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Prediction of Mesiodistal Diameter of Unerupted Second Premolars and Canines Non-radiographically

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Abstract **Introduction** : Prediction of the mesiodistal width of unerupted permanent canines and premolars is of majorinterest for orthodontic diagnosis and treatment planning. This prediction is used to determine the tooth size-arch length discrepancy in the mixed dentition which is often made before eruption of the permanentcanines and first and second premolars. **Method**: The intraoral periapical radiograph of mandibular premolar region was taken. Records of 20 patients aged 13 to 14 yrs of Marathwada region with unerupted second premolar was considered. The actual measurements compared with the predicted values derived from the Tanaka and Johnston and Boston university equations. **Result:** Two prediction method Tanaka Johnston and Boston University show significant result for marathwada population. **Conclusion**: Depending on the stage of dental development, i.e., which deciduous and permanent teeth are present, the Tanaka/Johnston approach can be used when the four mandibular incisors have completely erupted, whereas the Boston University approach can be used when all the deciduous canines and first molars are still present.

Keywords: *tanaka Johnston method, boston university method*

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1. Introduction

An important aspect of diagnosis in the mixed dentition is the determination of the tooth size-arch length relationship. Such determination is often made before to eruption of the permanent canines, first and second premolars. The mixed-dentition arch analysis is an important criterion in determining whether the treatment plan is going to involve serial extraction, guidance of eruption, space maintenance, space regaining, or just periodic observation of the patient. [1,2] The space available between the lateral incisor and the first permanent molar is limited, it is important to have a precise estimate of the space that will be needed for the canines and premolars that will erupt in this segment. Thus, space analysis has 2 components: space available and space required. Although space available is easily measured on plaster casts, problems arise with the prediction of the mesiodistal crown diameters of unerupted canines and premolars. The radiologic method is based on the measurement of the unerupted teeth on radiographs. [3] There are also combined methods that use the advantages of both methods to improve the precision. Prediction methods have been developed with simple regression analysis techniques, [1,2,14] multiple regression analysis and other approaches. [4,6,15]

Mixed dentition space analysis form an essential part of an early orthodontic evaluation. They help to determine the amount of space available, whether in the mandibular or the maxillary arch, for the accommodation of unerupted permanent teeth, usually the canines and premolars. [12] An accurate analysis is one important criterion in determining whether the treatmentplan may involve serial extraction, guidance of eruption, space maintenance, space regaining, or just periodic observation of the patient. [4]

The purpose of this investigation is to: (1) Determine the best correlation between the sum of the mandibular permanent incisors and the combined mesiodistal crown diameters of the maxillary and mandibular canine and premolars in a sample of marathwada population; (2) Examine the applicability of the Tanaka and Johnston method and Boston University method of prediction in Marathwada population.

2. Material and Methods

2.1. The Samples

The dental models of the dentition of 20 Marathwada patients who presented with incomplete eruption of permanent mandibular canines and premolars as well as maxillary canines and premolars, were obtained. The

criteria for selection were based on complete fulfillment of the following:

(1) The patient had to be of Marathwada background;

(2) The dental casts had to be of high quality, and free of distortions;

(3) The teeth measured had to be free of restorations, fractures, or proximal caries as determined by bite-wing radiographs and the dental casts;

(4) There had to be no evidence of hypoplasia or anomalous form to the teeth being measured; and

(5) A maximum of 18 years of age was used to preclude any discrepancies based on significant proximal wear.

2.2. The Measuring Device

The mesiodistal width of a tooth was obtained by measuring the greatest distance between contact points on the proximal surfaces. A Boley gauge with a vernier scale to read to the nearest 0.1 mm was held parallel to the occlusal surface.

2.3. Tooth Size Measurements

The mesiodistal widths of the maxillary and mandibular deciduous and succedaneous teeth were measured. These measurements were obtained from completely dentulous casts. The deciduous teeth were measured at the time of complete eruption of the deciduous dentition before significant attrition would have occurred at later stages of development. Crown diameters were taken as the distance between the anatomic contact points. [13] Values obtained for the right and left posterior segments were averaged so that there would be one value for the maxillary canine and premolars and one value for the mandibular canine and premolars for each value of the mandibular incisors.

2.4. Prediction Methods Compared

The *TIJ* approach to predict the mesiodistal diameter of the unerupted mandibular canine and two premolars is based on adding 10.5 mm to half the total width of the mandibular four incisors as measured from dental casts. The regression equations are as follows:

$$Y = 10.5 \text{ X } 0.5x$$

for the mandibular canine-premolar segment, and

$$Y = 11.0 \text{ X } 0.5x$$

for the maxillary canine-premolar segment,

where Y = the estimate of the sum of the mesiodistal widths of the unerupted canines and premolars on either the right or left side and

X = the sum of the mesiodistal widths of the four mandibular incisors. The difference between the predicted widths of the canine and premolars and the observed widths of the canine and premolars was recorded.

The BU prediction method is based on adding the sum of the width of the mandibular deciduous canines and twice the width of the first deciduous molars.

2.5. Statistical Analysis

Student *t* tests were used to determine whether significant differences were present between the right and left sides for both the male and female subjects as well as between males and females. Descriptive statistics, including the mean, standard deviation, and minimum and maximum values, were calculated. Correlation coefficients "r" were performed between the predicted and actual tooth size for both prediction methods. In addition the standard error of the measurements was calculated.

3. Result

The current finding was that the predicted widths derived from the Tanaka and Johnston equations and the actual measured widths from the study casts of the Marathwada polulation showed significant differences in both the maxillary and mandibular arches (*p* values of 0.001 and 0.003, respectively).

3.1. Differences between the Actual and Predicted Tooth Size

The descriptive statistics for the predicted tooth size with the use of the *T/J* and BU equations as well as the actual tooth size are presented in Table 1.

3.2. Correlation Coefficients (r) between the Predicted and Actual Tooth Size

The r values indicate the association between the predicted and actual tooth size. The findings (Table 2) indicated that there are statistically significant correlations between the predicted and actual tooth size.

3.3. Standard error of Estimate

The error involved in the prediction equationsis expressed as the standard error of the estimate(SEE). The present findings indicated that the SEE for*T/J* prediction equations ranged between 0.65 and 0.80mm and the correspondingvalues for the BU equations ranged between 0.90 and 1.04 mm.

Table 1. Descriptive statistics (in mm) of the predicted and actual mesiodistal diameters of the mandibular canine and first and second premolars

Predicted method	Mesiodistal width of upper		Mesiodistal width of lower		Mean	Standard deviation
Tanaka/Johnston Method	maximum	22.91	maximum	21.71	0.7	1.0
	Minimum	19.02	Minimum	20.04		
Boston University	maximum	25.01	maximum	24.02	0.5	1.1
	Minimum	20.26	Minimum	19.02		

Table 2. Correlation coefficients (r) between the predicted tooth size from the prediction methods and actual tooth size

Predicted method	R	p
Tanaka/Johnston Method	0.48	0.0001
Boston University	0.37	0.0001

*P=probability.

Table 3. Comparison of standard errors of estimate in mm (SEE) for the two prediction methods evaluated

Predicted Method	Sex	SEE
Tanaka/Johnston Method	Males	0.80
	Females	0.65
Boston University	Males	1.04
	Females	0.90

4. Discussion

The arch length analysis and the information thus obtained from its accurate measurements, together with other observations taken from the patient records, are used to arrive at a decision for each patient. One must remember that in addition to tooth size, the changes in arch dimensions as well as tooth position and inclination are a compensatory mechanisms that maintain the balance among the various functional and structural demands placed on the face and dentition. Many of these changes are difficult to predict in the deciduous dentition stage. Many clinicians and researchers are interested in predicting a tooth size-arch length discrepancy in their growing patients. If accurate predictions can be made while patients are in the deciduous or mixed dentition, clinicians will be able to intercept any developing malocclusions. On the other hand, if such discrepancies cannot be accurately predicted, one will have to question the advisability of such procedures. One of the objectives of the tooth-size arch length analysis in the mixed dentition is to obtain the most accurate prediction for each patient by reducing to aminimum the errors involved in measurement and judgment. If the patient/parent are unwilling to allow for radiographs, the clinicians may have to use nonradiographic methods for predicting the unerupted permanent canines and premolars.

In the present study the findings indicated that the standard error of the estimates for the two nonradiographic prediction methods of Tanaka/Johnston and Boston University were 0.80 and 0.90, respectively. Therefore, the accuracy of these two methods of tooth prediction is fairly comparable but is not as accurate as the radiographic methods of prediction. The most accurate prediction methods, the use of periapical films and particularly the use of the modified Hixon-Oldfather prediction equation that has a 0.44 mm SEE. [4-10]

The *TIJ* approach requires completely erupted mandibular permanent incisor but does not use deciduous tooth measurements. Whereas, the BU method requires the presence of the deciduous canines and first molars. As a result, the clinician can use either of these two methods depending on which teeth are available in the dental arches at the various stages of dentition.

5. Conclusion

The current findings suggest that the commonly used Tanaka and Johnston prediction method and BU method is applicable when applied to Marathwada population depending on which teeth are available in the dental arches at the various stages of dentition.

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