 DOI: 10.18231/2455-6785.2017.0031

Applicability of Moyer's mixed dentition analysis in Maharashtrian children of India

Govind R. Suryawanshi[1,*], Rajan K. Mahindra[2], Rakesh R. Mohode[3], Aarti U. Pathak[4], Harshal P. Bafna[5]

[1]Assistant Professor, [2]Professor & HOD, [3]Associate Professor, [4]Dental Surgeon, Dept. of Orthodontics, [5]Assistant Professor, Dept. of Preventive & Community Dentistry, Govt. Dental College & Hospital, Aurangabad,

***Corresponding Author:**
Email: dr.govindsuryawanshi@yahoo.com

Abstract

Background and Objective: The objective of present study is to evaluate the applicability of Moyer's mixed dentition analysis in Maharashtrian children of India.

Materials and Method: Present study consist sample of 200 (100 females and 100 males) Maharashtrian children of India. All participants were in the age group of 13 to 16 years old. Children selected were having fully erupted all permanent teeth. Actual mesiodistal dimensions of four permanent mandibular incisors, upper and lower canines, and premolars of right and left sides were measured using digital vernier caliper which had a resolution of 0.01mm. These all measurements were then averaged.

Statistical Analysis: The statistical analysis of obtained data was performed using SPSS 20.0. Student t test was used to compare between actual measurements and predicted values obtained with the Moyer's prediction tables. To find out the accuracy of the formed prediction equations the coefficient of determination (r^2) was calculated. To determine the validity of the proposed equations standard error of estimate (SEE) was calculated.

Results: The comparable differences found between the actual and predicted values of moyer's prediction table were statistically very highly significant in males and females ($P < 0.000$). No statistical significant difference was seen at male mandibular 75th percentile and female maxillary 50th percentile between the actual measured findings and moyers table.

Conclusion: There was comparable and statistically highly significant difference found between moyer's prediction measurements and measurements found in present study. Study on larger sample is required to test the accuracy of the predicted equation.

Keywords: Moyer's Analysis, Mixed dentition, Prediction.

Introduction

As we know that genetics is the factor which determines the skeletal and dental structure and its pattern of development, tooth size prediction values could not be universal for all ethnic and racial groups. Dental malocclusion begins during mixed dentition period in most of the individuals. Mesiodistal width of unerupted mandibular and maxillary canines and premolars can be assessed by measuring mesiodistal width of the erupted four permanent mandibular incisors. Prediction of the unerupted teeth size during mixed dentition period acts as a key factor in the management of developing malocclusion and establishing treatment plans.[(1)]

Space analysis in mixed dentition period helps in determining orthodontic treatment plan and assessing tooth eruption, space regaining, space maintenance, serial extraction, or for periodic evaluation.[(2,3)] Four basic principles involved during mixed dentition space analysis in prediction of the width of unerupted permanent premolars and canines i.e., from prediction tables and equation, measurement of unerupted teeth on intraoral periapical radiographs, regression equation methods and a combination of prediction tables and radiographs.[(4)] Presently, moyer's prediction tables[(5)] with 75th percentile level is universally used method for prediction of the mesiodistal crown width of unerupted teeth. Moyer's prediction was based on North American Caucasian children. It is not applicable to all racial groups because it has been observed that tooth dimension varies in different ethnicities, races and genders.[(2,7)] Durgekar and Naik[(7)] found different tooth size measurements in a study and created prediction equations for Indian school children of different locations. Another studies have shown that Moyer's prediction table is not applicable to all the races, and they have developed different prediction tables.[(8,9)] similarly, Hammad and Abdellatif developed new regression equations for tooth size prediction for Egyptian children.[(9)] Whole treatment may be a failure if the predicted values of unerupted premolar and canine are wrong.[(10)] Hence, this present study was done to evaluate tooth width in females and males and to assess the applicability of Moyers probability tables in the Maharashtrian children of India.

Materials and Method

This study was done from April 2017 to August 2017.School children belonging to the Marathwada Region of Maharashtra were included in this study. All Children's domicile and community were confirmed with the help of questionnaire, and the domicile certificate issued from the Tahshildar office. A sample of 200 school children (100 females and 100 males) of age group 13–16 years were selected randomly from the patients who visited to Govt. Dental College and Hospital Arangabad. The study nature was clearly discussed with the participants and parents. Written

informed consent was obtained from the parents of the all participating children.

Dental alginate impressions of the maxillary and mandibular arches of all participating children were made and all impressions were poured immediately. Dental stone (Type III) was used to prepare dental cast models to prevent dimensional changes. A single digital Vernier caliper with resolution of 0.01 mm was used for measuring the mesiodistal width of mandibular four permanent incisors and canine and premolars of mandibular and maxillary arches (Fig. 1). Actual values of the misiodistal width of the lower four incisors (LI), maxillary canine and premolars (UCPM), and mandibular canine and premolars (LCPM) were measured and recorded. Mean values were calculated from this data. Measured values of premolars and canines on the right and left side were then averaged and a single mean value was obtained.

As the method described by Jensen et al[(11)] all measurements were made parallel to the vestibular and occlusal surfaces and between two contact points of each tooth. The teeth on the prepared dental model casts were measured independently and manually by two investigators. To check the reliability of measurements, comparison was done between two obtained measurements values and if they varied by 0.2 mm or less, the values were averaged**.** Teeth were again re-measured if measurements varied by more than 0.2 mm and three nearest measurements were averaged.

Inclusion criteria for selection of sample: All subjects should be in the age range of 13–16 years. Parents of the participants should belong to the Maharashtra population. Both the patient and their parent should be a domicile of Maharashtra for a minimum of 20 years. All permanent teeth except third molars should be present and fully erupted in both the arches.

Participants who have undergone orthodontic treatment were excluded from the sample, Tooth loss mesiodistally due to interproximal caries, interproximal attrition, fractured tooth, skeletal deformity, or congenital defects, any congenital craniofacial anomaly subjects were excluded.

Statistical Analysis: Statistical analysis was performed using the Statistical Package for the Social Sciences software version 20.0. Descriptive statistics was performed to measure the mean, standard deviation, and maximum and minimum values (Table 1). The actual measurement values were compared with the predicted values of Moyers probability tables at 75th, 50th, and 35th, percentile confidence levels(Tables 2-5). To find the correlation between the sum of mandibular incisors with that of the sums of canine and premolars in both arches the coefficient of correlation (r) was calculated (Table 6). To compare between actual measured values and predicted values at the 35th, 50th, and 75th percentile confidence levels, a student t test was used. (Table 7)

Finally, regression equations were developed with the help of obtained data: $y = a + bx$

Where a, and b are regression coefficients, y is the summed width of mandibular incisors, x is the summed width of canine and premolar.

To find out the accuracy of the formulated regression equations the coefficient of determination (r^2) was calculated. To determine the validity of the proposed equations standard error of estimate (SEE) was calculated.(Table 6)

Table 1: Descriptive statistics for various tooth groups in different groups of subjects

Tooth Group	Gender	Range	Mean	Std. Deviation
UCPM*	Male	19.00-24.19	22.2419	1.21001
LCPM**	Male	17.76-24.81	21.6021	1.63375
UCPM*	Female	18.29-23.20	20.7516	1.06119
LCPM**	Female	16.74-21.24	18.9159	1.13262

*Sum of maxillary canine and premolars; **Sum of mandibular canine and premolars

Table 2: Prediction table for maxillary arch values in males with Moyer's probability chart

L*	75th Percentile	50th Percentile	35th Percentile	Present
19.5	20.3	19.7	19.3	20.7400
20.0	20.5	19.9	19.6	20.9000
20.5	20.8	20.2	19.9	21.0000
21.0	21.0	20.4	20.1	21.3117
21.5	21.3	20.7	20.4	21.5400
22.0	21.5	20.9	20.6	21.8400
22.5	21.8	21.2	20.9	22.0000
23.0	22.0	21.5	21.1	22.2095
23.5	22.3	21.7	21.4	22.4617
24.0	22.5	22.0	21.6	22.6604
24.5	22.8	22.2	21.9	22.8007
25.0	23.0	22.5	22.1	23.0000
25.5	23.3	22.7	22.4	23.5813

* Sum of mandibular incisors

Table 3: Prediction chart for mandibular arch values in males with Moyer's probability chart

L*	75th Percentile	50th Percentile	35th Percentile	Present
19.5	20.4	19.5	19.0	18.8853
20.0	20.6	19.7	19.3	20.7400
20.5	20.8	20.0	19.5	20.9000
21.0	21.0	20.2	19.7	21.0000
21.5	21.2	20.4	20.0	21.3400
22.0	21.4	20.6	20.2	21.5400
22.5	21.6	20.9	20.4	21.7000
23.0	21.9	21.1	20.6	21.9686
23.5	22.1	21.3	20.9	22.0925
24.0	22.3	21.5	21.1	22.2571
24.5	22.5	21.7	21.3	22.4403
25.0	22.8	22.0	21.5	22.6000
25.5	23.0	22.2	21.7	23.0291

* Sum of mandibular incisors

Table 4: Prediction table for maxillary arch values in females with Moyer's probability chart

L*	75th Percentile	50th Percentile	35th Percentile	Present
19.5	20.4	19.6	19.2	19.8306
20.0	20.5	19.8	19.4	19.9475
20.5	20.6	19.9	19.5	19.7450
21.0	20.8	20.1	19.7	20.1058
21.5	20.9	20.2	19.8	19.8533
22.0	21.0	20.3	19.9	20.7783
22.5	21.2	20.5	20.1	20.8700
23.0	21.3	20.6	20.2	20.6523
23.5	21.5	20.8	20.4	20.6542
24.0	21.6	20.9	20.5	21.2163
24.5	21.8	21.0	20.6	21.2473
25.0	21.9	21.2	20.8	21.1025
25.5	22.1	21.3	20.9	21.5163

* Sum of mandibular incisors

Table 5: Prediction chart for mandibular arch values in females with Moyer's probability chart

L*	75th Percentile	50th Percentile	35th Percentile	Present
19.5	19.6	18.7	18.2	17.9086
20.0	19.8	19.0	18.5	18.4525
20.5	20.1	19.2	18.8	18.7650
21.0	20.3	19.5	19.0	18.5983
21.5	20.6	19.8	19.3	17.6650
22.0	20.8	20.0	19.6	18.4150
22.5	21.1	20.3	19.8	19.6500
23.0	21.3	20.5	20.1	18.8841
23.5	21.6	20.8	20.3	19.0342
24.0	21.9	21.1	20.6	18.9596
24.5	22.1	21.3	20.9	19.3993
25.0	22.4	21.6	21.1	19.0475
25.5	22.7	21.8	21.4	19.8309

* Sum of mandibular incisors

Table 6: Coefficient of correlation (r), coefficient of determination (r^2), regression constants (a, b), and standard error of estimate (SEE) for various tooth groups in different groups of subjects

Variable	r	r^2	Regression Constants		Standard error of the estimate
			a	b	
Maxillary male	.994	.989	11.864	0.451	.9659
Mandibular male	.925	.856	10.196	0.506	.42112
Maxillary female	.928	.862	13.975	0.293	.23877
Mandibular female	.731	.534	13.540	0.234	.44536

Table 7: Comparison of actual and predicted values with student t test

Gender	Arch	75th percentile	50th percentile	35th percentile
Male	Maxillary	0.000**	0.000**	0.000**
Male	Mandibular	.499*	0.000**	0.000**
Female	Maxillary	0.000**	.154*	0.000**
Female	Mandibular	0.000**	0.000**	0.000**

*Non significant; **Very highly significant

Fig. 1: Measuring guage-digital caliper

Results

Differences between the actual measured values and predicted values of maxillary and mandibular permanent canines and premolars were statistically highly significant in males and females (P < 0.000). No statistically significant difference was seen between the current findings and moyers table at male mandibular 75th percentile and female maxillary 50th percentile. Mean mesiodistal teeth crown dimensions in the posterior segments of the maxillary and mandibular arches were larger in males than in females (Table 1). Since there was highly significant difference found between measurement values of present study and predicted values of moyers, new regression equations were derived for male and female subjects for prediction of tooth dimension.

Regression equation for male:

a) Maxilla - Y = 11.86 + 0.45x
b) Mandible - Y = 10.19 + 0.50x

Regression equation for female:

a) Maxilla - Y = 13.97 + 0.29x
b) Mandible - Y = 13.54 + 0.23x

Discussion

Presently, Moyer's mixed dentition prediction table at the 75th percentile is the globally used method to predict the width of unerupted permanent teeth.[7] Measurement and use of mandibular permanent incisors for prediction of unerupted teeth is advantageous and easy because it is easy to measure, it erupts early in mixed dentition, and it has minor tooth size variations. To measure tooth dimension a digital vernier caliper with a standard error of ±0.03 mm has shown to be a more accurate. Since maxillary incisors have lower predictive values and variable size they were not used in any predictive procedure.[10]

Because of the changing trends in tooth size and malocclusion revision in gender-based and racial space analysis is required once in every generation.[7]

In maxillary male the current observed values are significantly greater than the values given in the moyers chart (Table 2). In Mandibular the measurements at 50thand 35thpercentile, the mean value of present study subjects was significantly greater as compared to values given by Moyer (Table 3). Also in female Maxillary measurements at 75th percentile the mean value of present study subjects was significantly lesser as compared to values given by Moyer while at 35th percentile it was significantly greater (Table 4). In female Mandibular measurements the current observed values at 75th, 50th, 35th percentile were significantly smaller as compared to those given by moyers (Table 5). No significant difference was seen at male mandibular 75th percentile (Table 3) and female maxillary 50th percentile between the current findings and moyers chart (Table 4).

There was a statistically significant difference (P=0.000) found in tooth dimension between the actual and predicted values of moyer's chart for males and females in maxillary and mandibular arches except at the

75th (P=0.499) and 50th (P=0.154) percentile for males in mandibular archand for females in the maxillary arch respectively (Table 7). With these findings we can say that definite racial and ethnic differences are evident with regard to tooth size.

Mean mesiodistal width of the measured teeth (canine and premolars) was lesser in females compared to males (Table 1). This is in accordance to the studies conducted by Agarwal et al[6] and Durgekar and Naik.[7] This means Tooth dimension is associated with gender.

In our study males showed the highest r^2 (0.989) value for the maxillary posterior segment (Table 2). From this we can say that prediction equation is more precise for maxillary arch in male subjects. However, Prediction equation is least precise for the maxillary arch in female subjects as females showed lowest r^2 (0.862) value for the maxillary arch. Jaroontham et al.[13] obtained lower r^2 values (0.29) for maxillary teeth and (0.34) for mandibular teeth in males; (0.39) for maxillary teeth and (0.42) for the mandibular arch in females. In another similar study in Southern Thailand, r^2values were (0.47) and (0.46) for mandibular and maxillary teeth, respectively. The differences found in the sets of r^2values of all these studies might be due to ethnic mixes and different sample sizes.[14]

Our study results indicate that Moyer's prediction table is not accurate for the present study group. Hence, new prediction table and new regression equations has been formulated for the Maharashtrian population. The differences noted in Moyer's prediction table with that of our study are because of the changes in the ethnic and racial diversity (Table 2-5). Many studies have shown the variations in regression equation and prediction to evaluate unerupted teeth.[6,8]

Prediction table is not universal for all racial groups hence individual moyer's mixed dentition regression analysis and prediction table is more useful.[15] Multiple regression equation method using mandibular permanent incisors as a predictor value is nonradiographic, easy to assess, practical, and precise method for assessing the mesiodistal dimension of unerupted canine and premolars.[6] A limitation of this present study was smaller sample size.

Radiographic method for assessment of unerupted tooth size is difficult to use since teeth rotation and poor intraoral film image. New prediction tables and new regression equations can be used in the study population for accuracy in prediction of unerupted teeth size.

Conclusion

There was significant statistical difference found between moyer's prediction measurements and measurements found in present study.

Study on larger sample is required to test the accuracy of the prediction equation.

References

1. Juneja S, Mahajan N, Kaur H, Verma K G, Sukhija M, Bhambri E, "Comparative evaluation of three mixed dentition analyses and formulation of regression equations for North Indian population: A cross-sectional study" Biomed J (2015)38,450-5.
2. Al-Bitar Z B, Al-Omari I K, Sonbol H N, Al-Ahmad H T, Hamdan AM, "Mixed dentition analysis in Jordanian population" Angle Orthod (2008)78,670-5.
3. Tikku T, Khanna R, Sachan K, Agarwal A, Srivastava K, Yadav P,"A new proposed regression equation for mixed dentition analysis using the sum of permanent mandibular four incisors and first molar as a predictor of width of unerupted canine and premolars in a sample of North Indian population" J Orthod Sci (2013)2,124-9.
4. Toodehzaeim M H, Aghili H, Shariatifar E, Dehghani M, "New regression equations for mixed dentition space analysis in an Iranian population" J Contemp Dent Pract (2013)14,1156-60.
5. Moyer R E. "Handbook of orthodontics, Analysis of the dentition and occlusion. 4th ed. Year book medical publishers" (1988) p. 235-8.
6. Agarwal N, Shashikiran N D, Singla S, Kulkarni V K, Ravi K S, "Moyer's mixed dentition predictable values correlation among Hindu children of Bhopal city" Ann Essence Dent (2013)5,6-10.
7. Durgekar S G, Naik V, "Evaluation of Moyers mixed dentition analysis in school children" Indian J Dent Res (2009)20,26-30.
8. Thimmegowda U, Sarvesh S G, Shashikumar H C, Kanchiswamy LN, Shivananda DH, Prabhakar A C, "Validity of Moyer's mixed dentition analysis and a new proposed regression equation as a predictor of width of unerupted canine and premolars in children" J Clin Diagn Res (2015)9,ZC01-6.
9. Hammad S M, Abdellatif A M, "Mixed dentition space analysis in Egyptian children" Pediatric Dental J (2010)20,115-21.
10. Singh V, Singla A, Mahajan V, Jaj H S, Bawa T, "Development of a prediction equation for the mixed dentition in Himachal population" Indian J Dent Sci (2013)5,40-3.
11. Jensen E, Kai-Jen Yen P, Moorrees C F, Thomsen T O, "Mesiodistal crown diameters of the deciduous and permanent teeth in individuals" J Dent Res (1957) 36,39-47.
12. Philip N I, Prabhakar M, Arora D, Chopra S, "Applicability of the Moyers mixed dentition probability tables and new prediction aids for a contemporary population in India" Am J Orthod Dentofacial Orthop (2010)138,339-45.
13. Jaroontham J, Godfrey K, "Mixed dentition space analysis in a Thaipopulation" Eur J Orthod (2000) 22,127-34.
14. Supanee, Maratip, Hinkae W, "Accuracy of different methods for predicting size of unerutped canine and premolars" J Dent Assoc Thailand (1995) 45,189-92.
15. Kamalshikha Baheti, Prashant Babaji, Meer J Ali, Ashish Surana, Samvit Mishra, and Madhulika Shrivastava, "Evaluation of moyer's mixed dentition space analysis in Indian children" J Int. Soc. Prev. Community Dent. (2016) Sep-Oct, 6(5): 453-458.