Applicability of Tanaka-Johnston Mixed-Dentition Analysis in Indonesian Children

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Abstract

The Tanaka-Johnston method was used to predict the size of the un erupted canine and premolar teeth in the maxilla and mandible. However, the accuracy of the Tanaka-Johnston equation is still questionable when used in different ethnic groups. The objective of this study is to evaluate the Tanaka-Johnston method in predicting the size of un erupted permanent canines and premolars in Indonesian children. Dental study casts were obtained from 300 samples (130 males, 170 females) that fulfilled inclusion criteria. Mesiodistal crown widths of permanent teeth were measured using a digital calliper (Krisbow, Jakarta, Indonesia) of 0.01 mm resolution. The actual tooth measurements were then compared with predicted values using the Tanaka-Johnston equation. Tooth dimensions were statistically different between males and females, with males having larger teeth than females. There were significant differences between the values from actual measurements with the Tanaka-Johnston prediction value for both sexes. This study showed that the Tanaka–Johnston method cannot accurately predict the mesiodistal widths in Indonesian children

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Introduction

Malocclusion is a common problem in the field of pediatric dentistry. Malocclusion can be defined as a deviation from the ideal occlusion that can interfere with function and esthetics.[1] Prevalence of malocclusion in Indonesia is still high and can reach 80%. This shows that the majority of Indonesian children need thorough examinations to diagnose malocclusion problems and develop treatment plans.

An important aspect in diagnosing orthodontic cases in the period of mixed dentition is space analysis to determine the discrepancy between the size of the teeth and the size of the jaw. Space analysis in the period of mixed dentition can be divided into three methods: using the regression equation, using radiographs, and using a combination of the two. The most common method is using a regression equation in the form of Moyer's table and the Tanaka-Johnston equation.[2,3]

The Tanaka-Johnston equation uses the mesiodistal width of the four incisor teeth of the lower jaw to predict the size of the un erupted canines and premolars in the maxilla and mandible.[4] However, the accuracy of the Tanaka-Johnston equation is still in doubt when used on different ethnic groups.[2,5] Research on populations in Pakistan and Brazil shows that Tanaka-Johnston equations can accurately predict the size of the un erupted permanent teeth.[6,7]

Meanwhile, research conducted in Colombia, India, and Nepal shows that this method is not accurate and that researchers need to create new equations that are better-suited to their populations.[5,8,9] Therefore, in the present study, the authors wish to investigate the accuracy of the Tanaka-Johnston method in Indonesian children.

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Materials and Methods

This cross-sectional study was approved by the Ethical Committee of the Faculty of Dentistry, Universitas Indonesia, Jakarta, Indonesia, and parental consents were obtained. Samples of 300 Indonesian children (130 males,

170 females) were selected from 700 children who were enrolled in Jakarta Junior High School. The subjects were required to meet the inclusion criteria, which included the following: all permanent teeth must be completely erupted; the subject must have never undergone orthodontic treatment; and the teeth must be in good condition with no malformations, proximal cavities, fractures, or restorations.

Standard orthodontics trays with alginate materials were used to take impressions from all 300 students, using standard procedure, and were immediately poured with dental stone. All dental casts were checked and remade if any flaws were found.

Mesiodistal crown widths of the permanent upper and lower incisors, canines, and premolars were measured by one person using a digital calliper (Krisbow, Jakarta, Indonesia) with a resolution of 0.01 mm. The calliper was held parallel to the occlusal surface and perpendicular to the long axis against the contact points of the respective teeth.

Independent t-tests were carried out to compare the tooth sizes of males and females. The actual tooth measurements were then compared with the predicted values using the Tanaka-Johnston equation. The statistical analysis was performed with the Statistical Package for Social Sciences 17 (SPSS, Chicago, Illinois, USA).

Results

There was no statistical difference between the mesiodistal sum widths of the canines and premolars on the right and left sides of the maxillary and mandibular arches in males and females. There were significant differences ($p<0.01$) in tooth size with regard to gender. The mesiodistal tooth widths of males were larger than in females in both the maxillary and mandibular arches, as presented in Table 1.

Paired-sample t-tests were used to identify the differences between the actual sums of the permanent canine and both premolars and those predicted from the Tanaka-Johnston equations. This comparison shows that the actual value and that from the Tanaka-Johnston equation are significantly different (Table 2). Overall, the Tanaka-Johnston equation overestimated the sum of the mesiodistal widths of the maxillary and mandibular canines and premolars in Indonesian children.

Table 1 Comparison of mean values of tooth widths of males and females.

	Mean (mm) ± SD		p-value
	Males (n=130)	Females (n=170)	
Mandibular incisor	23,14 ± 1,47	22,70 ± 1,36	0,008
Maxillary canine-premolar	22,88 ± 1,17	22,20 ± 1,12	0,001
Mandibular canine-premolar	21,97 ± 1,25	21,37 ± 1,01	0,001

Table 2 Comparison of actual and predicted mesiodistal width using Tanaka-Johnston equation of canines and premolars.

Gender	Group	Actual value		Predicted value		p-value
		Mean	SD	Mean	SD	
Males (n=130)	Mx	22,88	1,17	22,57	0,74	<0,001
	Md	21,97	1,25	22,07	0,74	0,002
Females (n=170)	Mx	22,20	1,12	22,35	0,68	0,033
	Md	21,37	1,01	21,85	0,68	<0,001

Mx = maxillary, Md = mandibular.

Table 3 shows the regression parameters for predicting the sum of the mesiodistal widths of the canines and premolars (dependent variable) using the sum of the mesiodistal widths of the mandibular incisors (independent variable). In our study, the correlation coefficient (r) ranged from 0.57–0.71 for the maxilla and mandible in both genders. The coefficient of determination

(r^2) value ranged from 45–50% in males and 32–36% in females. The standard error of estimate, which indicates the error using the prediction equation, ranged from 0.81–0.93, which was lower in the female mandible (0.81).

Table 3. Regression parameter for predicting mesiodistal width canines and premolars in maxillary and mandibular on males and females.

Gender	r	Constant		r^2	SEE	p
		a	b			
Male (Mx)	0,67	10,51	0,54	0,45	0,87	0,001
Male (Md)	0,71	8,03	0,60	0,50	0,88	0,001
Female (Mx)	0,57	11,63	0,47	0,32	0,93	0,001
Female (Md)	0,61	11,16	0,45	0,36	0,81	0,001

Mx = maxillary, Md = mandibular.

Discussion

In our study, we found that males have larger teeth than females in both the maxillary and mandibular arches. This was consistent with the results reported by other studies.[5,10,11] Thus, this result necessitates a separate prediction formula for males and females, unlike the original equation by Tanaka and Johnston, in accordance with several other studies.[5,9,12] Moreover, there was no statistically significant difference between the sum of the canines and premolars in the right and left segments, so mean values of both sides were used for all measurement.[6,13]

The Tanaka-Johnston equation is one of the most widely used mixed-dentition analysis methods because of its simplicity. This method was originally conducted in the North-American population. Several studies have been done to discover the accuracy of this method when being used on different populations. Where as some researchers reported an accurate prediction using the Tanaka-Johnston equation on their populations,[6,7] others reported that the Tanaka-Johnston equation cannot accurately predict the widths of canines and premolars.[5,9,10,12]

In this study, the Tanaka-Johnston equation could not accurately predict the mesiodistal width of un erupted canine and premolar teeth in Indonesian children. Unlike research in India that concludes Tanaka-Johnston underestimated permanent tooth widths,[13] the Tanaka-Johnston equation overestimated the actual mesiodistal widths of the maxillary and mandibular canines and premolars in Indonesian children. This result is in accordance with other studies, and the equation was proposed based on the sample population.[12,14,15,16]

The correlation coefficient derived from the Indonesian sample ranges from 0.57–0.71. In the present study, the correlation coefficient is above 0.50 for both the maxilla and mandible in both sexes, which shows that these regression equations could be placed into clinical orthodontic use. The coefficient of determination (r^2) value, which indicates the predictive accuracy of the regression equation, ranged from 0.32–0.50. Our findings for both arches and both sexes were lower than research in Turkey[12], but higher than research in Nepal[5].

Based on the Indonesian sample, a new regression equation was proposed with separation by gender. For males, the width of the un erupted canines and premolars (Y) in maxillary arch Y = 0.54 X + 10.51, and in the mandibular arch, Y = 0.60 X + 8.03. For females, in the maxillary arch, Y = 0.47 X + 11.63, and in the mandibular arch, Y = 0.45 X + 11.16.

Conclusion

Based on the results of this study, we conclude that the mesiodistal tooth width was longer in males than in females in both the maxillary and mandibular arches. The Tanaka-Johnston equation was not accurate in predicting the size of the un erupted canines and

permanent premolars when applied to the Indonesian population.

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Declaration of Interest

The authors report no conflict of interest.

References

1. Cobourne M, DiBiase A. Handbook of Orthodontics. Philadelphia: Elsevier; 2010:280-2.
2. Dasgupta B, Zahir S. Comparison of Two Non-Radiographic Techniques of Mixed Dentition Space Analysis and Evaluation of Their Reliability for Bengali Population. Contemp Clin Dent. 2012;3(Suppl2):146-50.
3. da Cruz B, Rothier E, Viella B, Viella O, Nascimento R. Evaluation of Two Methods for Mixed Dentition Analysis Using the Method Error. Braz J Oral Sci. 2014;13(3):163-7.
4. Staley R, Reske N. Essentials of Orthodontics Diagnosis and Treatment. Iowa: Wiley-Blackwell; 2011:43-56.
5. Dhakal J, Shrestha R, Shresta S. Applicability of Tanaka and Johnston Analysis and Prediction of New Equation for Contemporary Nepalese Sample. Orthodontic Journal of Nepal. 2013;3(1):14-8.
6. Santos I, Noronha W. Estimation of Tanaka and Johnston's Predicting Regarding Mesiodistal Measurement of Unerupted Canine and Premolars. Rev Gaucha Odontol. 2013;61(1):55-60.
7. Tayyab M, Hussain U, Sumayya, Ayub A. Applicability of Tanaka and Johnston Mixed Dentition Analysis in A Peshawar Sample. Pak Oral Dental J 2014;34(2):322-5.
8. Botero M, Cuesta D, Agudelo S, Hincapie C, Ramirez C. Assessment of Moyers and Tanaka-Johnston Mixed Dentition Analyses for the Prediction of Mesiodistal Diameters of Unerupted Canines and Premolars. Rev Fac Odontol Univ Antioq. 2014;25(2):343-7.
9. Goyal RK, Sharma VP, Tandon P, Nagar A, Singh GP. Evaluation of Mixed Dentition Analysis in North Indian Population: A Comparative Study. Contemp Clin Dent. 2014;5(4):471-7.
10. Ahluwalia P, Jodhka S, Thomas AM. Prediction of Mesio-Distal Width of Canines and Premolars in A Sample of North Indian Population. Indian J Dent Adv. 2011;3(3):568-71.
11. Srivastava R, Jyoti B, Jha P, Gupta M, Devi P, Jayaram R. A Gender Determination from Mesiodistal Dimension of Permanent Maxillary Incisors and Canines : A Odontometric Study. J Indian Acad Oral Med Radiol. 2014;26(3):287-92.
12. Arslan SG, Dildes N, Kama JD, Genc C. Mixed-Dentition Analysis in A Turkish Population. World J Orthod. 2009;10(2):135-40.
13. Sholapurmath SM, Benni DB, Mandroli P. Applicability of Two Mixed Dentition Analysis in Children of Jangam Community of Belgaum City. World J Dent. 2012;3(4):324-9.
14. Khanehmasjedi M, Bassir L. Prediction of The Size of Unerupted Canines and Premolars in an Iranian Population. Indian J Dent Res. 2013;24(4):493-7.
15. Viella OV, Assuncao PS, Assuncao RL. The Tanaka-Johnston Orthodontic Analysis for Brazilian Individuals. Rev Odonto Cienc. 2012;27(1):15-9.
16. Kommineni NK, Reddy CVS, Chandra NS, Reddy DSR, Kumar AK, Reddy MVC. Mixed Dentition Analysis – Applicability of Two Non-Radiographic Methods for Chennai School Children. J Int Soc Prev Community Dent. 2014;4(2):133-8.