

## SPACE ANALYSIS BY MOYERS METHOD, TANAKA-JOHNSTON METHOD, AND SITEPU METHOD IN MIXED DENTITION

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### ABSTRACT.

**Background:** The prevalence of malocclusion in Indonesia is very high, which is around 80% of the total population. Orthodontic treatment in the mixed dentition stage is the right time to minimize the occurrence of malocclusion, and it requires space analysis in advance. To predict the space required in space analysis, prediction methods can be applied, such as Moyers method, Tanaka- Johnston method, and Sitepu method. These three methods are obtained from studies with different races.

**Objective:** This research was conducted to determine the differences in the results of space analysis with the three methods.

**Methods:** Seventy-three (73) dental casts were obtained from children aged 8-12 years at SD Negeri Gubeng 1. The space available and space required was measured by these three methods. The discrepancy of these methods was calculated based on the space available and the space required. The results were statistically analyzed using Kruskal-Wallis.

**Results:** By Kruskal-Wallis test, the space analysis measurement method in maxillary arch showed no significant differences ( $p > 0.05$ ), while in mandibular arch showed significant differences ( $p < 0.05$ ). Mann-Whitney Utest on the maxillary arch showed no significant differences ( $p > 0.05$ ), while in mandibular arch was ( $p < 0.05$ ). This means that there was a significant difference between the Moyers method in mandibular arch and the Sitepu method in mandibular arch, and also between the Tanaka-Johnston method in mandibular arch and the Sitepu method in mandibular arch.

**Conclusion:** By using these three methods, the results of space analysis on mandibular arch showed a significant difference, while on maxillary arch showed no significant differences.

**Keywords:** *malocclusion, orthodontic treatment, space analysis*

### INTRODUCTION

Mixed dentition is a phase that can be found from the existence of primary and permanent teeth in the oral cavity, usually occurring at the age of 6-12 years. This period is often associated with orthodontic problems due to the insufficiency of space for permanent teeth to erupt. The prevalence of malocclusion in Indonesia is still very high, which is around 80% of the total population and is one of the main dental health issues [1]. If orthodontic treatment is needed, the treatment must be taken from the mixed dentition stage because it is the right time to prevent the occurrence of malocclusion [2].

Orthodontic treatment is often confronted with problems of space requirements so that the teeth can erupt in the right position on the arch. To determine the treatment plan regarding whether treatment is needed with a space maintainer, a space regainer, or even without treatment, a space analysis is required in advance. Space analysis is a measurement of the space available in the arch and the space required for a permanent tooth to erupt. The space available is

a place in the mesial of the first permanent molar to the mesial of the first permanent molar on the other side. Meanwhile, the space required is the mesiodistal width of the permanent teeth between the mesial of the first permanent molar to the mesial of the first permanent molar on the other side in the right position[3].

In mixed dentition, not all of the permanent teeth have erupted, so to predict the space required, radiography can be used. However, the use of radiography is not always effective in predicting tooth eruption size, because it is often distorted, which will greatly affect the accuracy of the measurement results[4]. Another way to predict the tooth size is to use a certain formula. To use this formula, the mesiodistal width of the four lower insisivus permanentsis measured, then inserted into the formula. Then, the calculation result shows the mesiodistal width of permanent caninus, first premolar, and the second premolar on one side. To estimate the mesiodistal width of unerupted caninus-second permanent premolars, several prediction methods can be used[3]. The most widely used methods are the Moyers method, the Tanaka-Johnston method, and the Sitepu method[5,6].

Accurate space analysis is one of the important partsof determining a treatment plan. The accurate space analysis will produce an appropriate treatment plan so that it will give good results [4]. Space analysis in mixed dentition, its level of accuracy will be greatly influenced by the variations in tooth size [7]. Several studiesconducted previously stated that several factors affecting variations in tooth size are race and gender[8]. The Moyers, Tanaka -Johnston, and Sitepu methods were obtained from various research samples on race. The Moyers and Tanaka-Johnston methods were obtained from studiesof white North American children (Caucasoid), while the Sitepu method was from Deutero Malayu [3].Based on these descriptions, the researchers would like to find out the differences in the results of the space analysis with the Moyers method, the Tanaka-Johnston method, and the Sitepu method in mixed dentition.

## **METHODS**

Seventy-three (73) dental casts were obtained from children aged 8-12 years at SD Negeri Gubeng 1. The space available and space required was measured by three methods:the Moyers method, the Tanaka-Johnston method, and the Sitepu method. The discrepancy of these methods was calculated based on the available and space required. The results were statistically analyzed using the Kruskall-Wallis test.

## **RESULTS**

Measurements were performed on seventy-three samples in the maxillary arch and mandibular arch using three measurement methods. Those were the Moyers method, the Tanaka-Johnston method, and the Sitepu method. The results of the measurements obtained were then statistically analyzed. The first test was a normality test using Kolmogorov-Smirnov.

From the normality test that had been carried out, the results obtained from the Moyers method (in maxillary arch), the Tanaka-Johnston method (inmandibular arch), and the Sitepu method (in mandibular arch) showed the value of  $p < 0.05$ , so the data was not normally distributed. Therefore, thestatistical test that could be used was nonparametric statistical tests and then followed by the statistical test using the Kruskall-Wallistest.

By the Kruskall-Wallis test, the results of space analysis measurement by the Moyers method, the Tanaka- Johnston method, and the Sitepu method in the maxillary arch showed no significant differences ( $p > 0.05$ ), which means that the three methods did not havestatistically different results.Meanwhile, by theKruskall-Wallis test, the results of space analysis measurementby the Moyers method, the Tanaka- Johnston method, and the Sitepu method in mandibular arch showed significant differences ( $p < 0.05$ ), which mean that the three methods hadstatistically different results.

**Table 1.** Test of normality on maxillary arch and mandibular arch

Method	p Maxillary arch	p Mandibular arch
Moyers	0,011	0,072
Tanaka-Johnston	0,068	0,044
Sitepu	0,063	0,023

**Table 2. Mann Whitney U** test results of space analysis measurement results with Moyers method and Tanaka-Johnston method in maxillary arch and mandibular arch

	<b>P</b>
Maxillary arch	0.952
Mandibular arch	0.068

**Table 3. Mann Whitney U** test results of space analysis measurement results with Moyers method and Sitepu method in maxillary arch and mandibular arch

	<b>P</b>
Maxillary arch	0.068
Mandibular arch	0.009

**Table 4. Mann Whitney U** test results of space analysis measurement results with Tanaka-Johnston method and Sitepu method in maxillary arch and mandibular arch

	<b>P</b>
Maxillary arch	0.072
Mandibular arch	0.022

Furthermore, the Mann-Whitney U test was done to determine the differences in each method. The Mann-Whitney U test for the Moyers method and the Tanaka-Johnston method on the maxillary arch and mandibular arch showed no significant difference ( $p > 0.05$ ), which means the two methods did not have statistically different results. Moreover, the Mann-Whitney U test on the maxillary arch showed no significant difference ( $p > 0.05$ ), while on the mandibular arch showed ( $p < 0.05$ ), which means that there was a significant difference between the Moyers method on the mandibular arch and the Sitepu method on the mandibular arch. In addition, the Mann-Whitney U test on the maxillary arch showed no significant difference ( $p > 0.05$ ), while in the mandibular arch showed ( $p < 0.05$ ), which means that there was a significant difference between the Tanaka-Johnston method on the mandibular arch and the Sitepu method on the mandibular arch.

## DISCUSSION

Orthodontic treatment needs to be done from the mixed dentition stage to minimize the occurrence of malocclusion [2]. Space analysis of mixed dentition is an important part of orthodontic diagnosis and treatment planning. Space analysis is the space available in the arch and the space required for permanent tooth eruption in the right position. The space available can be measured directly, while the space required cannot be because some permanent teeth have not erupted. To determine the space required, it can be done through radiography or prediction methods [3].

Prediction methods that are widely used are the Moyers, Tanaka-Johnston, and Sitepu methods. These three methods resulted from research on different samples of races. Some research states that this method cannot be applied to all races. Each race has variations in tooth size and craniofacial structure which can affect the accuracy of the results if the method is

applied to other races[9]. Therefore, this study was conducted to determine differences in the results of space analysis by the Moyers method, the Tanaka-Johnston method, and the Sitepu method in mixed dentition.

Basically, the results of research from these three prediction methods obtain almost the same average results. The test analysis was performed using the Kruskal-Wallis and Mann-Whitney U tests to find out if there were significant differences between the three methods in statistics. The statistical test results from the space analysis measurement results by the Moyers and Tanaka-Johnston methods in the maxillary arch and mandibular arch showed no significant differences ( $p > 0.05$ ). This is in accordance with the theory that race is one of the factors influencing the results of the prediction method because the Moyers and Tanaka-Johnston methods were obtained from studies on samples of the same race, namely white North American children named Caucasoid [5,6].

The statistical test results from the space analysis measurement results by the Moyers-Sitepu methods and the Tanaka Johnston-Sitepu methods on the mandibular arch showed a significant difference ( $p < 0.05$ ). This is in accordance with the theory which states that race is one of the factors influencing the results of a prediction method because the Moyers and Tanaka-Johnston methods were obtained from studies of white North American children named Caucasoid, while the Sitepu method was from Deutero Malayu[3]. Sumantri and other authors explained that there was a difference in variations of tooth size variation of each race that could affect the results of the prediction method. In addition, previous research also stated that race had a formulaic influence that led to the Tanaka-Johnston shift constant formula when applied to populations other than Caucasoid[10].

The statistical test results from the space analysis measurement results by the Moyers-Sitepu and the Tanaka Johnston-Sitepu methods on the maxillary arch showed no significant differences ( $p > 0.05$ ). These results are not in accordance with the theory which states that race is one of the factors influencing the results of prediction methods. This can be explained by the theory of Durgekar and Naik which states that in addition to the race, there are several factors that can also affect the accuracy of the prediction method, i.e. gender, which is also related to the variations in the tooth shape and size [11]. Some researchers also say that malocclusion and environmental factors can also affect skeletal variations in tooth size[12]. Previous studies state that variations due to gender differences affect the size of permanent insisivus, permanent caninus, first premolars, and second premolars[13]. This shows that gender can also affect the results of the analysis[14].

In addition to the above factors, errors in the reading of the measurement results can occur. To anticipate errors in reading the measurement results, research is carried out carefully and based on standard procedures. From the results of the research conducted, the Moyers method, Tanaka-Johnston method, and Sitepu method have significant differences in the mandibular arch ( $p < 0.05$ ), and no significant differences in the maxillary arch ( $p > 0.05$ ).

## CONCLUSION

Based on the results of research conducted on the results of the space analysis measurement in mixed dentition using three methods, namely the Moyers method, the Tanaka-Johnston method, and the Sitepu method, it can be concluded that there are significant differences in the mandibular arch, and there are no significant differences in the maxillary arch.

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