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Mixed dentition among patients attending dental opds in tertiary care hospitals in Rural Sindh

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Abstract

Objective:

To evaluate the applicability of Moyers and Tanaka-Johnston mixed dentition prediction methods among patients attending dental outpatient departments in tertiary care hospitals in rural Sindh, Pakistan.

Methods:

A cross-sectional study was conducted over six months, involving three hundred patients (150 males and 150 females) aged 8-12 years from Bhitai Dental and Medical College, Mirpurkhas. Patients selected had all sound erupted permanent teeth except second and third molars, with no history of orthodontic treatment. Mesiodistal widths of teeth were measured using Mitutoyo digimatic calipers. Data was analyzed using SPSS-16, employing Student's t-test, paired t-tests, and simple linear regression to derive new prediction equations.

Results:

Significant discrepancies were found between the predicted and actual widths of unerupted canines and premolars using Moyers and Tanaka-Johnston methods, indicating these methods are unsuitable for this population. New regression equations were derived for the local demographic.

Conclusion:

The Moyers and Tanaka-Johnston prediction methods are ineffective for the population in rural Sindh. The study recommends the development of localized prediction models and further multicenter studies with larger, diverse samples to refine these equations. These findings are crucial for accurate orthodontic treatment planning and improving patient outcomes**.**

Keywords: mixed dentition, Dental opds, Duckling stage, Tooth Eruption

Introduction

Only one such study has been conducted for Syrians, but it did not consider sex differences (1).Many studies on various populations have found differences in the tooth sizes between male and female subjects (2.3). Therefore, more studies are needed to evaluate the applicability of these two prediction methods for the Syrian population.

A more recent review reported that no statistically significant differences between males and females were found for LI mesiodistal size, unlike those of UCPM and LCPM, where males presented statistically higher mesiodistal sizes than females. These results for the LI agree with studies published on Taiwanese(4) and Indian(5) populations, but are contrary to studies on Brazilian,(6) Pakistani,(7) Turkish(8) or Thai(9) populations, where statistically significant differences were found in LI sizes, as well as in UCPM and LCPM sizes.

Abhijeet K, et al., reported that the differences between the predicted widths of the canine and premolars with the Tanaka and Johnston equations and the actual widths were highly statistically significant, as indicated by t-tests. The actual widths of the maxillary canine and premolars showed a significant difference in size (P = 0.0001) from the widths predicted by the Tanaka and Johnston equation, as did the canine and premolars in the mandible (P = 0.0003).(10)

A study conducted on Nigerian population came up with the results that the regression equations for the maxillary arch males: Y=0.49x+10.98, females: Y=0.47x+12.95, sexes combined: Y=0.47x+11.49, and the mandibular arch males: Y=0.54x+9.53, females: Y=0.39x+12.75, sexes combined: Y=0.51x+10.27 were derived.

No statistically significant differences ($p>0.05$) were observed in the mesiodistal widths of maxillary canine and premolars for combined sexes at 75th percentile, and in the mandibular arch for male at 85th percentile confidence levels when compared with those of the Moyers' probability tables, while there were statistically significant differences ($p<0.05$) at all the remaining percentile levels. Tanaka and Johnston's equations underestimated canine and premolars mesiodistal widths in the mandibular and maxillary arches.(11)

A study from Java Indonesia reported that the use of Moyers and Tanaka-Johnston prediction methods for mixed dentition analysis among Indonesian Javanese children were unsuitable. Both methods underestimated the size of canine-premolar segments, with exception of the Tanaka-Johnston method in females.(12) The study further found that the predictions for females were more precise than those obtained for males, using both Moyers and Tanaka-Johnston methods.

For males, both methods underestimated the predicted size of $\sum$ 3 4 5 in both the maxillary and mandibular segments. For females, the Tanaka-Johnston method

provided a good prediction with regard to the maxillary segment but showed an over estimation with regard to the mandibular segment, while Moyers method showed an under estimation in both segments. The absolute size difference between the actual size and predicted sizes of ∑3 4 5 using both prediction equations were found.(12)
According to a Spanish study;(13) Moyer's tables tend to under-estimate UCPM and LCPM in Spanish ancestry subjects, only being of use at the 75% level percentile for the mandible, both in males and females, and for the maxilla at the 85% and 90% level percentile for males and females respectively. Further, they reported that the estimates obtained from the Tanaka-Johnston equation tend to overestimate UCPM and LCPM sizes in Spanish ancestry subjects. The Spanish had derived new equations.
Males: UCPM = 12:68 + 0.42LI and LCPM = 11:71 + 0.44LI
Females: UCPM = 12:06 + 0.43LI and LCPM = 10:71 + 0.46LI
Some studies were performed to investigate the correlation between primary teeth and their successor permanent teeth. The prediction of unerupted permanent teeth can be done as early as possible in the primary dentition. However, studies(14,15) have failed to find high coefficient of correlation values.
Moyer's prediction values at 35th, 50th and 755th percentile have been found inaccurate for Indian population to estimate the mesiodistal dimension of cuspids and bicuspids. And significance variance was found between sizes of teeth of both sexes.
Buccal segments of both the arches were found larger in males then females mesiodistally with P values 0.0478 and 0.0001, respectively. So, a new equation was derived for males and females in Bhopal India for prediction of widths of unerupted canine and premolars.

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A study from Syria,(16) notified that at the 50 % level of Moyer's chart underestimated the widths of unerupted cuspids and bicuspids in males but very significantly accurate for females. On the other hand, 75th percentile was comparable to males but was overestimating the widths of females' unerupted canines and premolars. While Tanaka and Johnston's equations overestimated the actual values in both study groups.
Typically, the mesiodistal dimensions of unerupted canines and premolars have been increased from measurements of the erupted permanent mandibular incisors using the Tanaka and Johnston prediction equations.(17) Prediction techniques were developed using a population of "probable" North European ancestry. However, neither study qualified the exact origins of the sampled studied. Unlike Moyers, Tanaka and Johnston documented their sample size (506 subjects).(18)
In 1975, Bailit(19) discussed the variations in permanent tooth size that exist among different races. Comparisons of the mesiodistal dimensions of maxillary permanent teeth were conducted using a non-described sample of white Americans, Japanese, Australian Aborigines and Norwegian Lapps. From his data, Bailit concluded that permanent tooth size does vary among different races.
Specifically, the mesiodistal dimension of the first molar in Australian Aborigines was almost 10% larger than that found in Norwegian Lapps. He also noted that there were racial differences in the relative size of specific teeth. For example, populations of Asian ancestry have large upper lateral incisors compared to their centrals. This trait is not demonstrated in the other racial groups listed. Evidence of racial tooth size variability suggests that prediction techniques based on a single racial sample may not be considered universal.(20)
Therefore, it is of the utmost importance that prediction techniques are interpreted relative to respective racial norms, since failure to consider tooth size racial variations would render the interpretation of Tanaka and Johnston prediction equations as misleading and erroneous.(17)

Material and Methods:
A study was conducted over six months following the approval of the synopsis, with data collected from patients attending dental OPDs in various Dental Schools in

Male (n=150) / Tooth Group	Minimum	Maximum	Mean	Std. Dev.
Maxil_incisors	21.50	22.70	21.40	2.40
UCPM	19.90	23.20	21.45	1.67
Mandi_incisors	19.20	20.50	19.39	2.47
LCPM	19.70	22.50	21.10	1.56

Karachi and Hyderabad. A total of three hundred patients, comprising 150 males and 150 females aged 8-12 years, were selected using a convenient (non-probability) sampling technique in a cross-sectional comparative study. The inclusion criteria required patients to have all sound erupted permanent teeth, except the second and third molars, and no history of orthodontic treatment. Exclusion criteria included interproximal caries or restorations, missing or supernumerary teeth, abnormal tooth size or morphology, and tooth wear. Dental impressions of the upper and lower arches were taken using alginate impression material and poured with dental stone. The mesiodistal width of teeth, from the right upper first molar to the left first molar, was measured using a Mitutoyo digimatic caliper to the nearest 0.1 mm, with measurements taken from anatomical contact points on the buccal surfaces, parallel to the occlusal plane. For rotated and malposed teeth, measurements were averaged from multiple readings if necessary. Data analysis was performed using SPSS-16, with Student's t-test and paired t-tests comparing tooth sizes. Simple linear regression was used to derive prediction equations for the widths of canines and premolars. Probability tables for predicting the mesiodistal widths of unerupted teeth were created separately for males and females in both arches.

Female (n=150) / Tooth Group	Minimum	Maximum	Mean	Std. Dev.
Maxil_incisors	21.40	22.40	19.36	1.44
UCPM	20.00	23.20	21.43	1.65
Mandi_incisors	21.30	22.50	20.33	2.45
LCPM	19.80	23.10	21.17	1.61

Results:

Table 1 & 2 three shows the descriptive data of measurements of 3 tooth groups (i-e; the maxillary incisors, maxillary canine + premolars & mandibular incisors & mandibular canine + premolars separately of males and females.

Table 1. The sum of mesiodistal width of the mandibular incisors, mandibular and maxillary canines, and premolar teeth.

. Table 2. The sum of mesiodistal width of the mandibular incisors, mandibular and maxillary canines, and premolar teeth.

Difference of all teeth mesiodistal crown widths measurements of male and female regarding gender were tested by applying student's t-test. There were slight differences found with highly significant p values (Table 3).

Table 3. Gender differences for all teeth.

	Gender	Mean	Std. Deviation	Mean difference	P value
Upper premolar	M	6.70	0.354	-0.270	0.0467
	F	6.75	0.378		
Upper canine	M	7.47	0.334	0.680	0.0160
	F	7.45	0.337		
Upper lateral incisor	M	6.26	0.269	0.467	0.0227
	F	6.29	0.271		
Upper Central Incisor	M	5.10	0.320	-0.665	0.0153
	F	5.12	0.293		
Lower central incisor	M	5.08	0.366	-0.346	0.0393
	F	5.11	0.356		
Lower Lateral incisor	M	6.26	0.255	0.480	0.0220
	F	6.28	0.283		
Lower Canine	M	7.32	0.317	-0.971	0.0013
	F	7.32	0.321		
Lower Premolar	M	7.23	0.343	0.113	0.0633
	F	7.17	0.348		
Maxil_ incisor	M	21.36	0.443	0.440	0.0380
	F	21.40	0.408		
UCPM	M	21.43	0.651	0.747	0.0246
	F	21.46	0.674		
Mandi_ incisor	M	20.34	0.453	-0.252	0.0613
	F	20.40	0.472		
LCPM	M	21.18	0.619	-0.281	0.0740
	F	21.10	0.567		

To formulate new probability tables on our population like those prepared by the Moyers; we used the regression equations derived in this study on parameters or local population. These tables are presented in tables 4 through 7.

Here it is also important to mention that Moyers prediction (75th percentile) tables and Tanaka and Johnston's prediction equation were compared with the actual sums of the widths of the canines and premolars in both arches in this study. It was noted that there were significant differences (P values <0.05) for both prediction methods when applied to our local population. It confirms the point that the Tanaka and Johnston's prediction equation are not applicable in local population.

Table 4. Probability tables for predicting the mesiodistal widths of unerupted mandibular canines and premolars.

Males													
Percentile	19.5	20	20.5	21	21.5	22	22.5	23	23.5	24	24.5	25	25.5
95%	20.98	20.35	21.56	21.91	22.22	22.6	22.89	23.23	23.54	23.92	24.23	24.56	24.91
85%	20.96	21.24	21.54	21.9	22.2	22.59	22.87	23.22	23.53	23.9	24.22	24.54	24.9
75%	20.55	21.02	20.33	21.58	21.89	22.27	22.55	22.9	23.21	23.59	23.9	24.23	24.58
65%	20.5	20.95	21.08	21.43	21.74	22.12	22.41	22.75	23.06	23.44	23.75	24.08	24.43
50%	20.33	20.7	21.01	21.36	21.67	22.05	22.34	22.68	23	23.37	23.69	24.01	24.37
35%	21.05	20.56	20.99	20.36	21.46	21.84	22.15	22.47	22.75	23.1	23.37	23.71	24.05
25%	20.17	20.47	20.76	21.09	21.4	21.74	22.02	22.39	22.69	23.03	23.31	23.62	24.01
15%	19.98	20.36	20.61	20.96	20.39	21.64	21.95	22.29	22.59	22.97	23.28	23.65	23.98
5%	19.91	21.08	20.58	20.94	20.34	21.6	21.91	22.26	22.57	22.95	23.26	23.59	23.94

Table 5. Probability tables for predicting the mesiodistal widths of unerupted mandibular canines and premolars.

Females													
Percentile	19.5	20	20.5	21	21.5	22	22.5	23	23.5	24	24.5	25	25.5
95%	20.96	20.33	21.59	21.89	22.25	23.54	22.91	23.26	23.55	23.92	24.26	24.57	25.88
85%	20.94	21.22	21.57	21.88	22.23	23.53	22.89	23.25	23.54	23.9	24.25	24.55	25.87
75%	20.53	21	20.36	21.56	21.92	23.21	22.57	22.93	23.22	23.59	23.93	24.24	25.55
65%	20.48	20.93	21.11	21.41	21.77	23.06	22.43	22.78	23.07	23.44	23.78	24.09	25.4
50%	20.31	20.68	21.04	21.34	21.7	22.99	22.36	22.71	23.01	23.37	23.72	24.02	25.34
35%	21.03	20.54	21.02	20.34	21.49	22.78	22.17	22.5	22.76	23.1	23.4	23.72	25.02
25%	20.15	20.45	20.79	21.07	21.43	22.68	22.04	22.42	22.7	23.03	23.34	23.63	24.98
15%	19.96	20.34	20.64	20.94	20.42	22.58	21.97	22.32	22.6	22.97	23.31	23.66	24.95
5%	19.89	21.06	20.61	20.92	20.37	22.54	21.93	22.29	22.58	22.95	23.29	23.6	24.91

Table 6. Probability tables for predicting the mesiodistal widths of unerupted maxillary canines and premolars.

Males													
Percentile	19.5	20	20.5	21	21.5	22	22.5	23	23.5	24	24.5	25	25.5
95%	19.95	18.7	18.25	20.89	21.11	21.52	21.93	21.46	22.34	22.68	22.88	23.54	23.86
85%	19.93	19.59	19.14	20.88	21.09	21.51	21.91	21.45	22.33	22.66	22.87	23.52	23.85
75%	19.52	19.37	18.92	20.56	20.78	21.19	21.59	21.13	22.01	22.35	22.55	23.21	23.53
65%	19.47	19.3	18.85	20.41	20.63	21.04	21.45	20.98	21.86	22.2	22.4	23.06	23.38
50%	19.3	19.05	18.6	20.34	20.56	20.97	21.38	20.91	21.8	22.13	22.34	22.99	23.32
35%	20.02	18.91	18.46	19.34	20.35	20.76	21.19	20.7	21.55	21.86	22.02	22.69	23
25%	19.14	18.82	18.37	20.07	20.29	20.66	21.06	20.62	21.49	21.79	21.96	22.6	22.96
15%	18.95	18.71	18.26	19.94	19.28	20.56	20.99	20.52	21.39	21.73	21.93	22.63	22.93
5%	18.88	19.43	18.98	19.92	19.23	20.52	20.95	20.49	21.37	21.71	21.91	22.57	22.89

Table 7. Probability tables for predicting the mesiodistal widths of unerupted maxillary canines and premolars.

Females													
Percentile	19.5	20	20.5	21	21.5	22	22.5	23	23.5	24	24.5	25	25.5
95%	20.06	19.23	18.23	21.02	21.39	21.73	21.83	22.2	22.44	22.87	23.32	23.57	23.68
85%	20.04	20.12	19.12	21.01	21.37	21.72	21.81	22.19	22.43	22.85	23.31	23.55	23.67
75%	19.63	19.9	18.9	20.69	21.06	21.4	21.49	21.87	22.11	22.54	22.99	23.24	23.35
65%	19.58	19.83	18.83	20.54	20.91	21.25	21.35	21.72	21.96	22.39	22.84	23.09	23.2
50%	19.41	19.58	18.58	20.47	20.84	21.18	21.28	21.65	21.9	22.32	22.78	23.02	23.14
35%	20.13	19.44	18.44	19.47	20.63	20.97	21.09	21.44	21.65	22.05	22.46	22.72	22.82
25%	19.25	19.35	18.35	20.2	20.57	20.87	20.96	21.36	21.59	21.98	22.4	22.63	22.78
15%	19.06	19.24	18.24	20.07	19.56	20.77	20.89	21.26	21.49	21.92	22.37	22.66	22.75
5%	18.99	19.96	18.96	20.05	19.51	20.73	20.85	21.23	21.47	21.9	22.35	22.6	22.71

Discussion:

In the day-to-day emerging practice of dentistry, it has become almost mandatory to be able to predict the size of unerupted tooth. It is not only crucial to for selecting the appropriated therapy but also gives an edge to the practice of dentist and increases the satisfaction of patient.(3,12,14,21) For this purpose the analysis and measurement of the space from mesial side of first permanent molar of one side to the mesial side of the lateral incisor on the same side is done. It is done so as to achieve a larger 'r' value and thus one can more accurately predict the size of unerupted teeth. It is commonly performed by the different researchers that they used the sum of upper primary first molars to predict the sum of unerupted canines and premolars of both sides. (21)

Moyers and Tanaka methods have been used by several researchers but have not found them accurate to predict the widths of unerupted cuspids and bicuspids for Pakistan population.(22,23)

Rasool G et al. (2008) tested applicability of regression equation established by Melgaco to predict mesiodistal width of unerupted mandibular cuspid and bicuspid from sum of mandibular incisors and first molars. They concluded that this equation is not appropriate in males while it can be applied to females in Islamabad population (one hundred males, 100 females).(24)

In 2011, separate prediction equations for males and females were developed to estimate MDW of unerupted canine and premolars was developed from sum of MDW mandibular incisors and mandibular first for Karachi population (106 males, 182 females).(24)

Bherwani et al (2011) established a regression equation to predict mesiodistal width of maxillary and mandibular canine and premolars. They used mesiodistal width of mandibular incisors with significant correlation for maxillary arch (r=0.65) and mandibular arch (r=0.59) on Karachi population (100 boys, 100 girls).(25) They reported no significant gender difference in tooth sizes which contrasts with the results of other researchers of the country.(24,26)

Separate equations for both genders and both arches must be developed to get more accuracy in prediction. Inaccurate mixed dentition space analysis may lead to unnecessary extractions and poor patient's facial profile.(21)

Conclusion

In previously conducted study in Pakistan there was only use of Mandibular incisors alone; and combination of Mandibular incisors and mandibular first molar to estimate the mesiodistal width of unerupted canine & premolars. Therefore, the applicability of Moyers and Tanaka and Johnston prediction was evaluated in the current study.

The current study has produced the conclusion that the mixed dentition space analysis of Moyers and Tanaka and Johnston are not of use in the local population. For our local population we need regression/ prediction equation which is based on local data. The current study has given the equation especially from the population of Sindh.

Recommendations

The current study also recommends conducting a multicenter study with larger & diverse samples to work up and accurately define the estimation of size of unerupted canine and premolars in our population. This will remove all the differences among tooth size and arch perimeter and will further help us in providing appropriate treatment on proper time.

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Author's Contribution:

Dr. Atif Mahmood: Research design and Drafting manuscript
Dr. Ali Maqbool: Data interpretation and final revision
Dr. Naveed Ahsan: Project Designing and data interpretation.
Dr. Muhammad Anique: Critical analysis and final revision
Dr. Muhammad Nazir: Data interpretation and revisions
Dr. Tariq: Referencing writing and Critical Revision