races, a study to establish the tooth length reference based on races is required.

There are only a few studies that examine the average length of anterior teeth in non-Caucasian races especially Mongoloid race in Indonesia. The purpose of this study was to compare the differences in the average length of maxillary central and lateral incisors between the deuteromalayid and the protomalayid sub-races and differences between men and women in both sub-races.



## Materials And Methods

This study is observational analytic research. The study was conducted at the Dental Hospital of Universitas Trisakti between January and December 2019. The sample of this study was periapical radiographs of male and female patients from deuteromalayid and protomalayid sub-races with two generations of vertical lineage from father and mother. The vertical lineage was confirmed through the questionnaire. Periapical radiographs of maxillary central and lateral incisors were obtained after informed consent under a protocol reviewed and approved by the Dental Research Ethics Committee, Faculty of Dentistry, Universitas Trisakti (348/S2-Sp/KEPK/FGK/5/2020). The inclusion criteria were incisive crown without fracture and attrition, completely closed roots, age 12-34 years, no root resorption, no internal and external resorption. Exclusion criteria were endodontically treated tooth, crown fractures with loss of the entire incisal, teeth that were treated with jacket crowns, teeth with root laceration, central and lateral incisors with caries on the incisors of teeth up to more than half incisal.

Two hundred subjects fulfilled the criteria and were involved in this study. The subjects were given a protective apron and the periapical radiographs were taken with parallel techniques using cone indicators (Hanshin, Japan). Radiograph image of maxillary incisors was obtained by using the digital imaging equipment (Dürr Dental Vitascan, England) and conventional dental X-ray (Veraview IX, Japan) with 70 kVp, 15 mA for 0.08 seconds. The image plate size 2 (Dürr Dental Vitascan, England) was placed vertically in the anterior bite block. The central-lateral incisor contact was centered on the plate. The plate was placed as far back into the mouth as possible so that the plate is parallel to the long axis of the tooth.

The resulting radiograph showed that the central-lateral incisors were centered in the image, and at least 2 mm of apical bones was visible above the root apex. The radiograph image was then printed with a certain scale. The tooth length was measured with digital calipers (Nankai, Japan) and carried out by two observers (radiologists). The agreement values of the observers were tested with the interclass correlation coefficient and the intra-examiner correlation test.

The normality of the data distribution was analyzed with Kolmogorov-Smirnov. The difference in average maxillary incisor length between the deuteromalayid and the protomalayid sub-races as well as in men and women in each sub-race was analyzed by an independent *t*-test. Data analysis was performed using IBM SPSS Statistics 20 software (SPSS Inc., Chicago, IL, USA), and the significance was set at 0.05.

## Results

The values of the interclass correlation coefficient for central and lateral incisors were 0.999 and 0.991 and the values of intra-examiner correlation were 0.75 and 0.71. The Kolmogorov-Smirnov test revealed that the data on maxillary central and lateral incisors were normally distributed ( $p > 0.05$ ). The independent *t*-test showed that there were significant differences in the length of the maxillary central incisor of the deuteromalayid ( $24.70 \pm 0.56$  mm) and the protomalayid sub-races ( $25.66 \pm 0.57$  mm). In addition, there were also differences in the length of the maxillary lateral incisors between the deuteromalayid ( $23.59 \pm 0.62$  mm) and the protomalayid sub-races ( $24.62 \pm 0.63$  mm). The average difference in tooth length between the two races can be seen in Table 1. The

**Table 1:** Comparison of the average length of maxillary incisors between sub-races

Tooth	Deuteromalayid (n = 100)	Protomalayid (n = 100)	p
I1 (mm)	24.70 ± 0.56	25.66 ± 0.57	<0.01*
I2 (mm)	23.59 ± 0.62	24.62 ± 0.63	<0.01*

\*Independent *t*-test ( $p < 0.05$ ); I1, maxillary central incisor; I2, maxillary lateral incisor

**Table 2:** Comparison of the average length of maxillary incisors between genders in deuteromalayid and protomalayid sub-races

Tooth		Male	Female	p
I1 (mm)	Deuteromalayid	25.06 ± 0.39	24.33 ± 0.47	0.00*
	Protomalayid	26.05 ± 0.39	25.27 ± 0.42	0.00*
	p	0.00*	0.00*	
I2 (mm)	Deuteromalayid	24.04 ± 0.44	23.14 ± 0.42	0.00*
	Protomalayid	25.09 ± 0.44	24.15 ± 0.41	0.00*
	p	0.00*	0.00*	

\*Independent *t*-test ( $p < 0.05$ ); I1, maxillary central incisor; I2, maxillary lateral incisor

length of the maxillary central and lateral incisors between the protomalayid sub-races is longer than the deuteromalayid sub-race ( $p < 0.05$ ).

The independent *t*-test analysis showed that there were significant differences in the length of the maxillary central incisors between deuteromalayid men and women ( $25.06 \pm 0.39$  and  $24.33 \pm 0.47$  mm). Likewise, there were significant differences in the length of the maxillary lateral incisors between deuteromalayid men and women ( $24.04 \pm 0.44$  and  $23.14 \pm 0.42$  mm). The length of the maxillary central and lateral incisors in deuteromalayid men was longer than in deuteromalayid women. The independent *t*-test also disclosed that there were significant differences in the length of the maxillary central incisor between protomalayid men and women ( $26.05 \pm 0.39$  and  $25.27 \pm 0.42$  mm). Likewise, there were significant differences in maxillary lateral incisor length between male and female protomalayids ( $25.09 \pm 0.44$  and  $24.15 \pm 0.41$  mm). The tooth length differences are presented in Table 2. The maxillary central and lateral incisor lengths of protomalayid men were longer than protomalayid women ( $p < 0.05$ ).

The independent *t*-test showed that there were significant differences in maxillary central incisor length between deuteromalayid and protomalayid men ( $25.06 \pm 0.39$  and  $26.05 \pm 0.39$  mm). Similarly, there were significant differences in the length of the maxillary lateral incisors between deuteromalayid and protomalayid men ( $24.04 \pm 0.44$  and  $25.09 \pm 0.44$  mm). The length of the maxillary central and lateral incisors in protomalayid men is longer than in deuteromalayid men. Analysis of the independent *t*-test also showed that there were significant differences in maxillary central incisor length between deuteromalayid and protomalayid women ( $24.33 \pm 0.47$  and  $25.27 \pm 0.42$  mm). Likewise, there were significant differences in maxillary lateral incisor length between deuteromalayid and protomalayid women ( $23.14 \pm 0.42$  and  $24.15 \pm 0.41$  mm). The lengths of maxillary central and lateral incisors in protomalayid women were longer than deuteromalayid women ( $p < 0.05$ ). The average differences in tooth length are presented in Table 2.

## Discussion

One of the guidelines for determining the average length of a tooth to establish the working length is Ingle and Grossman's measurements. Ingle's study did not distinguish the difference between genders and was merely conducted on Caucasians. It has been stated that the average lengths of the maxillary central and lateral incisors are 23.5 and 22 mm.<sup>3</sup> The other study showed that the average lengths are 23.6 and 22.5 mm.<sup>7</sup> Meanwhile, this study showed that the average lengths of central and lateral incisors in deuteromalayid and protomalayid sub-races are longer than the previous studies. The length of the maxillary central and lateral incisors varied in different racial or ethnic groups.

The previous study stated that Caucasian teeth are longer than Korean teeth.<sup>6</sup> Even though Korean and Indonesian (deuteromalayid and protomalayid) are classified as Mongoloid race, the result of this study showed otherwise. Therefore, comprehensive and sustainable research about average tooth length based on sub-races must be carried out. The data could be beneficial for demographic and forensic study in postmortem studies, such as natural disaster and plane crash.

In this study, the protomalayid group has a longer tooth length compared with deuteromalayid. It could be related to the face shape and jaw bone. The protomalayid has larger jawbones than the deuteromalayid, which affects the length of the teeth.<sup>8</sup> The previous study disclosed that large teeth are associated with larger jawbones and larger bodies. Tall individuals tend to have longer teeth than short individuals.<sup>9</sup> In addition, there are differences in the length of the root canal between populations, namely the black (Bantu), Caucasian, and Asian populations.<sup>10</sup> It can be assumed that there are variations between sexes, races, and genetics that affect the tooth dimensions. Environment and food habits can also alter the morphology and dimensions of teeth, apposition, and mineralization. Heredity plays an important role in the development of the characteristics of each individual tooth.<sup>10</sup>

According to the result of this study, both the maxillary central and lateral incisors of protomalayid men were longer than women ( $p < 0.05$ ). This is consistent with the results of a previous study which stated that the length of the maxillary permanent central incisors in men (26.3 mm) was longer than women (24.3 mm) on Batak tribe students.<sup>11</sup> Previous studies stated that there are significant differences in men and women in terms of tooth height, tooth diameter, and root length.<sup>12</sup> The Y chromosome has an effect on the development of tooth roots rather than the X chromosome so that men have longer roots than women.<sup>12,13</sup> It has also been proved that the length of the crown and roots was longer in men than women, including maxillary central incisors.<sup>6,9</sup> Hölttä et al. reported that the average tooth length of maxillary incisors in Finish men is longer than women, based on panoramic radiographic examination.<sup>14</sup>

Sexual dimorphism determines the tooth length. The presence of sexual dimorphism on tooth size differed between populations. It is influenced by genetic, epigenetic, and environmental factors that affect tooth development in each population. Environmental factors such as nutrition, disease, and weather also play a role. In humans, the masticatory apparatus plays an important role in mastication. Therefore, eating habits can affect the size of teeth. Sexual dimorphism on tooth size is strongly influenced by heredity.<sup>15</sup> The research of mapping the tooth length in all sub-races is crucial anthropologically.

In this research, the selection of samples aged 12-34 years is based on the increase in tooth wear, especially attrition. Tooth

wear increases with age and is more common in men than women. According to a national survey from 2000 to 2002, 17.4% were 12 years old, 29.7% were 15 years old, 38.1% were 16-24 years old, 7.2% were 35-44 years old and 9.3% were older, from 65 years.<sup>16,17</sup> Percentage of adults with tooth wear increased from 3% at age 20 years to 17% at age 70 years. Tooth wear significantly increases with age.<sup>18</sup>

According to Fisher, the factors that lead to various human geographical patterns in Indonesia are the ethnic and cultural invasion that lasted for centuries and the fragmentation of regions that cause the diffusion of races and cultures.<sup>8</sup> There are many races, ethnicities, languages, and cultures in Indonesia. There are two groups based on the physical characteristics of the Indonesian people namely the deuteromalayid and the protomalayid.<sup>8</sup> Protomalayids are characterized by moderate to dark skin color, curly or wavy hair, rather short, dolichocephalic face shape, narrow forehead and mandible, and short facial length. Deuteromalayids are characterized by light yellow to light brown skin with straight or slightly wavy hair, short, brachycephalic facial features, thick lips, and pug nose.<sup>19</sup>

The protomalayid and deuteromalayid sub-races are a mixture of two main races with different intensities. According to Glinka, the Indonesian population can be divided into three groups namely Protomalayid (Eastern Indonesia), Deuteromalayid (Western Indonesia), and Dayakid (Kalimantan, Jambi). The protomalayid group is thought to have inhabited Indonesian territory first while the deuteromalayid was the latest migration group to enter Indonesian territory.<sup>20</sup> The old Malayu or protomalayid group entered Indonesia around 1500 BC via the Malayu Peninsula. Their culture is often called an advanced stone culture because they used tools from mashed stones. The next wave of migration originated from the Asia mainland and is called the young Malayu group or the deuteromalayid. This group entered Indonesia around 300 BC. Their culture is more advanced than the old Malayu group because they were able to make bronze items.<sup>21</sup>

In this study, the technique used for periapical radiographs is the parallel technique. The receptor position, the tooth position, and the X-ray cone position minimize distortion and produce images in the actual anatomy.<sup>22</sup> Modifications of the parallel technique are made in delicate anatomical conditions, such as the shallow palate, bony growths, or sensitive premolar mandibular areas. Alignment between the receptor and the dental axis is difficult to achieve in patients with a shallow palate. An adjustment was done by tilting the bite block, but this caused some misalignment between the receptor and the long axis of the tooth. If this misalignment does not exceed 20°, the image can be used. However, if the misalignment exceeds 20°, it is modified by using two cotton rolls placed on both sides of the bite block.<sup>23</sup>

The observation of this research was limited to maxillary central and lateral incisors. Further studies are needed to examine the average length of maxillary and mandibular canine, premolars, and molars from both protomalayid and deuteromalayid to complete the tooth length reference of these sub-races. This study did not compare the right and the left regions because they are normally considered to have symmetrical morphologies, but further study needs to be conducted. The subjects of this study were also limited to the Batak tribe representing the protomalayid sub-race and the Javanese/Sundanese tribe representing the deuteromalayid.

## Conclusion

The length of the maxillary central and lateral incisors of the protomalayid sub-race is longer than the deuteromalayid sub-race. The length of a man's central and lateral incisors is longer than a woman's for both sub-races.

## Clinical Significance

The clinical application of this study is to be used as a reference to determine the estimated working length in endodontic treatment and as a demographic data reference regarding the length of the deuteromalayid and the protomalayid sub-racial teeth.

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# Difference in Average Length of Maxillary Incisors between the Deuteromalayid and Protomalayid Sub-races

*by* Joko Kusnoto

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# Difference in Average Length of Maxillary Incisors between the Deuteromalayid and Protomalayid Sub-races

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## Abstract

**Aim and objective:** The purpose of this study was to compare the differences in the average length of maxillary central and lateral incisors between the deuteromalayid and the protomalayid sub-race generally and differences between men and women in both sub-races.

**Materials and methods:** The samples of this study were maxillary central and lateral incisors periapical radiographs of male and female patients from deuteromalayid and protomalayid sub-races in Universitas Trisakti Dental Hospital ( $n = 200$ ). Radiographic images were obtained from 50 men and 50 women in each of deuteromalayid and protomalayid aged 12-34 years, then the tooth length was measured using digital calipers (Nankai, Japan). The parallel technique of periapical radiograph was taken using the paralleling cone indicator device (Hanshin, Japan), digital dental X-ray devices (Dürr Dental Vitascan, England), and conventional dental X-ray (Veraview IX, Japan).

**Results:** The average length of maxillary central and lateral incisors from the deuteromalayid and protomalayid sub-races was analyzed with an independent t-test and revealed that there were significant differences between the groups ( $p < 0.05$ ). The average length of maxillary central and lateral incisors for deuteromalayid was  $24.70 \pm 0.56$  and  $23.59 \pm 0.62$  mm, and the protomalayid was  $25.66 \pm 0.57$  and  $24.62 \pm 0.63$  mm, respectively. Based on gender, there were significant differences in the average length of maxillary central and lateral incisors between sub-races ( $p < 0.05$ ). The average length of maxillary central and lateral incisors for protomalayid men was  $26.05 \pm 0.39$  and  $25.09 \pm 0.44$  mm, and protomalayid women was  $25.27 \pm 0.42$  and  $24.15 \pm 0.41$  mm, respectively. The average length of maxillary central and lateral incisors for deuteromalayid men was  $25.06 \pm 0.39$  and  $24.04 \pm 0.44$  mm, and deuteromalayid women was  $24.33 \pm 0.47$  and  $23.14 \pm 0.42$  mm, respectively. The interclass correlation coefficients were 0.999 and 0.991 and the intra-examiner correlation were 0.75 and 0.71.

**Conclusion:** The average length of the protomalayid maxillary central and lateral incisors is longer than the deuteromalayid sub-race. The men have a longer average length than women in both sub-races.

**Clinical significance:** The clinical application of this study is to be used as a reference to determine the estimated working length in endodontic treatment and as a demographic data reference regarding the length of the deuteromalayid and protomalayid sub-racial teeth.

**Keywords:** Central incisor, Deuteromalayid, Gender, Lateral incisor, Maxilla, Protomalayid, Tooth length.

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## Introduction

Knowledge of tooth length is very important to determine the working length in root canal treatment. Determination of the length of the instrument that enters the root canal during cleaning and shaping of the root canal is a crucial factor in endodontic treatment. The working length is defined as the distance from the reference point on the coronal to the final point of cleaning, shaping, and filling the root canal which is about 0.5-2 mm from the apex.<sup>1</sup> A reference about average tooth length will assist the endodontists in predicting working length before root canal treatment. Simultaneously, radiography is needed to diagnose hard tissue, determine the number, size, shape, and length of the root canal, evaluate obturation, and success of treatment.<sup>2</sup>

The references on tooth length are available previously for the Caucasian race. The average tooth length of the Caucasian race was numerous and varied. According to Ingle, the average maxillary central incisor length was 23.5 mm and the maxillary lateral incisor was 22 mm.<sup>3</sup> Grossman reported the average maxillary central incisor length of 22.8 mm and maxillary lateral incisor of 22.5 mm.<sup>4</sup> The average length of maxillary permanent central incisors in Batakese students at the Faculty of Dentistry, Sumatera Utara University, was 24.9 mm in female students and 26.3 mm in male students.<sup>5</sup> In Acehese students, the tooth length of maxillary

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permanent central incisors was 25.86 mm.<sup>6</sup> Since tooth length is influenced by races and sub-races, a study to establish the tooth length reference based on races is required.

There are only a few studies that examine the average length of anterior teeth in non-Caucasian races especially Mongoloid race in Indonesia. The purpose of this study was to compare the differences in the average length of maxillary central and lateral incisors between the deuteromalayid and the protomalayid sub-races and differences between men and women in both sub-races.



## MATERIALS AND METHODS

This study is observational analytic research. The study was conducted at the Dental Hospital of Universitas Trisakti between January and December 2019. The sample of this study was periapical radiographs of male and female patients from deuteromalayid and protomalayid sub-races with two generations of vertical lineage from father and mother. The vertical lineage was confirmed through the questionnaire. Periapical radiographs of maxillary central and lateral incisors were obtained after informed consent under a protocol reviewed and approved by the Dental Research Ethics Committee, Faculty of Dentistry, Universitas Trisakti (348/S2-Sp/KEPK/FGK/5/2020). The inclusion criteria were incisive crown without fracture and attrition, completely closed roots, age 12-34 years, no root resorption, no internal and external resorption. Exclusion criteria were endodontically treated tooth, crown fractures with loss of the entire incisal, teeth that were treated with jacket crowns, teeth with root laceration, central and lateral incisors with caries on the incisors of teeth up to more than half incisal.

Two hundred subjects fulfilled the criteria and were involved in this study. The subjects were given a protective apron and the periapical radiographs were taken with parallel techniques using cone indicators (Hanshin, Japan). Radiograph image of maxillary incisors was obtained by using the digital imaging equipment (Dürr Dental Vitascan, England) and conventional dental X-ray (Veraview IX, Japan) with 70 kVp, 15 mA for 0.08 seconds. The image plate size 2 (Dürr Dental Vitascan, England) was placed vertically in the anterior bite block. The central-lateral incisor contact was centered on the plate. The plate was placed as far back into the mouth as possible so that the plate is parallel to the long axis of the tooth.

The resulting radiograph showed that the central-lateral incisors were centered in the image, and at least 2 mm of apical bones was visible above the root apex. The radiograph image was then printed with a certain scale. The tooth length was measured with digital calipers (Nankai, Japan) and carried out by two observers (radiologists). The agreement values of the observers were tested with the interclass correlation coefficient and the intra-examiner correlation test.

The normality of the data distribution was analyzed with Kolmogorov-Smirnov. The difference in average maxillary incisor length between the deuteromalayid and the protomalayid sub-races as well as in men and women in each sub-race was analyzed by an independent *t*-test. Data analysis was performed using IBM SPSS Statistics 20 software (SPSS Inc., Chicago, IL, USA), and the significance was set at 0.05.

## Results

The values of the interclass correlation coefficient for central and lateral incisors were 0.999 and 0.991 and the values of intra-examiner correlation were 0.75 and 0.71. The Kolmogorov-Smirnov test revealed that the data on maxillary central and lateral incisors were normally distributed ( $p > 0.05$ ). The independent *t*-test showed that there were significant differences in the length of the maxillary central incisor of the deuteromalayid ( $24.70 \pm 0.56$  mm) and the protomalayid sub-races ( $25.66 \pm 0.57$  mm). In addition, there were also differences in the length of the maxillary lateral incisors between the deuteromalayid ( $23.59 \pm 0.62$  mm) and the protomalayid sub-races ( $24.62 \pm 0.63$  mm). The average difference in tooth length between the two races can be seen in Table 1. The

**Table 1:** Comparison of the average length of maxillary incisors between sub-races

Tooth	Deuteromalayid (n = 100)	Protomalayid (n = 100)	p
I1 (mm)	24.70 ± 0.56	25.66 ± 0.57	<0.01*
I2 (mm)	23.59 ± 0.62	24.62 ± 0.63	<0.01*

\*Independent *t*-test ( $p < 0.05$ ); I1, maxillary central incisor; I2, maxillary lateral incisor

**Table 2:** Comparison of the average length of maxillary incisors between genders in deuteromalayid and protomalayid sub-races

Tooth		Male	Female	p
I1 (mm)	Deuteromalayid	25.06 ± 0.39	24.33 ± 0.47	0.00*
	Protomalayid	26.05 ± 0.39	25.27 ± 0.42	
	p	0.00*	0.00*	
I2 (mm)	Deuteromalayid	24.04 ± 0.44	23.14 ± 0.42	0.00*
	Protomalayid	25.09 ± 0.44	24.15 ± 0.41	
	p	0.00*	0.00*	

\*Independent *t*-test ( $p < 0.05$ ); I1, maxillary central incisor; I2, maxillary lateral incisor

length of the maxillary central and lateral incisors between the protomalayid sub-races is longer than the deuteromalayid sub-race ( $p < 0.05$ ).

The independent *t*-test analysis showed that there were significant differences in the length of the maxillary central incisors between deuteromalayid men and women ( $25.06 \pm 0.39$  and  $24.33 \pm 0.47$  mm). Likewise, there were significant differences in the length of the maxillary lateral incisors between deuteromalayid men and women ( $24.04 \pm 0.44$  and  $23.14 \pm 0.42$  mm). The length of the maxillary central and lateral incisors in deuteromalayid men was longer than in deuteromalayid women. The independent *t*-test also disclosed that there were significant differences in the length of the maxillary central incisor between protomalayid men and women ( $26.05 \pm 0.39$  and  $25.27 \pm 0.42$  mm). Likewise, there were significant differences in maxillary lateral incisor length between male and female protomalayids ( $25.09 \pm 0.44$  and  $24.15 \pm 0.41$  mm). The tooth length differences are presented in Table 2. The maxillary central and lateral incisor lengths of protomalayid men were longer than protomalayid women ( $p < 0.05$ ).

The independent *t*-test showed that there were significant differences in maxillary central incisor length between deuteromalayid and protomalayid men ( $25.06 \pm 0.39$  and  $26.05 \pm 0.39$  mm). Similarly, there were significant differences in the length of the maxillary lateral incisors between deuteromalayid and protomalayid men ( $24.04 \pm 0.44$  and  $25.09 \pm 0.44$  mm). The length of the maxillary central and lateral incisors in protomalayid men is longer than in deuteromalayid men. Analysis of the independent *t*-test also showed that there were significant differences in maxillary central incisor length between deuteromalayid and protomalayid women ( $24.33 \pm 0.47$  and  $25.27 \pm 0.42$  mm). Likewise, there were significant differences in maxillary lateral incisor length between deuteromalayid and protomalayid women ( $23.14 \pm 0.42$  and  $24.15 \pm 0.41$  mm). The lengths of maxillary central and lateral incisors in protomalayid women were longer than deuteromalayid women ( $p < 0.05$ ). The average differences in tooth length are presented in Table 2.



## Discussion

One of the guidelines for determining the average length of a tooth to establish the working length is Ingle and Grossman's measurements. Ingle's study did not distinguish the difference between genders and was merely conducted on Caucasians. It has been stated that the average lengths of the maxillary central and lateral incisors are 23.5 and 22 mm.<sup>3</sup> The other study showed that the average lengths are 23.6 and 22.5 mm.<sup>7</sup> Meanwhile, this study showed that the average lengths of central and lateral incisors in deuteromalayid and protomalayid sub-races are longer than the previous studies. The length of the maxillary central and lateral incisors varied in different racial or ethnic groups.

The previous study stated that Caucasian teeth are longer than Korean teeth.<sup>6</sup> Even though Korean and Indonesian (deuteromalayid and protomalayid) are classified as Mongoloid race, the result of this study showed otherwise. Therefore, comprehensive and sustainable research about average tooth length based on sub-races must be carried out. The data could be beneficial for demographic and forensic study in postmortem studies, such as natural disaster and plane crash.

In this study, the protomalayid group has a longer tooth length compared with deuteromalayid. It could be related to the face shape and jaw bone. The protomalayid has larger jawbones than the deuteromalayid, which affects the length of the teeth.<sup>8</sup> The previous study disclosed that large teeth are associated with larger jawbones and larger bodies. Tall individuals tend to have longer teeth than short individuals.<sup>9</sup> In addition, there are differences in the length of the root canal between populations, namely the black (Bantu), Caucasian, and Asian populations.<sup>10</sup> It can be assumed that there are variations between sexes, races, and genetics that affect the tooth dimensions. Environment and food habits can also alter the morphology and dimensions of teeth, apposition, and mineralization. Heredity plays an important role in the development of the characteristics of each individual tooth.<sup>10</sup>

According to the result of this study, both the maxillary central and lateral incisors of protomalayid men were longer than women ( $p < 0.05$ ). This is consistent with the results of a previous study which stated that the length of the maxillary permanent central incisors in men (26.3 mm) was longer than women (24.3 mm) on Batak tribe students.<sup>11</sup> Previous studies stated that there are significant differences in men and women in terms of tooth height, tooth diameter, and root length.<sup>12</sup> The Y chromosome has an effect on the development of tooth roots rather than the X chromosome so that men have longer roots than women.<sup>12,13</sup> It has also been proved that the length of the crown and roots was longer in men than women, including maxillary central incisors.<sup>6,9</sup> Hölttä et al. reported that the average tooth length of maxillary incisors in Finish men is longer than women, based on panoramic radiographic examination.<sup>14</sup> Sexual dimorphism determines the tooth length. The presence of sexual dimorphism on tooth size differed between populations. It is influenced by genetic, epigenetic, and environmental factors that affect tooth development in each population. Environmental factors such as nutrition, disease, and weather also play a role. In humans, the masticatory apparatus plays an important role in mastication. Therefore, eating habits can affect the size of teeth. Sexual dimorphism on tooth size is strongly influenced by heredity.<sup>15</sup> The research of mapping the tooth length in all sub-races is crucial anthropologically.

In this research, the selection of samples aged 12-34 years is based on the increase in tooth wear, especially attrition. Tooth

wear increases with age and is more common in men than women. According to a national survey from 2000 to 2002, 17.4% were 12 years old, 29.7% were 15 years old, 38.1% were 16-24 years old, 10% were 35-44 years old and 93% were older, from 65 years.<sup>16,17</sup> Percentage of adults with tooth wear increased from 3% at age 20 years to 17% at age 70 years. Tooth wear significantly increases with age.<sup>18</sup>

According to Fisher, the factors that lead to various human geographical patterns in Indonesia are the ethnic and cultural invasion that lasted for centuries and the fragmentation of regions that cause the diffusion of races and cultures.<sup>8</sup> There are many races, ethnicities, languages, and cultures in Indonesia. There are two groups based on the physical characteristics of the Indonesian people namely the deuteromalayid and the protomalayid.<sup>8</sup> Protomalayids are characterized by moderate to dark skin color, curly or wavy hair, rather short, dolichocephalic face shape, narrow forehead and mandible, and short facial length. Deuteromalayids are characterized by light yellow to light brown skin with straight or slightly wavy hair, short, brachycephalic facial features, thick lips, and pug nose.<sup>19</sup>

The protomalayid and deuteromalayid sub-races are a mixture of two main races with different intensities. According to Glinka, the Indonesian population can be divided into three groups namely Protomalayid (Eastern Indonesia), Deuteromalayid (Western Indonesia), and Dayakid (Kalimantan, Jambi). The protomalayid group is thought to have inhabited Indonesian territory first while the deuteromalayid was the latest migration group to enter Indonesian territory.<sup>20</sup> The old Malayu or protomalayid group entered Indonesia around 1500 BC via the Malayu Peninsula. Their culture is often called an advanced stone culture because they used tools from mashed stones. The next wave of migration originated from the Asia mainland and is called the young Malayu group or the deuteromalayid. This group entered Indonesia around 300 BC. Their culture is more advanced than the old Malayu group because they were able to make bronze items.<sup>21</sup>

In this study, the technique used for periapical radiographs is the parallel technique. The receptor position, the tooth position, and the X-ray cone position minimize distortion and produce images in the actual anatomy.<sup>22</sup> Modifications of the parallel technique are made in delicate anatomical conditions, such as the shallow palate, bony growths, or sensitive premolar mandibular areas. Alignment between the receptor and the dental axis is difficult to achieve in patients with a shallow palate. An adjustment was done by tilting the bite block, but this caused some misalignment between the receptor and the long axis of the tooth. If this misalignment does not exceed 20°, the image can be used. However, if the misalignment exceeds 20°, it is modified by using two cotton rolls placed on both sides of the bite block.<sup>23</sup>

The observation of this research was limited to maxillary central and lateral incisors. Further studies are needed to examine the average length of maxillary and mandibular canine, premolars, and molars from both protomalayid and deuteromalayid to complete the tooth length reference of these sub-races. This study did not compare the right and the left regions because they are normally considered to have symmetrical morphologies, but further study needs to be conducted. The subjects of this study were also limited to the Batak tribe representing the protomalayid sub-race and the Javanese/Sundanese tribe representing the deuteromalayid.



## Conclusion

The length of the maxillary central and lateral incisors of the protomalayid sub-race is longer than the deuteromalayid sub-race. The length of a man's central and lateral incisors is longer than a woman's for both sub-races.

## Clinical Significance

The clinical application of this study is to be used as a reference to determine the estimated working length in endodontic treatment and as a demographic data reference regarding the length of the deuteromalayid and the protomalayid sub-racial teeth.

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GENERAL COMMENTS

**Instructor**

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