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**Original article**

# Maxillary central incisor and rugae distance in angle class I and II malocclusion: a comparative study

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**ABSTRACT**

**Background:** Malocclusion can be defined as an abnormal occlusion between teeth in the same arch or in opposing arches. Malocclusion cases can be treated with orthodontic care, which can be evaluated using palatal rugae. Several studies have shown that palatal rugae have high stability, making them very suitable for use as a means of identification and evaluation in malocclusion treatment. **Purpose** of this study was to determine the difference in the distance between the first maxillary incisors and the second palatal rugae in Angle Class I and Angle Class II students of the 2015 and 2016 cohorts at the Faculty of Dentistry, Padjadjaran University. Methods: This study was an analytical cross-sectional study with a quantitative approach conducted at the orthodontic laboratory of the Faculty of Dentistry, Padjadjaran University. The sample consisted of 99 study models of 2015 and 2016 students divided into two groups, Angle Class I and Angle Class II. The measurement of the distance between the incisors and the second palatal rugae was performed three times, and the average value was taken. **Results:** Data analyzed with the t-test showed no significant difference between the two sample groups with a p-value > 0.05. **Conclusion:** There was no difference in the distance between the first incisal edge of the upper jaw and the second palatal rugae in Angle Class I and Class II classifications.

**Keywords**: angle class I malocclusion; angle class II malocclusion; palatal rugae

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## INTRODUCTION

Malocclusion can be defined as an abnormal occlusion between teeth in the same arch or in opposing arches.[1,2] The prevalence of malocclusion ranks third after caries and periodontal disease.[3,4] The prevalence of malocclusion varies greatly among countries, ranging from 11% to 93%, depending on age, race, genetics, and environmental factors such as soft foods that can cause a lack of stimulus for jaw growth.[2,3] Malocclusion cases can be treated with orthodontic care, which can be evaluated using palatal rugae.[5,6]

Primary palatal rugae are commonly used as a benchmark by researchers, but in some studies, secondary palatal rugae are a better reference point than primary palatal rugae.[7,8] Secondary palatal rugae are located in the midpalatal region, which is the point or area for analysis, where secondary palatal rugae are (X) as the anterior point that intersects with the palatine raphe.[7–9] Palatal rugae in the field of dentistry have had a significant impact, particularly for forensic identification and orthodontics.[10,11] In orthodontic research, malocclusion treatment does not show any significant changes in rugae patterns. Several studies also indicate that palatal rugae have high stability, making them highly suitable for use as a means of identification and evaluation in malocclusion treatment.[6,12,13]

Research has been conducted on the position of palatal rugae as influenced by orthodontic therapy, and it was found that the medial and lateral points of palatal rugae appear to be stable markers for the establishment of anatomical reference points in the analysis of longitudinal study models.[13,14] Dalam penelitian mereka tentang pergerakan anteroposterior gigi

geraham dan gigi seri relatif terhadap rugae palatal, ditemukan bahwa pergerakan gigi tidak memengaruhi rugae palatal pertama dan kedua, yang menunjukkan bahwa rugae ini dapat berfungsi sebagai titik referensi yang stabil. Penelitian ini tidak secara spesifik meneliti jenis maloklusi atau rentang usia.[14]

To date, no study has specifically investigated the relationship between incisors and palatal rugae in the anteroposterior direction for Angle Class I and Class II malocclusions. This gap prompted researchers to explore the difference in distance between the first maxillary incisor and the second palatal rugae in Angle Class I and Class II students in 2015 and 2016 at the Faculty of Dentistry, Padjadjaran University. This study aimed to test the hypothesis that there is no significant difference in the average distance between the first maxillary incisor and the second palatal rugae between the two classifications.

## MATERIAL AND METHOD

The method used was a cross-sectional analytical study with a quantitative approach at the Orthodontics Laboratory of the Faculty of Dentistry, Padjadjaran University. The research population was secondary data, namely the study models of students at the Faculty of Dentistry, Padjadjaran University, in 2015 and 2016. The research sample was taken from the population using purposive sampling, which is a sampling technique that uses specific criteria.

The inclusion criteria used in this study were (1) The anatomy of the study model was accurately printed, so that the occlusion of the teeth and surrounding soft tissue was clearly visible. (2) A full set of teeth up to the second molars. (3) Study models that had not undergone/were not undergoing orthodontic treatment.

The sample that met the inclusion and exclusion criteria consisted of 99 study models. The distance from the second palatal rugae to the first incisor of the upper jaw was measured using a caliper Mitutoyo with a unit of millimeters (mm) (Fig 3 and 4). The samples were measured simultaneously, and 2-3 measurements were taken from each study model, then the average value was taken. The measurements on the previous samples had been calibrated and had

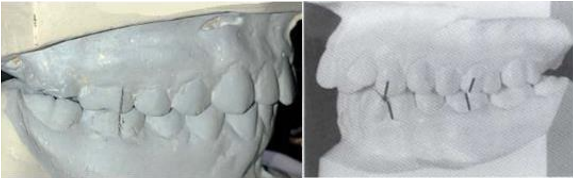


**Figure 1.** Axial line of Angle Class I malocclusion

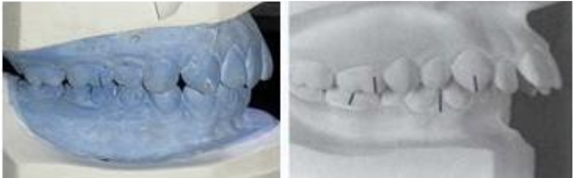
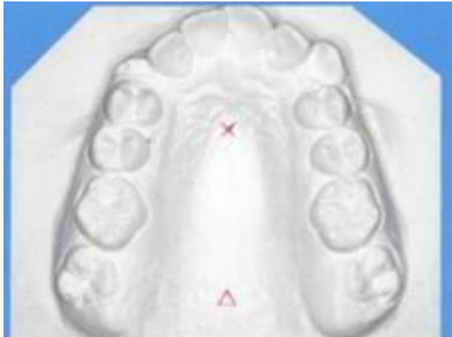
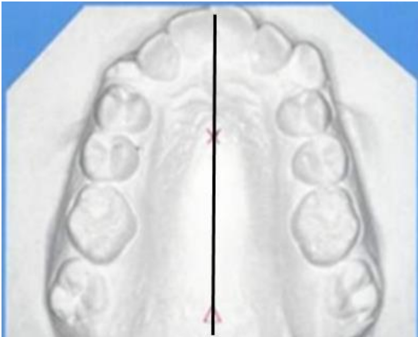


**Figure 2.** Axial line of Angle Class II malocclusion



(a)



(b)

**Figure.** 3. A) Point X is the marker used for measurement on the second palatal raphe (mid palatal raphe), B) Median line.[9]

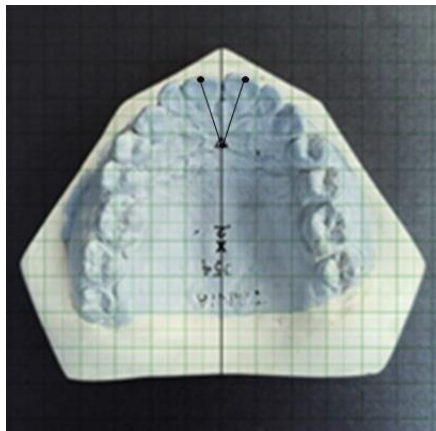


**Figure 4.** Measurements are taken from point x (mid palatal raphe) to the midpoint of the incisal edge of the incisors

obtained ethical approval no. 1061/UN6.KEP/EC/2022 from the Research Ethics Commission of Padjadjaran University. Calibration was carried out for one week by measuring 5 samples every 3 days to see if the measurement results had a difference of less than 0.1 mm. If the difference was greater than 0.1 mm, the calibration was repeated, and if the difference was not greater than 0.1 mm, the measurement process continued. Calibration was performed to ensure measurement accuracy. Data collection from the samples was conducted in October-November.

The data obtained from the measurements are in the form of average distances between two groups, namely Angle Class I and Angle Class II. This data will then be presented in tabular form and tested using a t-test, provided that the data is normally distributed. The t-test is a parametric statistical test used to test the significance or difference between one group or two groups of samples.

**Table 1.** Average measurement results

| Group | Avarage | std. dev. | n |
|---|---|---|---|
| Class I left | 16.37 | 1.94 | 73 |
| Class II left | 15.89 | 1.88 | 26 |
| Class II right | 16.05 | 1.92 | 73 |
| Class II right | 15.73 | 1.87 | 26 |
| Class I both sides | 16.21 | 1.91 | 73 |
| Class II both sides | 15.81 | 1.85 | 26 |

## RESULTS

Measurements were taken on 99 study models with 2 groups based on Angle classification: Angle Class I (Figure 1) and Angle Class II (Figure 2). The study models were measured using calipers from the center of the incisal edge of the incisors to the second palatal rugae, performed 3 times (Figure 3). Observations made in this study were divided into two parts, namely the first incisor of the upper jaw region 1 and the first incisor of the upper jaw region 2. The purpose of observing two different regions was to obtain more specific results regarding the distance to the second palatal rugae. The measurement results were then recorded in a table and averaged. The average distance of the measurement results can be seen in Table 1.

Class I left = Angle Class I malocclusion on the left side, Class II left = Angle Class II malocclusion on the left side, Class I right =

**Table 2.** T-test results

| Comparison | df | comparison | Standard differences in errors | Standard deviation of error | t | p-value (two-tailed) |
|---|---|---|---|---|---|---|
| Class I-right - Class II-right | 97 | 0.32 | 0.44 | 0 | 0.74 | 0.4632 |
| Class I-left Class II-left | 97 | 0.48 | 0.44 | 0 | 1.09 | 0.2787 |
| Class I both sides - Class II both sides | 97 | 0.40 | 0.43 | 0.00 | 0.92 | 0.3574 |

*DF: the sum of values minus the sum of mathematical restrictions.
*T: the t-value obtained from the difference between the average values of two comparative data sets.

Angle Class I malocclusion on the right side, Class II right = Angle Class II malocclusion on the right side, Class I both sides = Angle Class I malocclusion on both sides, Class II both sides = Angle Class II malocclusion on the right and left sides. *The sample in this study consisted of 279 subjects because one study model was observed in three different treatments

The next average distance was analyzed using an independent t-test. The t-test is a statistical test to see the differences between Class I-left (Class I Angle left) and Class II-left (Class II Angle left), Class I-right (Class I Angle right) and Class II-right (Class II Angle right), and Class I-right left (Class I Angle right and left) with Class II-right left (Class II Angle right and left) by comparing the two groups of average distances. The t-test results can be seen in Table 2.

Table 2 shows the p-value results of statistical tests between two groups of average distances. The p-value shows how the results of the comparison between the two measurement groups, where a p-value $< 0.05$ indicates a statistically significant test, meaning that there is a difference between the measurements. while a p-value $> 0.05$ indicates statistically non-significant results, meaning there is no difference between measurements.

The t-test on the measurements of left class I with an average of 16.37 mm compared to left class II with an average of 15.89 mm, right class I with an average of 16.05 mm compared to II-right with an average of 15.73 mm, class I-left-right with an average of 16.21 mm compared to class II-left-right with an average of 15.81 mm. All test results produced p-values $>0.05$, meaning that there were no statistically significant differences.

## DISCUSSION

The palatal rugae are parts of the mouth that will not change position even if a person experiences severe trauma or an accident.[10,12,15] The palatal rugae have high stability so that they can be used as a means of individual identification and orthodontic treatment evaluation. [5,16] Based on the results of this study conducted on 99 study models of students from the 2015 and 2016 cohorts at the Faculty of Dentistry, Padjadjaran University, there was a difference in the average distance between the first maxillary incisor and the second palatal rugae between Angle Class I and Angle Class II, but the results of the t-test showed that there was no significant difference between the two sample groups. Similar observations over a four-year period regarding incisor movement demonstrated a negligible average change in rugae position of only 0.1 mm. As this difference was found to be statistically insignificant, the medial rugae are considered reliable, stable landmarks for assessment.[17]

Cephalometric analysis comparing incisor movement to the medial and lateral rugae revealed no statistically significant differences, supporting the conclusion that palatal rugae serve as stable reference points for assessing anteroposterior tooth movement . [18] This study is further supported by previous research regarding the anteroposterior effects of orthodontic therapy, which established that palatal rugae serve as valid and stable markers for study model analysis.[13,14]

Previous findings indicate that palatal rugae patterns exhibit high stability, showing no significant alterations before and after treatment. Furthermore, these structures possess the unique ability to regenerate to their original configuration even following damage caused by chemical exposure, trauma, or disease. [5.13] Comparative research regarding Class I and Class II Division 1 malocclusions has revealed that there is no statistically significant difference in intermolar widths between the two groups.[19]

These reports show that palatal rugae have unique characteristics, distances, and patterns that differ in each individual, making them a stable reference point. [5,17,18] The results of this study show that there are no statistical differences between the two comparison groups, namely Angle Class I and Angle Class II. From the results of this study, the researchers

conclude that palatal rugae can be used as a stable marker for evaluating orthodontic treatment. This is in line with other studies that say that palatal rugae can serve as a stable marker for assessing incisor tooth movement in orthodontic treatment.

This study was conducted using a method designed to obtain accurate measurement results, but there were several factors that could influence the results, namely that the measurements were taken using calipers with human vision on the study model. Other studies examining palatal rugae typically use cephalometric radiography, but Hogan and Sadowsky found that the anteroposterior movement of molars and incisors can be assessed as accurately with a study model as with maxillary cephalometry. 18 This study, however, has been designed to ensure that measurements are as accurate as possible by calibrating and measuring each sample group three times to minimize measurement errors.

## CONCLUSION

This study shows that there is no statistically significant difference in the distance between the first maxillary incisor and the second palatal rugae between Angle Class I and Angle Class II. The second palatal rugae can be used as a reference point for evaluating orthodontic treatment in the anteroposterior direction.

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