ORIGINAL ARTICLE

Applicability of Different Mixed Dentition Analyses among Children Aged 11–13 Years in Chennai Population

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Abstract

Introduction: Mixed dentition is the stage where both primary and permanent teeth are present and hence is the time for developing occlusion. Mixed dentition analysis forms an essential part of an orthodontic assessment. Moyer's method which is commonly used for this analysis is based on data derived from a Caucasian population. Tanaka–Johnston developed prediction tables comparable with that of Moyer's from teeth measurement study models.

Aim: To test the reliability of Moyer's and Tanaka–Johnston's mixed dentition space analyses among children in Chennai.

Materials and methods: The mesiodistal measurements of the mandibular incisors, maxillary canines, and premolars were taken by measuring the greatest distance between the contact points on the proximal surfaces using a dental digital caliper set on dental casts of 1,000 children. Predicted values were obtained using Moyer's probability analysis at the 75th percentile and Tanaka–Johnston method. The statistical analysis for both sexes was done using Student's *t* test and unpaired *t* test.

Results: On application of the statistical analysis after the collection of data, it was found that the mean value in males was higher than the actual values in maxillary right and left sides when compared with the mandibular right and left sides while employing Moyer's method. The standard deviation (SD) was higher in the actual values when compared with the predicted values. Statistically significant values were obtained for the maxillary left side and the mandibular left side, but there was no statistical difference in the maxillary and mandibular right sides. Among females, it was found that the actual values had a higher mean value in the maxillary arch when compared with the mandibular arch than the values obtained when Moyer's formula was applied.

Conclusion: Both Moyer's and Tanaka–Johnson's mixed analyses when applied to children in Chennai tended to show that predicted values were higher than actual values with no significant differences observed among the regression equations.

Keywords: Mixed dentition, Moyer's analysis, Tanaka–Johnson analysis.

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Introduction

The phase of mixed dentition begins at the age of 6 with the eruption of the first molars. This period is used to assess the future spacing or crowding events, thus predicting the dental development in the child. This plays an important role in orthodontic treatment.[1–3] Hence, it is important to analyze the space required for the unerupted canine and premolar before their eruption by a method called mixed dentition analysis. The importance of this is to predict the space taken up after the eruption of the canine and premolar compared with the available space. This will lead to clear-cut projection of the potential discrepancies and hence may necessitate interceptive orthodontics to prevent undesirable outcomes and aids in the proper alignment and treatment planning of the patient. The treatment plan may involve serial extractions, eruption guidance, regaining of space, space maintenance, or simple observation of patient for the time period is required.[4–6]

A mixed dentition analysis can be done by various methods: Moyer's analysis, Tanaka–Johnston's method, Hixon and Oldfather's method, Staley Kerber's method, Huckaba's method, and Ballard and Wylie's method. Radiographic, non-radiographic, and a combination of these two methods are employed for a mixed dentition analysis.[7] Depending on the age of the patient, the mixed dentition analysis is done to assess the available space, allowing intervention to reduce the chances of malocclusion. An accurate mixed dentition analysis with respect to the tooth size and arch length leads to an accurate prediction of the mesiodistal widths of the unerupted canines and premolars. Hence, this plays in important role in evaluating the degree of crowding in the mixed dentition. Moyer's method was found in 1958 which is used to predict the mesiodistal width of the unerupted canine and premolars based on the width of the mandibular incisors. It has been widely used and popularized by Profit and Ackerman due to its many advantages such as being time efficient, ease of use, minimal errors, and ability to apply to both maxilla and mandible.[8,9] Similarly, Tanaka–Johnston's method (1974) is an easy method which has high accuracy and is efficient due to its applicability to both the maxilla and mandible in both genders.[10]

Moyer's and Tanaka–Johnston's methods, though widely used, have been restricted to the people of North European descent. It

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has been of popular opinion that there have been secular trends and sexual dimorphisms when these methods have been applied to other populations of different ethnicities. The parallelism between the size of the teeth and the size of the arch forms the basis of these methods; hence, it becomes questionable when applied to different populations necessitating the need for simultaneous modifications that have to be progressively made in order to be applicable for all populations. As stated by Balilt and Lavelle, the tooth sizes change according to the sex and show variations within a population. Hence, this study aims at evaluating the applicability of the two mixed dentition analyses in Chennai population.[11,12]

Materials and Methods

The ethical approval for this study was obtained from the Ethical Committee Board of Saveetha Dental College (STP/SDBDS16PED4-A). The present study was conducted in the Department of Pedodontics and Preventive Dentistry of Saveetha Dental College and Hospitals. The subjects for this study were derived from the existing diagnostic records of the Department of Pedodontics and Preventive Dentistry, Saveetha Dental College and Hospitals. Informed consent was obtained from all the subjects. This cross-sectional study had a sample size of 1,000 subjects (500 boys and 500 girls) between the age groups of 11 years and 15 years across a period of 4 months. The inclusion criteria were no history of orthodontic treatment, indigenous subjects of Chennai origin with permanent dentition in both jaws, patient should be free from systemic disease, and high-quality dental casts without any distortion. The exclusion criteria were casts with proximal restorations or fractures and study models without dental anomalies. High-quality study models were used for the study. The impressions were taken using alginate, and casts were prepared using high-quality dental stone. The mesiodistal measurements were taken by measuring the greatest distance between the contact points on the proximal surfaces using a dental digital caliper set nearest to 0.01 mm and parallel to the occlusal surface of the tooth in normal alignment. The sum of the mesiodistal measurements of the mandibular incisors and the combined width of the maxillary canines and premolars was measured on both the quadrants. The expected mesiodistal width of the maxillary and mandibular canines and premolar is calculated using Moyer's mixed dentition analysis for both the sexes along with Tanaka–Johnston's method. The statistical analysis was done using Statistical Package for Social Sciences version 15.0 statistical analysis software. The actual and predicted widths calculated using Moyer's and Tanaka–Johnston's methods were used to calculate the mean and the SD in both the genders. The comparison and correlations were done using the Student's *t* test between the actual and predicted sum.

Results

Among females, it was found that the actual values had a higher mean value in the maxillary arch when compared with the mandibular arch than the values obtained when Moyer's formula was applied. The actual values had a higher SD values in the maxillary and mandibular arches than the predicted values. There was a statistical significance observed in the mandibular arch when compared with the maxillary arch with a *p* value being lesser then 0.001 (Table 1).

On application of the statistical analysis, it was found that the mean value when Moyer's method was used in males was higher than the actual values in maxillary right and left sides when compared with the mandibular right and left sides. The SD was higher in the actual values than the predicted values. Statistically significant values were found for the maxillary left side and the mandibular left side, but there was no statistical difference in the maxillary and mandibular right sides (Table 2).

Among the females, there was a significant difference in both the maxillary and mandibular arches. The mean of the actual values was lower in both the maxilla and mandibular arches than the predicted values with the SD being higher in both the arches for the actual values (Table 3).

On comparison of the actual values and the predicted values on application of Tanaka–Johnston's method for males, it was found that the mean of the actual values obtained was lower in the maxillary when compared with the mandible than the predicted values. The SD for the actual values was higher than the predicted values with only the mandibular right side being of statistical significance. There was no significant difference in the maxillary arch (Table 4).

Discussion

The mixed dentition phase plays a vital role in the developmental phase as the final skeletal growth and the occlusal relationship is formed and hence can be actively utilized in order to predict the sizes of the permanent dentition.[13] It is regarded as a crucial phase

Table 1: Actual and predicted values of females using Moyer's method

Measurement (females)	*Actual*		*Predicted (Moyer's)*		*Significance of difference (paired t test)*	
	Mean	*SD*	*Mean*	*SD*	*t*	*p*
Maxillary right	21.45	1.6	21.08	0.4	0.23	0.988
Maxillary left	21.36	1.81	21.08	0.4	1.8	0.127
Mandibular right	20.46	1.48	20.96	0.78	5.83	0.0008
Mandibular left	20.44	1.54	20.96	0.79	4.99	0.005

Table 2: Actual and predicted values of males using Moyer's method

Measurement (males)	*Actual*		*Predicted (Moyer's)*		*Significance of difference (paired t test)*	
	Mean	*SD*	*Mean*	*SD*	*t*	*p*
Maxillary right	22.47	2.66	22.5	0.85	5.93	0.002
Maxillary left	22.37	2.47	22.5	0.85	5.46	0.001
Mandibular right	22.52	3.77	22.31	0.49	1.81	0.087
Mandibular left	22.50	3.39	22.31	0.49	2.05	0.001

Table 3: Actual and predicted values of females using Tanaka–Johnston's method

	Actual		*Predicted (Tanaka–Johnston's)*		*Significance of difference (paired t test)*	
Measurement (females)	*Mean*	*SD*	*Mean*	*SD*	*t*	*p*
Maxillary right	21.45	1.60	22.19	0.88	6.86	0.0003
Maxillary left	21.36	1.81	21.81	0.88	3.26	0.001
Mandibular right	20.46	1.48	21.63	0.92	6.29	0.0007
Mandibular left	20.47	1.54	21.62	0.92	3.99	0.0009

Table 4: Actual and predicted values of males using Tanaka–Johnston's method

	Actual		*Predicted (Tanaka–Johnston's)*		*Significance of difference (paired t test)*	
Measurement (males)	*Mean*	*SD*	*Mean*	*SD*	*t*	*p*
Maxillary right	22.47	2.66	22.54	0.86	3.52	0.007
Maxillary left	22.37	2.47	22.54	0.86	3.87	0.004
Mandibular right	22.52	3.77	22.06	0.85	1.68	0.032
Mandibular left	22.50	3.39	22.06	0.85	1.68	0.052

to recognize the deviations from a normal mixed dentition and facilitating timely correction by recognizing the size of the teeth, arch size, and the space available. The dentist can assess the space available for the permanent dentition and accordingly plan the treatment by interceptive treatment options including extraction, space maintainers, and future orthodontic treatment.

The mixed dentition involves three phases, the first transitional phase, inter-transitional phase, and second transitional phase. The first transitional phase occurs at about 6–12 years of age and is indicated by the emergence of the permanent incisors and molars and the establishment of occlusion. The inter-transitional phase is a stagnant period; no changes occur for about 2 years. During this phase, the permanent molars are present along with the deciduous canine and molars. In the second transitional phase, which occurs during 9–10 years of age, the ugly duckling stage would be corrected and the posterior teeth completely erupted. The permanent mandibular incisors and the first permanent molars are needed for the space analysis to be performed.[14] It acts as a guide for potential orthodontics treatment planning.[6]

The space analysis is done by many methods, which can be radiographic, non-radiographic and can involve a combination of both, in which cephalometric and periapical radiographs are used. The various methods of space analysis are Moyer's method, Tanaka–Johnston's method, Hixon and Oldfather's method, Nance's method, Ballard and Wylie's method, Huckaba's method, and Stanley Kerber's method. In this, Nance's method and Huckaba's method require the need of radiographs. Moyer's method, Tanaka–Johnston's method, and Ballard and Wylie's method do no need radiographs for the evaluation of space, while the Hixon and Oldfather's method and Stanley Kerber's method is a combination of both radiographic and non-radiographic methods.[14–19] The space analysis which does not involve the use of radiographs makes use of study models which are made either out of dental stone or plaster and have specific tables or charts which are used to predict the values. The study models help us to get a clear perspective of the occlusion and the severity of malocclusion, thus helping us to be more precise with the prediction of the unerupted teeth. The space analysis is done by predicting the mesiodistal width of the permanent unerupted canine and premolar with the help of measuring the mesiodistal width of the lower inscisors.

Moyer's method and Tanaka–Johnston's method are two of the most commonly used methods because of the various advantages. Moyer's method has been widely advocated because it is known to have minimum systematic error, easy and simple to use, reliable, and can be used for both maxilla and mandible.[20] Tanaka–Johnston's method has similar advantages with the key feature being that it does not require a prediction chart unlike Moyer's method. However, both these methods have been derived, used and seem to be precise only when it is applied to Caucasian population with a significant overestimation or underestimation of values when otherwise applied to people of other ethnicities. Hence, they cannot be universally applied. Moyer's method has other disadvantages as it is a probability analysis, and it does not account for the lingual and buccal tipping of the mandibular incisors. Moyer's method led Tanaka and Johnston to give prediction tables similar to Moyer's using the values of the measurement from the teeth and led to the formulation of regression equations which can be applied to obtain the combined mesiodistal widths of the unerupted canines and premolars.[6,21] Due to the continuously progressive secular trends, this indicates the need for a continuous modification in dimensions among the different races and hence has to be revised periodically.

In this study, the study models that were used were made of high-quality type III dental stone on children with the maximum age limit of 15 years which reduced the chances of physiological and pathological discrepancies that could alter the result of the study. The deciduous teeth are never considered for the mixed dentition analysis due to the fact that the deciduous teeth and the permanent teeth having a weaker correlation. The loss of deciduous teeth prematurely either by extraction or by exfoliation can lead to the loss of spaces due to the migration of the adjacent teeth, and to prevent this, the usage of space maintainers is required.[22] This loss of space becomes more significant when the first molar is affected either by premature extraction or exfoliation.[23–25] The mandibular incisors, being one of the earliest teeth to erupt in the oral cavity, are thus chosen for measurement as it is found to be commonly involved in problems of space management. The maxillary incisors are not preferred because they vary in size and on correlation with the other teeth is found to be of weaker significance.[26]

In this study, it was found that there was a statistical significance between the measurements of the mesiodistal widths of males and females. This is in line with a study conducted by Grover et al. and Nuvvula et al.[6,27] In this study, it was found that Tanaka–Johnston's method tended to overestimate the mesiodistal widths of both the maxilla and the mandible for females as it had statistical significance

with a *p* value less than 0.001. This is similar to a study conducted by Grover et al., wherein both the maxillary and mandibular arches in the females had values higher predicted values than the actual values.[6] In a study conducted in Saudi Arabian population by Al-Khadra in 1993, the buccal segments were found to be overestimated.[28] In a population study conducted in the Kodava population, the predicted values of the mandibular canines and premolars in females were overestimated in a study conducted by Ramesh et al which is similar to the results of this study.[29] In a study conducted in the Nalgonda population by Manjula et al., Tanaka–Johnston's method showed a significant overestimation of the mesiodistal widths in both the maxillary and the mandibular arches, but occurred in both males and females.[30] In a study conducted in the Sri Lankan and Ugandan population by Diagne et al. and Buwembo et al., the values were overestimated than the actual values.[13,31]

Conclusion

Based on the results from our study, it is found that the current methods of mixed dentition analysis require periodic modifications according to the secure area trends, races, and gender. When applied to the Chennai population, these methods overestimate the values, and hence, a modification of the current method is required to derive accurate results. Based on this study, it is also recommended to have a standardization of these values for Asian population to which will benefit the dentist in coming up the most accurate treatment plan for children needing occlusion correction.

References

1. Juneja S, Mahajan N, Kaur H, et al. Comparative evaluation of three mixed dentition analyses and formulation of regression equations for North Indian population: A cross-sectional study. Biomed J 2015;38(5):450–455. DOI: 10.4103/2319-4170.161333.
2. Thimmegowda U, Sarvesh SG, Shashikumar HC, et al. 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(8):ZC01–ZC06. DOI: 10.7860/JCDR/2015/13384.6269.
3. Hammad SM, Abdellatif AM. Mixed dentition space analysis in Egyptian children. Pediatric Dental J 2010;20(2):115–121. DOI: 10.1016/S0917-2394(10)70203-2.
4. Melgaço CA, de Sousa Araújo MT, de Oliveira Ruellas AC. Mandibular permanent first molar and incisor width as predictor of mandibular canine and premolar width. Am J Orthod Dentofacial Orthop 2007;132(3):340–345. DOI: 10.1016/j.ajodo.2005.07.033.
5. Schirmer UR, Wiltshire WA. Orthodontic probability tables for black patients of African descent: Mixed dentition analysis. Am J Orthod Dentofacial Orthop 1997;112(5):545–551. DOI: 10.1016/s0889-5406(97)70082-9.
6. Grover N, Saha S, Tripathi AM, et al. Applicability of different mixed dentition analysis in Lucknow population. J Indian Soc Pedod Prev Dent 2017;35(1):68–74. DOI: 10.4103/0970-4388.199220.
7. Kondapaka V, Sesham VM, Neela PK, et al. A comparison of seven mixed dentition analysis methods and to evaluate the most reliable one in Nalgonda population. J Indian Orthod Soc 2015;49(1):3–9. DOI: 10.4103/0301-5742.158626.
8. Buwembo W, Luboga S. Moyer's method of mixed dentition analysis: a meta-analysis. Afr Health Sci 2004;4(1):63–66.
9. Durgekar SG, Naik V. Evaluation of Moyers mixed dentition analysis in school children. Indian J Dent Res 2009;20(1):26–30. DOI: 10.4103/0970-9290.49056.
10. Arsalan W, Sidra B, Saima C, et al. Mixed dentition space analysis: A review. PODJ 2012;32.
11. Bishara SE, Fernandez Garcia A, Jakobsen JR, et al. Mesiodistal crown dimensions in Mexico and the United States. Angle Orthod 1986;56(4):315–323. DOI: 10.1043/0003-3219(1986)0562.0.CO;2.
12. Ahluwalia P, Jodhka S, Thomas AM. Prediction of mesio-distal width of canines and premolars in a sample of North Indian population. Indian J Dent Adv 2011;3(03):568–571. DOI: 10.5866/3.3.568.
13. Diagne F, Diop-Ba K, Ngom PI, et al. Mixed dentition analysis in Senegalese population and elaboration of prediction tables. Am J Orthod Dentofacial Orthop 2003;124(2):178–183. DOI: 10.1016/s0889-5406(03)00390-1.
14. Vishnu Prasad S, Madan K, Mahesh R, et al. Report on oral health status and treatment needs of 5-15 years old children with sensory deficits in Chennai, India. Spec Care Dentist 2018;38(1):58–59. DOI: 10.1111/scd.12267.
15. Ballard ML, Wylie W. Mixed dentition case analysis-estimating size of un-erupted permanent teeth. Am J Orthod 1947;33(11):754–759. DOI: 10.1016/s0096-6347(47)90073-2.
16. Nance HN. The limitations of orthodontic treatment: Mixed dentition diagnosis and treatment. Am J Orthod 1947;33(4):177–223. DOI: 10.1016/0096-6347(47)90051-3.
17. Ganesh J. Premature loss of primary teeth and developing malocclusion: A review. J Pharma Res 2018;12(2):190–193.
18. Foster RR, Wylie WL. Arch length deficiency in the mixed dentition. Am J Orthod 1958;44(6):464–476. DOI: 10.1016/0002-9416(58)90004-6.
19. Tanaka MM, Johnston LE. The prediction of un-erupted canines and premolars in a contemporary population. J Am Dent Assoc 1974;88(4):798–801. DOI: 10.14219/jada.archive.1974.0158.
20. Staley RN, O'Gorman TW, Hoag JF, et al. Prediction of the widths of un-erupted canines and premolars. J Am Dent Assoc 1984;108(2):185–190. DOI: 10.14219/jada.archive.1984.0436.
21. Philip NI, Prabhakar M, Arora D, et al. Applicability of the Moyers mixed dentition probability table and new prediction aids for a contemporary population in India. Am J Orthod Dentofacial Orthop 2011;140(5):626–632. DOI: 10.1016/j.ajodo.2011.02.024.
22. Andreeva RS, Arnautska HI, Belcheva AB, et al. Loss of space according to the time and the type of the premature extracted deciduous teeth. J Imab 2016;22(2):1169–1171. DOI: http://dx.doi.org/10.5272/jimab.2016222.1169.
23. Mutafchiev V, Krumova V, Jordanov V. (Orthodontia for general practitioners.) (In Bulgarian) Nemezida Sofia. 2003. 311–314.
24. Petrunov V. Epidemiological re- search of malocclusions and the need of orthodontic treatment among the Bulgarians in the mixed to permanent dentition period. (In Bulgarian) Disertation, Sofia 2012. 62.
25. Prabhu N, Alexander S, Wong P, et al. Erythromelalgia presenting with premature exfoliation of primary teeth: a diagnostic dilemma. Pediatr Dent 2012;34(5):422–426.
26. Abu Alhaija ES, Qudeimat MA. Mixed dentition space analysis in a Jordanian population: Comparison of two methods. Int J Paediatr Dent 2006;16(2):104–110. DOI: 10.1111/j.1365-263X.2006.00700.x.
27. Nuvvula S, Vanjari K, Kamatham R, et al. Primary dentition analysis: Exploring a hidden approach. Int J Clin Paediatr Dent 2016;9(1):1–4. DOI: 10.5005/jp-journals-10005-1323.
28. Al-Khadra BH. Prediction of the size of unerupted canines and premolars in a Saudi Arab population. Am J Orthod Dentofacial Orthop 1993;104(4):369–372. DOI: 10.1016/S0889-5406(05)81335-6.
29. Ramesh N, Reddy MS, Palukunnu B, et al. Mixed dentition space analysis in Kodava population: A comparison of two methods. J Clin Diagn Res 2014;8(9):ZC01–ZC06. DOI: 10.7860/JCDR/2014/10001.4777.
30. Manjula M, Rani ST, David SR, et al. Applicability of tooth size predictions in the mixed dentition space analysis in Nalgonda population. J NTR Univ Health Sci 2013;2(4):269.
31. Buwembo W, Kutesa A, Muwazi L, et al. Prediction of width of un-erupted incisors, canines and premolars in a Ugandan population: a cross sectional study. BMC Oral Health 2012;12(1):23.