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ORIGINAL ARTICLE

Comparison of Two Different Non-Radiographic Mixed Dentition Analysis

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Abstract

Objective: To evaluate the applicability of two different non-radiographic mixed dentition analysis in school going children of Aligarh district, India. **Material and Methods:** Mesiodistal dimension was measured on the dental casts of 120 school going children with electronic digital vernier caliper. The following inclusion criteria were adopted: presence of all fully erupted permanent teeth; no congenital craniofacial anomalies; no previous history of orthodontic treatment; and presence of intact dentition with no proximal caries, restoration, or age related attrition. Predicted values of canines and premolars were obtained from Moyer's at 75th percentile and Tanaka and Johnston mixed dentition analysis. Descriptive statistics were used to calculate the mean and standard deviation. Paired observations were compared by t-test. The level of significance was at $p<0.001$. **Results:** The mean difference between the predicted and the actual value of canines and premolars using Moyer's probability table at 75th percentile and Tanaka and Johnston regression equation were statistically significant. No significant differences were found between Moyer's analysis 75th percentile and Tanaka and Johnston mixed dentition analysis in both arch and sexes. **Conclusion:** These two non-radiographic mixed dentition analysis overestimated the mesiodistal width of canines and premolars.

Keywords: Dentition, Mixed; Orthodontics; Odontometry.

Introduction

An accurate prediction by mixed dentition space analysis is an important part of early orthodontic diagnosis and treatment planning. The commonly used methods for mixed dentition space analysis are: direct measurements on dental cast, measurement on radiographs and based on calculation of regression equations. Moyer's probability tables and Tanaka and Johnston's regression equations are commonly used mixed dentition analysis [1-3].

Moyer's developed probability tables to predict mesiodistal measurement of unerupted canine and premolars based on sum of four permanent mandibular incisors. It is widely used because it has following advantages: 1) less systematic error; 2) less time consuming with equal reliability; 3) can be used by beginner and expert; 4) doesn't require radiographs and sophisticated instruments and 5) used in both the archs. Currently, the 75th percentile level of Moyer's prediction tables is the globally used method to estimate the mesiodistal crown width of unerupted canines and premolars. This is based on the data obtained from an unspecified number of North American white children. However, the accuracy with this method is questionable when applied to a population of different ethnic origin [4,5].

Tanaka and Johnston developed simple linear regression equations to predict mesiodistal dimension of canines and premolars by using sum of four permanent mandibular incisors. It is widely used method with an acceptable accuracy for both the arches and sexes. It is very easy, simple and noninvasive space analysis method. Regression equations based analysis is a statistical process for estimating the relationship among variables. This analysis is also based on data obtained on North American Caucasian children so this method is less accurate for other population groups and appears to have systemic errors for specific race [6,7].

The present study was done to assess the reliability and applicability of two most commonly used non-radiographic mixed dentition analysis method in children of Aligarh district, Uttar Pradesh, India.

Material and Methods

Study Design and Sample

The present cross-sectional study was conducted on school going children (aged 11-14 years) of Aligarh District, Uttar Pradesh, India. One hundred and twenty children were selected from Out Patients Department of Pediatric and Preventive Dentistry, Dr. Z. A. Dental College and Hospital.

The following inclusion criteria were adopted: a) presence of all fully erupted permanent teeth; b) no congenital craniofacial anomalies; c) no previous history of orthodontic treatment; and d) presence of intact dentition with no proximal caries, restoration, or age related attrition.

As exclusion criteria, it was established: a) teeth with proximal restorations, proximal wear proximal caries or fracture as determined by clinical examination; b) teeth with hypoplasia or other dental anomalies which may alter the size, shape, number or form of the teeth; c) partially erupted teeth; and d) no retained deciduous teeth present in the dental arches.

Dental impressions of the selected children were recorded with irreversible hydrocolloid alginate impression material and casts were made immediately with dental stone to avoid any dimensional changes.

Measurement of Mesio-Distal Width

The greatest mesiodistal dimension of each tooth was measured between its contact points, with the digital sliding caliper placed parallel to the occlusal and vestibular surfaces [8].

Mixed Dentition Model Analysis

In the present study two non-radiographic mixed dentition analysis were used to predict the mesio-distal width of canine and premolars: 1) Tanaka and Johnston Method; 2) Moyer's (75th Percentile) Method.

- Tanaka & Johnston method: Y = a + bx; For Maxillary teeth, a = 11.0, b = 0.5; For Mandibular teeth, a = 10.5, b = 0.5; x = sum of four lower incisors.
- Moyer's (75th Percentile) Method - Moyer's Probability Table at 75th Percentile (Table 1).

Table 1. Moyer's Probability table at 75th percentile.

Total Mandibular Incisors Width	Predicted Width of Canines and Premolars	
	Maxilla	Mandible
19.5	20.6	20.1
20.0	20.9	20.4
20.5	21.2	20.7
21.0	21.3	21.0
21.5	21.8	21.3
22.0	22.0	21.6
22.5	22.3	21.9
23.0	22.6	22.2
23.5	22.9	22.5
24.0	23.1	22.8
24.5	23.4	23.1
25.0	23.7	23.4
25.5	24.0	23.7
26.0	24.2	24.0
26.5	24.5	24.0
27.0	24.8	24.6
27.5	25.0	24.8
28.0	25.3	25.1
28.5	25.6	25.4
29.0	25.9	25.7

Data Analysis

Data were analyzed using IBM SPSS Statistics for Windows Software, version 20 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to calculate the mean and standard

deviation. Paired observations were compared by paired t-test. The level of significance was set at $p<0.001$.

Ethical Aspects

This research project was approved by the Board of Studies, Department of Paediatric and Preventive Dentistry, Dr. Z. A. Dental College, AMU, Aligarh. Written and informed consent were obtained from the parents.

Results

The distribution of mean and standard deviation of mesiodistal width of maxillary canine and premolars in males measured by Moyer's analysis 75th percentile, Tanaka and Johnston and Actual value were 21.24 ± 0.624, 21.26 ± 0.678, 19.39 ± 1.346, respectively. On applying t-test, we had found the mean differences of mesiodistal width of maxillary canine and premolars in males between Moyer's analysis 75th percentile – Actual value (1.851) and Tanaka and Johnston - Actual value (1.874) were significant ($p<0.001$) (Tables 2 and 3 and Figure 1).

Table 2. Distribution of mesiodistal width of maxillary canine and premolars according to gender.

Method	Gender							
	Male				Female			
	Mean	N	SD	SDEM	Mean	N	SD	SDEM
Moyer's Analysis (75th Percentile)	21.24	60	0.624	0.081	21.16	60	0.495	0.064
Tanaka and Johnston Analysis	21.26	60	0.678	0.088	21.23	60	0.491	0.063
Actual Value	19.39	60	1.346	0.174	19.30	60	1.098	0.142

SDEM = Standard Error Mean.

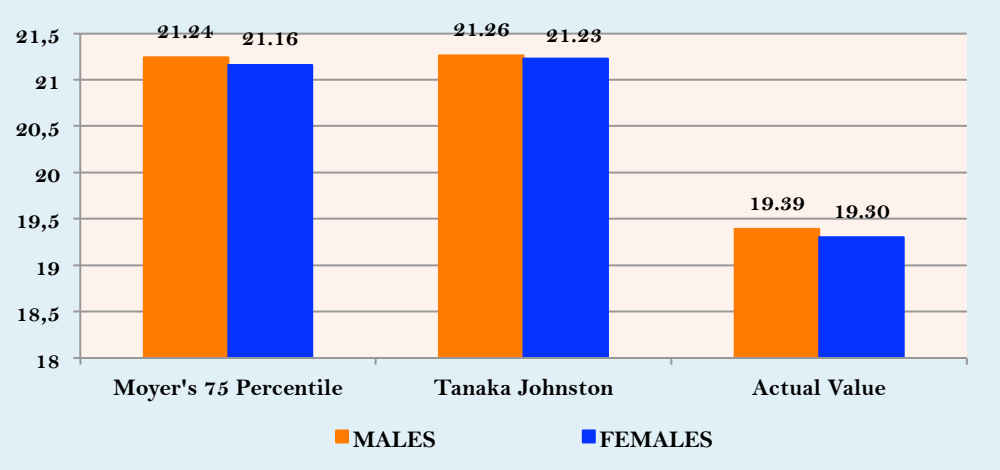

Figure 1. Means of mesiodistal width of maxillary canine and premolars according to gender.

The distribution of mean and standard deviation of mesiodistal width of maxillary canine and premolars in females measured by Moyer's analysis 75th percentile, Tanaka and Johnston and Actual value were 21.16 ± 0.495, 21.23 ± 0.491, 19.30 ± 0.142, respectively. On applying t-test, we had found the mean differences of mesiodistal width of maxillary canine and premolars in females

between Moyer's analysis 75th percentile – Actual value (1.865) and Tanaka and Johnston - Actual value (1.962) were significant (p<0.001) (Tables 2 and 3).

Table 3. Comparison of means of mesiodistal width of maxillary canine and premolars.

Gender and Method	Paired Differences					t	df	p-value
	Mean	SD	SDEM	95% CI				
				Lower	Upper			
Male								
Moyer's Analysis - Actual Value	1.851	1.139	0.147	2.145	1.557	12.585	59	0.000*
Tanaka and Johnston - Actual Value	1.874	1.121	0.145	2.164	1.584	12.945	59	0.000*
Female								
Moyer's Analysis - Actual Value	1.865	0.946	0.122	2.109	1.620	15.272	59	0.000*
Tanaka and Johnston - Actual Value	1.962	0.944	0.122	2.206	1.718	16.099	59	0.000*

SDEM = Standard Error Mean; *Significant: p<0.001; t-test.

The distribution of mean and standard deviation of mesiodistal width of mandibular canine and premolars in males measured by Moyer's analysis 75th percentile, Tanaka and Johnston and Actual value were 20.78 ± 0.665, 20.76 ± 0.677, 19.00 ± 1.283, respectively. We had found the mean differences of mesiodistal width of mandibular canine and premolars in males between Moyer's analysis 75th percentile – Actual value (1.787) and Tanaka and Johnston - Actual value (1.760) were significant (p<0.001). The distribution of mean and standard deviation of mesiodistal width of mandibular canine and premolars in females measured by Moyer's analysis 75th percentile, Tanaka and Johnston and Actual value were 20.72 ± 0.534, 20.74 ± 0.490, 18.97 ± 0.994, respectively. On applying t - test for two dependent groups we had found the mean differences of mesiodistal width of Mandibular canine and premolars in females between Moyer's analysis 75th percentile – Actual value (1.744) and Tanaka and Johnston - Actual value (1.784) were significant (p<0.001) (Tables 4 and 5, Figure 2).

Table 4. Distribution of mesiodistal width of mandibular canine and premolars according to gender.

Method	Gender							
	Male				Female			
	Mean	N	SD	SDEM	Mean	N	SD	SDEM
Moyer's Analysis (75th Percentile)	20.78	60	0.665	0.086	20.72	60	0.534	0.069
Tanaka and Johnston Analysis	20.76	60	0.677	0.087	20.74	60	0.490	0.063
Actual Value	19.00	60	1.283	0.166	18.97	60	0.994	0.128

SDEM = Standard Error Mean.

Table 5. Comparison of means of mesiodistal width of mandibular canine and premolars.

Gender and Method	Paired Differences					t	df	p-value
	Mean	SD	SDEM	95% CI				
				Lower	Upper			
Male								
Moyer's Analysis - Actual Value	1.787	0.986	0.127	-2.041	-1.532	-14.037	59	0.000*
Tanaka and Johnston - Actual Value	1.760	0.898	0.116	1.992	1.528	15.173	59	0.000*
Female								
Moyer's Analysis - Actual Value	1.744	0.794	0.103	1.949	1.538	17.008	59	0.000*
Tanaka and Johnston - Actual Value	1.784	0.781	0.101	1.986	1.582	17.693	59	0.000*

SDEM = Standard Error Mean; *Significant: p<0.001; t-test.

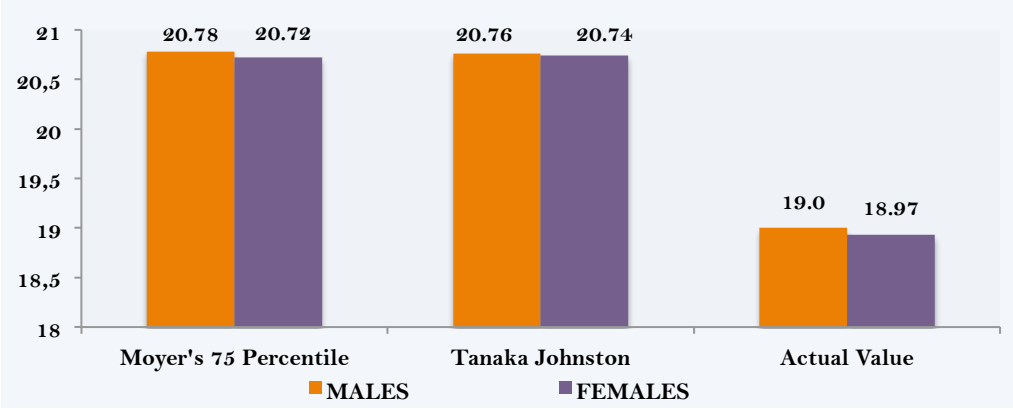

Figure 2. Means of mesiodistal width of mandibular canine and premolars according to gender.

Discussion

The correct Prediction of the mesiodistal width of unerupted permanent canines and premolars during the mixed dentition period is of clinical importance in early diagnosis and treatment planning [2,3].

Moyer's analysis 75th percentile and Tanaka and Johnston mixed dentition are based on dimensions of teeth of white North American children, but their applicability in different populations is questionable due to variation in tooth dimensions in different racial and ethnic groups. Therefore, the present study was conducted to see the applicability of two different non-radiographic most commonly used mixed dentition analysis in children within the age range of 11-14 years, of Aligarh district, located in Uttar Pradesh, India.

In the present study, the younger age group was selected as at this age permanent teeth erupt into the oral cavity and to minimize the alteration of the mesiodistal tooth width because of proximal caries, attrition and restoration [9]. Electronic Digital caliper was used for measuring the mesiodistal width of teeth on the dental cast.

In the present study, significant differences ($p<0.001$) were found between the predicted value of canine and premolars calculated by Moyer's analysis 75th percentile and Tanaka and Johnston mixed dentition analysis and actual values of canine and premolars recorded on dental cast in both arch and sexes. In comparison, no significant differences were found between Moyer's analysis 75th percentile and Tanaka and Johnston mixed dentition analysis in both arch and sexes.

In our study population, Moyer's analysis 75th percentile and Tanaka and Johnston mixed dentition analysis overestimated the mesiodistal width of canine and premolars in both the arches and both the sexes. Some authors reported that Moyers' probability tables are more accurate at some specific percentiles probability [1,10]. But in our study population, Moyer's analysis at 75th percentile overestimated the mesiodistal width of canine and premolars.

Moyer's method can be used at 65% probability level for males and at 75% and 85% level for maxillary arch and 50% and 65% level for mandibular arch in females [11]. Previous authors reported that Moyer's prediction tables are not an accurate method to estimate mesiodistal width of canine and premolars for their respective populations [5,12].

The mean difference between the actual and predicted values of canines and premolars using Moyer's method at 75th percentile and Tanaka-Johnston mixed dentition analysis were clinically and statistically significant. This is in accordance with previous studies [13-16].

Moyer's method at 75th percentile overestimated the actual value of canine and premolars except for the maxillary arch in female subjects as previsouly reported for Kodava population [17]. This result is partly similar to our study. The Moyer's probability tables significantly overestimated the mesiodistal widths of the permanent canine and premolars [18,19]. This result is similar to our study.

Tanaka and Johnston mixed dentition analysis overestimated the mesiodistal width of canine and premolars. The mean difference between the actual and predicted values of canines and premolars were clinically and statistically significant. This is in accordance with the literature [7,10-12,17,20-26]. Tanaka and Johnston method was very close to the actual values of canine and premolars therefore, this method can be reliable for mixed dentition analysis in their samples as previously reported for Pakistani population [1,27].

Many previous studies have confirmed the variability of these results when these two non-radiographic methods (Moyer's and Tanaka and Johnston) are used in children of different populations. The differences in the racial and ethnic origin of the population might explain these results.

Conclusion

Moyer's mixed dentition analysis at 75th percentile and Tanaka and Johnston method significantly overestimated the mesiodistal widths of the permanent canine and premolars of children of Aligarh district, Uttar Pradesh, India. Statistically significant and clinically relevant differences between the actual and predicted widths of canines and premolars were observed when Moyer's mixed dentition analysis at 75th percentile and Tanaka and Johnston method were applied to this population. So, these methods are not accurate for our study population.

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Conflict of Interest: The authors declare no conflicts of interest.

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