

Orthodontic Study Model Discrepancy Analysis on Mixed Dentition: A Narrative Review

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ABSTRACT

Background: Attention in the form of dental treatment should be given to the phase of children's teeth that are still in the growth and development stage. The analysis of mixed dentition phase arch is an important criterion in determining the orthodontic treatment plan. Ideally, there is sufficient space so that unerupted teeth can erupt into the oral cavity and not cause crowding of teeth. Several analyzes are needed to confirm the orthodontic diagnosis, one of which is the analysis of the study model. The most widely used alternating mixed dentition analysis is the analysis of the Moyers prediction table and the analysis of the Tanaka-Johnston equation. Both analyzes came from populations of Northern European ancestry but proved unapplicable to populations of various races. **Purpose:** The purpose of this study aims to determine whether the analysis of the Moyers prediction table and the analysis of the Tanaka-Johnston equation is an accurate analysis if used in several populations through narrative review. **Review:** Based on the results of the research that has been done, certain populations showed higher prediction results than the actual value. **Conclusion:** The analysis of the Moyers prediction table and the Tanaka-Johnston equation is not suitable if applied to certain populations, because the results differ from the actual value with the predicted value.

Keywords: Orthodontics; Mixed Dentition Analysis; Moyers Analysis; Tanaka-Johnston Analysis; Medicine

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INTRODUCTION

For human life, oral health is an important health investments for lifelong health which have functions for mastication, speech, and aesthetics, known as stomatognathic function.¹ Attention should be paid to the dental care of children who are still in the stage of growth and development.² Primary teeth and permanent teeth are found together in the oral cavity.³ The most common clinical feature of malocclusion in the dentition phase is crowding. In this phase the occlusion is still temporary, so it is the right time to diagnose crowding teeth and perform appropriate treatment to prevent malocclusion from developing during eruption of permanent teeth.⁴

Orthodontic treatment is often faced with the problem of space requirements, so that the teeth can grow in the right position in the dental arch.³ Ideally there is sufficient space so that unerupted teeth can erupt properly into the oral cavity, and not cause crowding of teeth. The mandibular dental arch is a reference in determining the diagnosis and orthodontic treatment.⁵ Currently, the 75% percentile level of the Moyers prediction table is the analysis used globally to estimate the mesiodistal width of unerupted teeth.⁶ This

analysis came from a population of Northern European descent and proved to be inapplicable to populations of various racial backgrounds.⁷

Tanaka-Johnston developed a variation using the mesiodistal equation and width of the mandibular incisors to predict the size of the unerupted canines and premolars. This analysis of the Tanaka-Johnston equation does not require radiographic images or reference tables. This analysis has good accuracy for children from the European population.⁸ However, the accuracy of the Tanaka-Johnston equation is still questionable if it is used in different populations.⁹ The purpose of this study aims to determine whether the analysis of the Moyers prediction table and the analysis of the Tanaka-Johnston equation is an accurate analysis if used in several populations through narrative review.

REVIEW

This research is a narrative review to find a study on the analysis of model discrepancies in the dentition phase using Moyers and Tanaka-Johnston analysis. The literature sources used in writing this article are the Pubmed, Science Direct

and Google Scholar electronic databases published in the last 10 years with the keywords Arch Length Discrepancy Mixed Dentition Analysis, Moyers Mixed Dentition Analysis, and Tanaka Johnston Mixed Dentition Analysis. A total of 13 articles were selected after the authors read the entire contents of the articles based on relevant topics, inclusion and exclusion criteria (Table 1).

DISCUSSION

Teeth are one of the organs that have a role for mastication, speech, and esthetics consisting of teeth in the upper and lower jaws.¹ The process of tooth eruption varies in each child which can occur at any period in the process of tooth growth and development. Factors include heredity (genetic),

Table 1. Summarized data of the 13 articles included in this review

Article	Sample, Gender, and Age	Population	Outcome
Ravinthar, et al. ¹⁰	1.000 (500 ♂ dan 500 ♀) ages 11-15 years.	Chennai, Tamil Nadu, India.	Moyers 75% ♀ ↑ U ↓ L Moyers 75% ♂ ↑ U ↓ L T-J ♀ ↑ U and L T-J ♂ ↑ U ↓ L
Agrawal, et al. ¹¹	60 (30 ♂ dan 30 ♀) ages 12-15 years.	Indore, India.	T-J ♀ ↑ U and L T-J ♂ ↑ U and L
Bhatnagar, et al. ⁶	120 (60 ♂ dan 60 ♀) ages 11-14 years.	Morabadad District, India.	Moyers 75% ♀ ↑ U and L Moyers 75% ♂ ↑ U and L
Baheti, et al. ¹²	200 (100 ♂ dan 100 ♀) ages 13-16 years.	Rajasthan, India.	Moyers 75% ♀ ♂ ↑ U and L Moyers 50% and 35% ♀ ♂ ↓ U and L
Hambire, et al. ¹³	300 (147 ♂ dan 153 ♀) ages 12-15 years.	Mumbai, India.	T-J ♀ ♂ ↓ U and L
Thimmegowda, et al. ¹⁴	400 (200 ♂ dan 200 ♀) ages 13-16 years.	Bangalore, India.	T-J ♀ ♂ ↑ U and L
Kommineni, et al. ¹⁵	470 (343 ♂ dan 127 ♀) maximum age of 15 years.	Chennai, India.	Approaching Moyers 50% ♀ ♂ T-J ♀ ♂ ↑ U and L
Kakkar, et al. ¹⁶	150 (73 ♂ dan 77 ♀) ages 11-16 years.	City of Sri Ganganagar, Rajasthan, North West India.	Moyers 50% approaching ♂ Moyers 75% approaching ♀
Kamatham, et al. ⁷	201 (100 ♂ dan 101 ♀) ages 11-15 years.	South Andhra Pradesh (Southeast India).	T-J ♀ ♂ ↑ U and L Moyers 75% ♀ ♂ ↑ U and L
Bhatnagar, et al. ¹⁷	120 (ages 11-14 years).	Aligarh, Uttar Pradesh, India.	Moyers 75% ♀ ♂ ↑ U and L T-J ♀ ♂ ↑ U and L
Puri, et al. ³	73 (ages 8-12 years).	Gubeng, Surabaya, Indonesia.	Moyers 75% dan T-J ♀ ♂ ↑ L
Handayani, et al. ¹⁸	33 (12 ♂ dan 21 ♀) ages 13 - 14 years.	Pekalongan, Central Java, Indonesia.	Moyers 75% ♀ ♂ ↑ L T-J ♀ ♂ ↑ L
Pardede, et al. ⁹	300 (130 ♂ dan 170 ♀) registered at JHS in Jakarta.	Jakarta, Indonesia.	T-J ♀ ♂ ↑ U and L

*information about symbol and legend:

- ↑ = Have a greater value
- ↓ = Have a smaller value
- ♀ = Female
- ♂ = Male
- U = Upper Arch
- L = Lower Arch

race, gender, environment.¹⁹ The phase during which the primary and permanent teeth are present in the oral cavity is known as the dentition phase.¹⁸

The use of the mandibular permanent incisors to predict mesiodistal width has the advantage that the incisors erupt earlier in the dentition phase, are easy to measure, have small size variations, and have fewer anomalies. The maxillary incisors were not used in any predictive procedure, as they vary in size.^{12,13 12,13} Space analysis is important for calculating the amount of space available for teeth in the dental arch because treatment varies, depending on whether the space is adequate, insufficient, or excessive.⁸ The most widely used replacement tooth analysis methods are Moyers prediction table analysis and Tanaka-Johnston analysis using the mesiodistal size equation of the erupting tooth. Both of these analyzes were from populations of Northern European descent and proved unapplicable to populations of various races.⁷

Results of the study in the analysis of Moyers turnover teeth in Chennai, Tamil Nadu, India. Applying Moyers' predictive value to women, it was found that the actual value had a higher value for the maxillary arch, while the mandibular arch was lower than Moyers' predicted value. In males, it was found that Moyers' predictive value was higher than the true value on the right and left sides of the maxilla, while in the mandible the true value was higher than the predicted value. In the Tanaka-Johnston analysis, there were significant differences in the maxillary and mandibular arches in women. The actual values were lower in the maxillary and mandibular arches. In males, it was found that the true value for the maxilla was lower, while the true value for the mandible was higher than the predicted value.¹⁰

In a study conducted in Indore, India. Tanaka-Johnston analysis showed that there was a significant difference between the true value and the predicted value in the maxilla and mandible in both sexes. The results showed that the analysis value of the Tanaka-Johnston alternating teeth was higher in both sexes and in the arch.¹¹ These results are the same as those of a study conducted on a population of Bangalore, India in that the predicted value of the Tanaka-Johnston analysis was significantly higher than the true mesiodistal width value, in both the upper and lower jaws in both males and females.¹⁴

In a study by Moyers analysis conducted in Upper Morabadad District, India, it was stated that Moyers' predicted value was higher than the true value for both arches and both sexes.⁶ Research conducted in the Marwari community, Rajasthan, India also stated that the Moyers prediction table analysis was less accurate in predicting the mesiodistal teeth.¹² Research in South Andhra Pradesh, stated that the Tanaka-Johnston analysis proved less accurate because the predicted value was higher than the actual value.⁷ According to research in the Chennai population, the predictive value of the Tanaka-Johnston equation analysis is less accurate.¹⁵ Research conducted on junior high school students in Jakarta, Indonesia found that Tanaka-Johnston's predicted value was higher than the actual value. So based

on this study, the analysis of the Tanaka-Johnston equation is less accurate in predicting canines and premolars.⁹

However, the results of a study conducted on an Arab population in Pekalongan, Central Java, Indonesia showed that the 75% Moyers and Tanaka-Johnston percentile prediction values were quite accurate for maxillary measurements, but less accurate for mandibles. The difference between the actual value and the predicted value of the 75% Moyers analysis in this study was not statistically significant, in this study it showed that the Moyers and Tanaka-Johnston analysis could be used in the calculation of the replacement tooth analysis. It can be concluded that the Moyers 75% and Tanaka-Johnston analyzes are quite accurate for the analysis of alternating teeth in the Arab population in Pekalongan in Indonesia for maxillary measurements, but less accurate for mandibular measurements in the Arab population in Pekalongan.¹⁸ In a study conducted in Gubeng, Surabaya, Indonesia, namely the analysis of Moyers, Tanaka-Johnston, and Sitepu, it can be concluded that there is a significant difference in the lower arch, and there is no significant difference in the upper arch.³ This narrative review has limited results so that the detail and expert review method such as systematic review with meta-analysis should be conducted to examine Moyers, Tanaka-Johnston prediction to study model discrepancy to plan orthodontic treatment in several specific populations.

CONCLUSION

From the results of several studies that have been carried out, the predictive value of the Moyers prediction table analysis is higher than the actual value. Similar to the values of Tanaka and Johnston's analysis, the predictions were higher than the mesiodistal widths of the canines and premolars in the actual values that less accurate when used in certain populations. Further study is still required to develop the specific and accurate prediction formula to calculate study model discrepancy in several population.

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