Mixed Dentition Analysis: Applicability of Three Non-Radiographic Methods for Patiala Population

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ABSTRACT

Introduction: The present study was undertaken to evaluate the accuracy of methods proposed by Moyers, Bachmann and Trankmann et al to forecast the mesiodistal dimensions of permanent canine and premolars in Patiala population.

Material and Methods: Mesiodistal dimensions of teeth were measured from study models representing 27 male and 23 female subjects (aged 11–14 years) of North Indian descent. The mesiodistal dimensions of the teeth were measured using a digital caliper (providing measurements to 0.01 mm accuracy). The measurements of canine and premolars were summed up and compared with those derived from Moyers probability tables (75th percentile), and Bachmann and Trankmann et al equations.

Results: All the three methods exhibited overestimation of actual sum of permanent canine and premolars in both the arches and genders in this population. These values were found to be statistically significant.

Conclusion: All the methods evaluated in the study overestimated the mesiodistal widths of permanent canine and premolars in North Indian population. However, Moyers at 75th percentile gave relatively closer estimate as compared to Bachmann and Trankmann et al equations for both arches in males as well as females.

Keywords: Bachmann Analysis, Mixed Dentition, Moyers Analysis, Trankmann et al Equation.

INTRODUCTION

The period of mixed dentition is a critical period for the prevention or interception of any developing malocclusion. Early diagnosis and successful treatment of dento-alveolar discrepancies can help in achieving the goal of occlusal harmony, function and dento-facial aesthetics. The method of mixed dentition analysis is a diagnostic tool that allows to quantify crowding and to predict dentoalveolar discrepancy by identifying the available and necessary space for teeth not yet erupted. Several methods have been developed for estimating the mesiodistal widths of unerupted teeth. The development of these methods was based on the data derived from the population of various descents. Therefore, the accuracy of these prediction methods may be in question when applied to other population groups because it has been well established in the literature that tooth sizes vary considerably between the racial groups. Hence, this study was an attempt to compare three different types of mixed dentition analysis methods (Moyers, Bachmann and Trankmann) and to determine the most applicable method for boys and girls of Patiala population.[1-3]

The aim of the present study was to evaluate the applicability of Moyers, Bachmann and Trankmann et al mixed dentition analysis methods for Patiala population.

MATERIAL AND METHODS

A total of 50 children (27 boys and 23 girls) in the age group of 11-14 years of Patiala City population were taken for the present study.

The following selection criteria were used:-

- All the subjects had permanent dentition.
- No active caries or restorations were present.
- No obvious anomalies regarding number, form, size or structure of the teeth were there.
- The mesiodistal and buccolingual surfaces of the crowns of all permanent teeth were intact.
- Relatively well aligned arches which enabled the measurement of mesiodistal widths.
- The subjects had no history of previous orthodontic treatment.

Informed consent was taken from all the study subjects. Impressions for all the subjects were made in alginate impression material and were poured using dental stone, without delay to prevent dimensional changes. The measurements of teeth on dental casts were done using a calibrated digital caliper with an accuracy of 0.01 mm. The mesiodistal dimensions of permanent canines and premolars of both the jaws were measured and recorded. All measurements were carried out twice and the mean of the two values was used.

The methods which were compared are:

Moyer's method (1988):

According to Moyers' method the sum of the mesiodistal widths of the permanent mandibular incisors is calculated to predict the sum of mesiodistal dimensions of mandibular and maxillary permanent canines and premolars at various probability levels (5% to 95%). Hence, the mesiodistal dimensions of the mandibular permanent central and lateral incisors were measured from the dental casts and recorded. The sum of mesiodistal dimensions of all the four mandibular incisors was calculated and this value was used to predict

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the width of permanent canines and premolars of both jaws according to Moyer's probability charts at 75th percentile levels. The predicted values of permanent canines and premolars of both the jaws were compared with the actual values recorded.

Bachmann's method (1986)

Mesiodistal dimensions of upper permanent left lateral incisor, upper permanent left first molar and lower permanent left lateral incisor of each patient were measured from the dental cast and recorded. According to Bachmann's method, mesiodistal of unerupted permanent canines and premolars were calculated with following regression equations:

Maxilla = 0.81× (22) +0.54× (26) +0.56× (32) +6.98

Mandible = 0.71× (22) +0.39× (26) +0.86× (32) +6.96

where 22 represents mesiodistal dimension of upper left lateral incisor, 26 represents mesiodistal dimension of upper left first permanent molar and 32 represents mesiodistal dimension of lower left lateral incisor of each patient. The calculated values of permanent canines and premolars of both the jaws were compared with the actual values measured from the dental casts of each patient.

Trankmann et al. (1990) method:

Trankmann gave following equations to predict the width of unerupted permanent canines and premolars.

Boys:

Maxilla = 0.93X + 5.50,

Mandible = 0.94X + 5.06

Girls:

Maxilla = 0.99X + 4.47,

Mandible = 0.96X + 4.43

where X represents sum of mesiodistal dimension of lateral incisor and mesiodistal dimension of first permanent molar of respective quadrant of each patient. Hence, mesiodistal dimensions of lateral incisors and first permanent molars were measured from the dental casts and according to above regression equations mesiodistal widths of permanent canines and premolars of both the jaws were calculated and compared with actual values.

STATISTICAL ANALYSIS

Descriptive statistical analysis of the measured teeth dimensions and comparison of actual teeth sizes between right and left sides was done. The mesiodistal dimensions of maxillary and mandibular incisors, canines, premolars and first molars were subjected to statistical analysis, and the mean values and standard deviation were derived for males and females separately. Paired t test was used for the comparison.

RESULTS

No significant differences were present between teeth in left and right sides, where P value > 0.05 showing no statistically significant difference in size of teeth of both the sides.

Sex comparisons of mesiodistal tooth widths: The dimensions of both maxillary and mandibular canine and premolars were greater in males than in females and the difference was significant statistically ($p < 0.005$). (Table 1)

Comparisons of predicted and actual tooth size: Measurements on the left side of the dentition were considered. The two-tailed t test was employed to compare the differences between the actual and predicted mesiodistal dimensions of the sum of unerupted permanent canines, first and second premolars. All the three methods; Moyers, Bachmann's and Trankmann et al exhibited overestimation when the predicted values were compared with actual sum of permanent canine and premolars in males as well as females. The difference was highly significant ($p < 0.01$). (Tables 2-4)

DISCUSSION

The present study was an attempt to establish the validity of Moyers prediction tables, Bachmann and Trankmann et al equations for mixed dentition analysis in a sample of Patiala population. This cross-sectional study was undertaken on a random sample of school children, 11-14 years of age, living in Patiala City.

In this study, there were no statistically significant differences between the left and right sides. These findings indicate that either the right or the left side measurements could be used to represent the mesiodistal tooth widths for this sample. Therefore, the values of the left sides of each jaw were used in the statistical analyses. The results of unpaired t tests showed that there were statistically significant differences in the tooth widths between the male and female subjects. The mean mesiodistal tooth widths of male subjects were generally larger than those of females in both mandibular and maxillary dental arches ($p < 0.05$). Thus, data analysis

	Males		Females		t value	significance
	Mean (mm)	SD	Mean (mm)	SD		
Mandibular C	7.62	0.44	7.08	0.42	4.41	<0.001*
Mandibular PM1	7.05	0.46	6.64	0.40	3.33	<0.005**
Mandibular PM2	6.99	0.36	6.58	0.44	3.62	<0.001*
Mandibular M1	10.97	0.43	10.53	0.36	3.88	<0.001*
Maxillary C	7.94	0.38	7.56	0.41	3.40	<0.005**
Maxillary PM1	7.34	0.42	6.88	0.38	3.15	<0.005**
Maxillary PM2	6.98	0.38	6.15	0.45	3.19	<0.005**
Maxillary M1	10.22	0.42	9.85	0.42	3.11	<0.005**
Sum of mandibular incisors	23.03	1.22	22.78	1.20	3.06	<0.005**

*Highly significant, ** Very Significant, C – Canine, PM1 – First Premolar, PM2 – Second Premolar, M1 – First permanent molar

Table-1: Mean mesiodistal widths of the mandibular and maxillary teeth in males and females

Prediction methods	Predicted values of C+PM1+PM2 (in mm)	Actual Values of C+P-M1+PM2 (in mm)	Difference predicted/ actual (in mm)	Significance (p value)
Mandibular				
Moyers	21.03 ± 0.81	20.23± 1.18	0.80 ±0.62	0.01
Bachmann	21.27 ± 0.90	20.23 ± 1.18	1.04 ± 1.41	<0.001
Trankmann et al	21.11 ± 0.66	20.23 ± 1.18	0.88 ± 0.54	0.005
Maxillary				
Moyers	21.58 + 0.36	20.94 + 1.24	0.68 + 0.91	<0.05
Bachmann	22.28 + 0.90	20.94 + 1.24	1.34 + 0.65	<0.001
Trankmann et al	21.98 + 0.67	20.94 + 1.24	1.04 + 0.94	<0.001

Table-2: Actual and predicted Sum of C+PM1+PM2 (mandibular and maxillary), mean differences, and standard deviations with all the three methods in Females

Prediction methods	Predicted values of C+PM1+PM2 (in mm)	Actual Values of C+P-M1+PM2 (in mm)	Difference predicted/ actual (in mm)	Significance (p value)
Mandibular				
Moyers	21.66 ± 0.54	21.12 ± 1.15	0.54 ± 0.49	0.031
Bachmann	21.84 ± 0.54	21.12 ± 1.15	0.72 ± 0.50	0.004
Trankmann et al	22.16± 0.70	21.12 ± 1.15	1.04 ± 0.59	0.001
Maxillary				
Moyers	22.00 + 0.61	21.37 + 1.14	0.63 + 0.14	0.014
Bachmann	22.74 ± 0.96	21.37 ± 1.14	0.86 ± 0.49	0.000
Trankmann et al	22.54 + 0.61	21.37 + 1.14	1.05+ 0.44	0.000

Table-3: Actual and predicted C+PM1+PM2 (mandibular and maxillary), mean differences, and standard deviations with all the three methods in males.

Method	Males		Females	
	Maxillary arch	Mandibular arch	Maxillary arch	Mandibular arch
Moyers	0.684	0.616	0.645	0.615
Bachmann	0.555	0.521	0.509	0.499
Trankmann et al	0.475	0.496	0.490	0.478

Table-4: Correlation coefficients for all the three methods in males and females

was performed separately for each gender. These results agree with many studies that have also found the average mesiodistal widths of individual teeth of permanent dentition in males to be larger than in females in many ethnic groups.

The results of this study show that all the three mixed dentition analyses overestimate the actual value of permanent teeth. However Moyers probability tables at 75th percentile gave relatively more appropriate estimate of width of unerupted canine and premolars as compared to Bachman and Trankmann et al mixed dentition analyses for the upper and lower arch in males as well as females.

Different racial and ethnic groups can have variations in the tooth and facial characteristics. Most methods, used to predict the widths of unerupted permanent teeth, were developed based on the North American and European populations. The accuracy of these prediction methods when applied to population groups other than white subjects is, however, questionable because it has been well established in the literature that tooth sizes vary considerably between different racial groups. Racial and gender specific mixed dentition space analyses require revision or validation once every generation (approximately 30 years) because of changing trends in malocclusion and tooth size. The accurate width of an unerupted tooth is important for correct diagnosis of a case.[3-6] Neither overestimation nor underestimation of width should be done for an accurate treatment plan. Thereafter, many studies aiming to test and confirm the applicability and consistency of these methods in different populations have been performed. Ballard and Wylie (1947) developed a prediction method by correlating the sum of mesiodistal widths of four mandibular incisors with the combined widths of mandibular canines and premolars on one side of the arch. The correlation coefficient was found to be moderately positive(r = 0.64). Singh and Nanda (1972) discovered that the values for the Indian children were very different from those of Caucasian children, from which they concluded that there were racial discrepancies in tooth size and therefore data collected from one ethnic group were not transferrable to other.[7-10]

This has been demonstrated in the present study by significant amount of differences between the mean values of actual mesiodistal widths of permanent canines and premolars and those derived from Moyers, Bachmann and Trankmann et al prediction equations for children from northwestern European ancestry.

Limitations of study: The sample size in the present study could have been larger. Using the larger sample a regression equation to predict the mesiodistal widths of permanent canine, first and second premolars can be arrived at.

CONCLUSION

Tooth widths exhibit statistically significant differences between male and female subjects, with male teeth generally being larger. Thus, Patiala children should be divided according to gender prior to a mixed dentition analysis.

The mixed dentition space analyses proposed by Moyers, Bachmann and Trankmann et al show overestimation of the mesiodistal widths of maxillary and mandibular canine premolar segment in both males and females.

The Moyers mixed dentition analysis method at 75th percentile gave relatively closer estimate for prediction of mesiodistal dimensions of permanent canines and premolars amongst the methods compared in Patiala population.

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