Review Article

Applicability of Mixed Dentition Analyses on Indian Population -A Literature Review

Abstract

Prediction of mesiodistal tooth dimension of the unerupted permanent canines and premolars are the essential component of diagnosis and treatment planning, to better manage the tooth size and arch length discrepancies in mixed dentition period. Mixed dentition analyses are used to predict the mesiodistal width of the unerupted premolars and canines and the amount of space available in the dental arch for the alignment of the succedaneous teeth. Tooth size prediction values are not universal for all ethnic and racial groups and the accuracy and applicability of various space analyses on populations of other ethnic groups has been uncertain and questioned. Hence, this paper attempts to review the applicability of mixed dentition analyses on Indian population.

Key words – Mixed dentition, Tooth size, Space analyses

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Introduction

The mixed dentition stage is the period of developing occlusion, in which simultaneously permanent and deciduous teeth are present. Being the most dynamic phase in terms of changes in occlusion and final outcome of dentoskeletal relationship[1] it makes possible to predict the mesiodistal width of unerupted permanent canines and premolars. It is considered as a crucial phase to identify the deviations from a normal mixed dentition and facilitating timely correction by recognizing the size of tooth and the available space.[2] Prediction of mesiodistal dimension of the unerupted permanent canines and premolars are the essential

component of diagnosis and treatment planning that favours the better management of tooth size and arch length discrepancies in mixed dentition period.[3]

In order to identify space discrepancies several methods of mixed dentition space analyses have been introduced. An appropriate mixed dentition space analysis helps to reduce the severity of a developing malocclusion or may remove it, if interceptive treatment is timely initiated. The purpose of a mixed dentition analysis is to predict the mesiodistal width of the unerupted premolars and canines and the amount of space available in the dental arch for the alignment of the succedaneous teeth.[4,5] Different methods of predicting the sizes of permanent canines and premolars have been published. Tooth size prediction values are not universal for all ethnic and racial groups and the accuracy and applicability of various space analyses on populations of other ethnic groups has been uncertain and questioned.[6] Hence, this paper attempts to review the applicability of mixed dentition analyses on Indian population.

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2. Applicability on Indian population

The space analysis is done by numerous methods, which can be radiographic, non-radiographic and may involve a combination of both. The space analysis is done by predicting the mesiodistal width of the permanent unerupted canine and premolar by measuring the mesiodistal width of the lower incisors. There are several important factors that facilitate the applicability of mixed dentition analysis, such as minimum time required, a predictable methodical error, the requirement of special instruments and whether it can be commenced directly on both maxillary and mandibular dentitions.[7]

Moyer's method and Tanaka–Johnston's method are the two most commonly used methods because of the several advantages. Moyer's method has been applied broadly because of

minimum systematic error, easy and simple to use, reliable, and can be employed for both maxilla and mandible. Tanaka–Johnston's method also has similar advantages with the key feature that unlike Moyer's method of analysis, it does not require a prediction chart. However, both these analyses have been developed, used and advocated only when it is applied to Caucasian population with a significant overestimation or underestimation of values when applied to people of other ethnic groups. Majority of researches revealed overestimation of the predicted values by Moyer's analysis on Indian population.[1-3,6,8-15] However, Sholapurmath MS et al[16], Sonahita A et al[17]and Phillip I et al[18] observed underestimated values in both the genders. Moreover, Ravinthar k et al[2] and Grover N et al[1] found over and under estimated values for male and female respectively in their study. On contrary, Manjula M et al[19] found Moyer's prediction table applicable at all probability levels for both male and female of Nalgonda in their study. Similarly overestimated values are seen frequently in various studies using Tanaka and Johnston space analysis on Indian population,[1-3,8-9,11-13,19] conversely Grover N et al[1] observed an underestimated value for males in their study done on north Indian population. The applicability and outcomes of space analyses on Indian population are tabulated in Table 1.

3. Discussion

The mixed dentition space analysis is performed when the four permanent mandibular incisors and the first permanent molars are erupted.[1] Using mandibular incisors in the mixed dentition analysis has multiple advantages including early eruption ease of measurement, least prone to caries, and fewer reported anomalies. The maxillary incisors are not used as they show too much variation in size and their correlations with other groups of teeth are of lower predictive values.[8] It is a well known fact in the literature that mesiodistal widths of teeth differ considerably between different racial groups and data collected from one ethnic group for predicting the size of un-erupted permanent canine and premolar usually, is

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unlikely to be accurate or applicable to other ethnic groups.[4,5] Moyer's probability tables were developed at the University of Michigan based on the odontometric data of American White subjects of Northwestern European descent. Moyer's prediction tables are based on a correlation between the sum of the width of mandibular incisors and the combined width of the mandibular canine and premolars.[20] Studies done among Indian population have found different values for sum of mesidistal dimension of permanent mandibular incisors. Likewise ,Goyal R et al[3] found 22.08 and 21.52 mm for male and female resp. in their study performed in north Indian population and Umapathy T et al[4] also found values different from those calculated among white population with 23.87 and 23.51 mm width for male and female resp. in their study done in south Indian population. The reasons for the tooth size variations in different racial groups have not been clearly explained, although, genetic factors play a primary role while nutrition and environmental exposure during tooth development might have secondary roles.[1]

Factors affecting the tooth size are extrinsic as well as intrinsic. The intrinsic factors are heredity, race and gender. The extrinsic factors are dental caries, attrition, means of measuring the mesiodistal width of the tooth that include method and material used for cast preparation, instrument used for measuring the tooth size, and method of analysis of error.[8]

Sexual dimorphisms in tooth sizes have been observed in various odontometric studies. There is strong evidence that tooth size is expressed through X-linked inheritance in which 2X chromosomes in females may offer a measure of control which is lacking in males.[9] Several studies have reported larger mesiodistal dimension of teeth in males than females .[3,4,6-8,10,17,21-22] In addition to this, Goyal R et al[3] ,Hambire CU et al[8] and Kommineni NK et al[22] noted larger mesiodistal width of teeth

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in males than females in both the arches in their study. Thus racial and gender-specific mixed dentition analysis necessitates revision of validation once every generation.[1]

Conclusion

Space analysis in the mixed dentition is an important aspect of orthodontic diagnosis and treatment planning. Early intervention of the developing malocclusions can be done by a proper space evaluation in mixed dentition phase. However data collected from one ethnic group for the purpose of predicting the size of un-erupted permanent teeth usually, is unlikely to be accurate or applicable to other ethnic groups and cannot be universally applicable. Population adjusted new regression equation may be useful in the accuracy and applicability of these analyses.

Clinical Relevance

Malocclusion is one of the major problems faced during dento-facial development. Early intervention of this problem can be done by a proper space evaluation in mixed dentition phase. An appropriate knowledge about the applicability of these space analyses on Indian population and formulation of new population based regression equations may aid in the accuracy of the treatment planning and outcome.

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Table 1: Recent studies and their outcomes of mixed dentition analysis for Indian population

	Author	**Study Population , Age (yrs)**	**Space analysis used**	**Predicted value and Gender variation** (mesiodistal widths of permanent canine and premolars)	
				Males	**Females**
1.	Ravinthar K et al[2] 2020	Chennai, 11-15	Moyer's and Tanaka-Johnston's	Overestimated values by both the analyses.	Moyer's-Underestimated Tanaka-Johnston's-Over estimated
2.	Bhatnagar A et al[12] 2019	Aligarh, 11-14	Moyer's and Tanaka-Johnston's	Overestimated values in both the genders.	
3.	Kakkar A et al[21] 2019	Sri Ganganagar, 11-16	Moyer's,Tanaka-Johnston's and Bernabe-Flores Mir	Overestimated values in both the genders and in both the arches.	

4.	Bhatnagar A et al[10] 2018	Moradabad ,11-14	Tanaka–Johnston, Bernabe-Flores Mir and Ling–Wong regression equations.	Overestimated values in both the genders.	
5.	Grover N et al[1],2017	Lucknow, 11-15	Moyer's and Tanaka-Johnston's	Moyer's-Overestimated Tanaka-Johnston's-Underestimated	Moyer's-Underestimated Tanaka-Johnston's-Overestimated
6.	Kamatham R et al[13] 2017	Nellore, 11-15	Moyer's and Tanaka-Johnston's	Tanaka-Johnston- Overestimated for both the genders. Moyer's- Overestimation at 75%, Under estimated at 35%.	
7.	Baheti K et al[6],2016	Jodhpur, 13-16	Moyer's analysis	At 75th percentile -overestimates, At 50th and 35th percentile, -underestimates the actual values in both the genders.	
8.	Shobha MB et al[9] 2016	South India, 13-15	Moyer's and Tanaka-Johnston's	Tanaka-Johnston-Overestimation, Moyer's- 75% level-overestimation.	Tanaka-Johnston-Overestimation Moyer's- 75% level-Underestimation.
9.	Mittal S et al[14],2016	Gandhinag-ar, 12-14	Moyer's and Melgaco	Over predicted the values. However Melgaco gave better prediction value comparatively. No significant gender difference noted.	
10	Umapathy et al[4],2015	Bangalore, 13-16	Moyer's analysis	50% is more applicable to boys and 75% to girls.	
11	Hambire C et al[8],2015	Mumbai, 12-15	Tanaka-Johnston's	Slightly overestimated predicted value. Greater deviation in values seen in females.	
12	Ramesh N et al[15], 2014	Kodava, 16-23	Moyer's and Tanaka-Johnston's	Tanaka-Johnston's –Overestimated for both genders. Moyer's-at 75% -Overestimated values more in males than females.	
13	Komminei NK et al[22] 2014	Chennai, 13-15	Moyer's and Tanaka-Johnston's	Tanaka and Johnston-Overestimated. Moyer's- can be applicable closer to 50% probability level.	
14	Goyal R et al[3],2014	NorthIndian ,14-22	Moyer's and Tanaka-Johnston's	Overestimated values in both males and females.	
15	M.Manjula et al[19], 2013	Nalgonda, 13-16	Moyer's and Tanaka-Johnston's	Tanaka and Johnston- Over-estimated the values in both the genders for both the arches. Moyer's- can be used at all probability levels.	
16	Dasgupta B et al[11] 2012	WestBengal,11-14	Moyer's and Tanaka-Johnston's	Overestimated values. No separate values for gender.	

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17.	Sholapurmath MS et al[16] 2012	Belgaum, 13-16	Moyer's and Tanaka-Johnston's	Underestimated values in both the genders and in both the arches.
18	Sonahita A et al[17], 2012	Bangalore, 13-21	Moyer's and Tanaka-Johnston's	Tanaka and Johnston- Over estimated values and Moyer's- Under estimated values for both the genders.
19	Phillip I et al[18],2010	Contemporary Indian poulation	Moyer's	Under estimated the values for both male and female.

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