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VALIDITY OF MOYER'S MIXED DENTITION ANALYSIS FOR EGYPTIANS

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Abstract

***Introduction**: Treatment planning is crucial for proper tooth alignment in a mixed dentition stage. An examination of the mixed dentition should be able to predict the mesiodistal widths of the unerupted permanent teeth. Overestimating of width for unerupted teeth could increase the space required and lead to unnecessary extractions.* ***Design**: Cross-sectional study.* ***Participants**: This study included 307 subjects (148 males and 159 females) aged from 16 to 22 years.* ***Material and methods**: Digital Vernier calipers was used to measure Mesio-distal tooth width on study cast Measurements of the predicted width of canine and premolars according to Moyer's prediction tables were compared with the measured values on plater models.* ***Results:** No statistically significant difference in measured width of upper and lower canine and premolars (UCPM, LCPM, respectively) in male vs. female. Poor reliability (ICC<0.5) for all measures in comparison with the predicted values except for 50th percentile for females in lower canine & premolars which was moderate (ICC =0.534).* ***Conclusions:** The Egyptian population is not consistent with Moyer's prediction tables.*

Introduction

Early orthodontic treatment has been extremely popular among people in recent years. This growing early treatment trend reveals a better understanding of developing malocclusion, as well as an improved diagnosis and results.[(1)] During the mixed dentition, the majority of malocclusions are apparent, and this is also when the occlusal development stage offers the possibility of favourable growth modification, space management as well as eruption guidance. An adequate mixed dentition space analysis (MDSA) may assist to minimize the severity of an occurring malocclusion or perhaps eliminate it if urgent interceptive therapy is performed.[(2, 3)]

There must be harmony between sum of mesiodistal dimensions of teeth and the available space in dental arches to accommodate dentition. A spaced or crowded dentition arises when the total number of teeth and the arch's perimeter are not closely consistent.[(4)] For assessing whether there is a discrepancy between size of dental arches and mesiodistal dimensions of teeth in mixed dentition, it is essential to apply a reliable method to estimate the mesiodistal diameter of unerupted canines and premolar teeth.[(5)] Extraction choices made as a result of poor and unreliable MDSA may significantly impact facial esthetics of the patient.[(6)]

Three main approaches have been utilized in the estimation of the mesiodistal crown widths of the permanent canines and premolar teeth during the mixed dentition stage. Measurement of the unerupted teeth on the radiographic films [(7, 8)], application of the

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regression equation that correlates the mesio-distal widths of erupted teeth to that of unerupted teeth[2, 9], a combination of both techniques ,measurements of certain erupted teeth and radiographs of unerupted teeth.[1, 10, 11]

The quality of the available radiographs and the availability of dental x-ray devices are both questionable in developing countries.[12, 13] Because of such financial constraints, the radiographic based prediction approaches do not provide sufficient solutions. The non-radiographic approaches for MDSA are more commonly used in our daily orthodontic practice. One of the most used techniques for MDSA at the moment is Moyers mixed dentition space analysis.[14] Moyers' probability tables were developed using odontometric data collected from white American subjects. The mandibular incisors' width was the basis for Moyer's technique. Profit and Ackerman have widely used and popularised it because of its many benefits, including time efficiency, simplicity, low error rate, and ability to be employed on both arches.[6, 15]

the accuracy of this procedure when used on a population of varied ethnic origins is in doubt because it is well established that there is variations regarding teeth dimensions in different racial groups. [16-18] this study aimed at determining whether Moyers' mixed dentition space analysis is applicable to the Egyptian population.

Material and methods

Sample size:

The calculation of Sample size was performed using Power Analysis and Sample Size (PASS) Software (v 15, 2017). NCSS, LLC. Kaysville, Utah, USA. Initially, we performed a pilot study on 20 subjects. Based on the results of this pilot study, an ICC of 0.25 was hypothesized. A sample size of 148 persons per group achieves 93% power to determine an intraclass correlation of 0.25000 under the alternative hypothesis when the intraclass correlation under the null hypothesis is 0.00000 utilizing an F-test with a significance level of 0.05000.

Ethical Clearance

The dental ethical review committee of Faculty of Dentistry, Mansoura University, Mansoura, Egypt, gave its approval to this study (Code No. A18011122). Participants and their parents were informed of the study's objectives, and the parents' written agreement was acquired.

Sample selection

Dental casts of the required sample size were prepared after examination of about 500 patient from the outpatient clinic of the Orthodontic Department, Faculty of Dentistry, Mansoura University. The inclusion criteria included [19-21]: 1) Fully erupted permanent dentition in the mandibular and maxillary arches except for the second and third molar teeth; 2) No previous orthodontic treatment; 3) No teeth wear; 4) Free of proximal caries; 5) Free of congenital crown defects; and 6) Age range from 12 to 25 years. Figure (1) show

flow chart for the subjects enrolled in the study

Procedures

Alginate impressions were made for all patients included in our study, after which high-quality dental plaster was poured immediately, Only well prepared dental casts were used in the study. A dental digital calliper set to the nearest 0.01 mm and parallel to the tooth's occlusal surface in normal alignment was used for measuring the mesiodistal measurements of teeth (figure 2).

Measurements of the subsequent groups of teeth were obtained ,The mesiodistal width of the lower four incisors (LI), UCPM, and LCPM. The average of the values of the left and right side was obtained as a single mean value.

Teeth measurements were done manually by a single skilled investigator. The pilot sample research provided confirmation of the test's reliability coefficient. The intra-examiner reliability of measurements was evaluated by choosing 20 dental casts from the sample randomly with measuring them twice with 2 weeks interval. With an intra-class correlation (ICC) value of 0.994, there was a very strong correlation between the two measurements. Excellent agreement was reached.

Statistical analysis:

Data was analyzed by SPSS software, v 21 (IBM Corp., Armonk, NY, US) for Windows. Quantitative data were tested for normality with Shapiro-Wilk's test with data being normally distributed if $p > 0.05$. Significance was tested using inspecting boxplots. To determine the gender differences, a separate sample t-test was conducted. A paired sample t-test was performed for comparing means of measured and predicted mesio-distal widths of canine and premolars based on the Moyers's probability tables at 35^{th},50^{th} and 75^{th} percentile. Appropriate charts were utilized to graphically present the results whenever required. For any of the utilized tests, results were considered as statistically significant if p value $\leq$ 0.050.

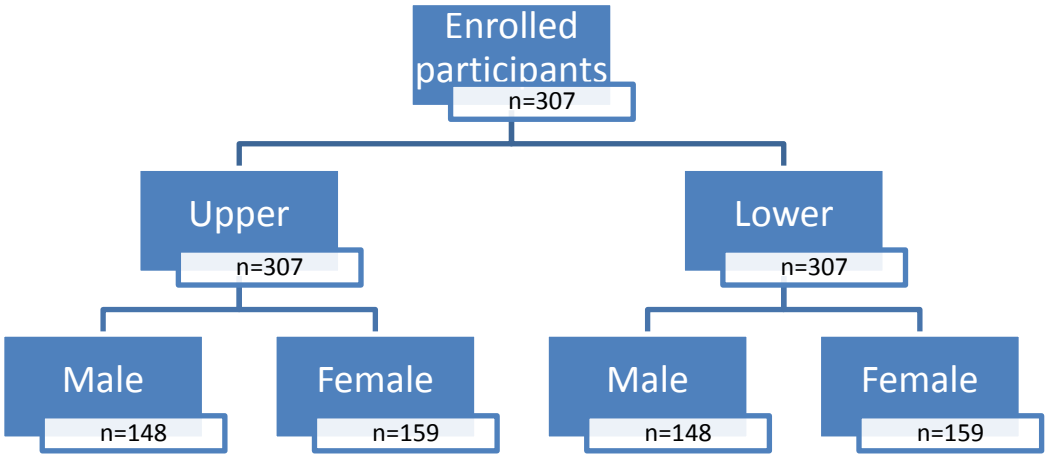

Figure (1): flow chart for the included patients.

Figure (2): digital caliper for measuring mesiodistal dimensionsions

Results

Table 1 demonstrates statistics for the sum of the mesio-distal width of UCPM, LCPM according to gender. In neither arch were the canine-premolar segments noticeably larger among males compared with females (P 0,477 and .197) (Figure 3 a,b)

Table (1): Descriptive statistics of the sum of the mesio-distal width of UCPM and LCPM values in both gender.

Site	Male	Female	MD (95% CI)	p-value
Upper	21.1 (20.2-21.7)	21 (20.3-21.7)	0.1 (-0.17 to 0.38)	0.477
Lower	20.4 (19.9-21.1)	20.1 (19.6-21)	-0.14 (-0.4 to 0.12)	0.197

MD = Hodges-Lehmann median difference. Test of significance is Mann-Whitney U-test.

Table 2 shows significant differences between predictive values obtained with various percentiles according to Moyers probability tables and the actual sum of widths of permanent canines and premolar teeth for upper and lower arches in male participants.

Table (2): Test for agreement between measured and predicted for the UCPM and LCPM in males

Quartile	Measured UCPM in one side			Measured LCPM in one side		
	ICC	95% CI	p-value	ICC	95% CI	p-value
35th	0.367	0.218-0.498	**<0.001**	0.402	0.258-0.529	**<0.001**
50th	0.400	0.255-0.527	**<0.001**	0.442	0.301-0.563	**<0.001**
75th	0.316	0.115-0.482	**<0.001**	0.255	0.060-0.504	**<0.001**

Notes: ICC = intraclass correlation coefficient. CI = confidence interval.

This table shows a statistically significant reliability. However, this reliability was poor (ICC<0.5) for all measures.

Regarding females, statistically significant differences existed at all Moyers percentile levels in the maxillary arches and mandibular arches, with the exception of the 50th percentile in the mandibular arches. (Table 3)

Table (3): Absolute agreement between measured vs. predicted for upper and lower in female participants

Quartile	Upper canine & premolars in one side			Lower canine & premolars in one side		
	ICC	95% CI	p-value	ICC	95% CI	p-value
35th	0.223	0.076-0.476	**<0.001**	0.456	0.127-0.657	**<0.001**
50th	0.311	0.045-0.513	**<0.001**	**0.534**	0.411-0.637	**<0.001**
75th	0.420	0.283-0.540	**<0.001**	0.456	0.154-0.647	**<0.001**

Notes: ICC = intraclass correlation coefficient. CI = confidence interval.

Table 3 shows a statistically significant reliability. However, this reliability was poor (ICC<0.5) for all measures except for 50th percentile in lower canine & premolars which was moderate (ICC between 0.5 and 0.75).

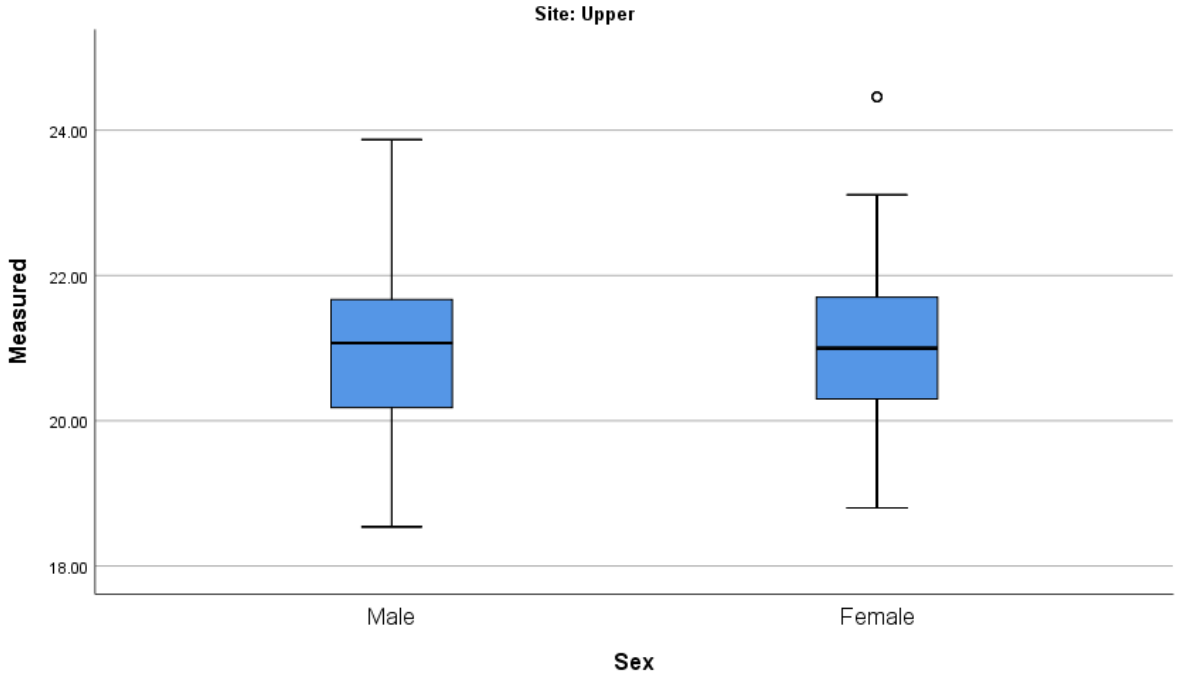

Figure 3 (a): Comparison of the mesio-distal width of UCPM in both genders

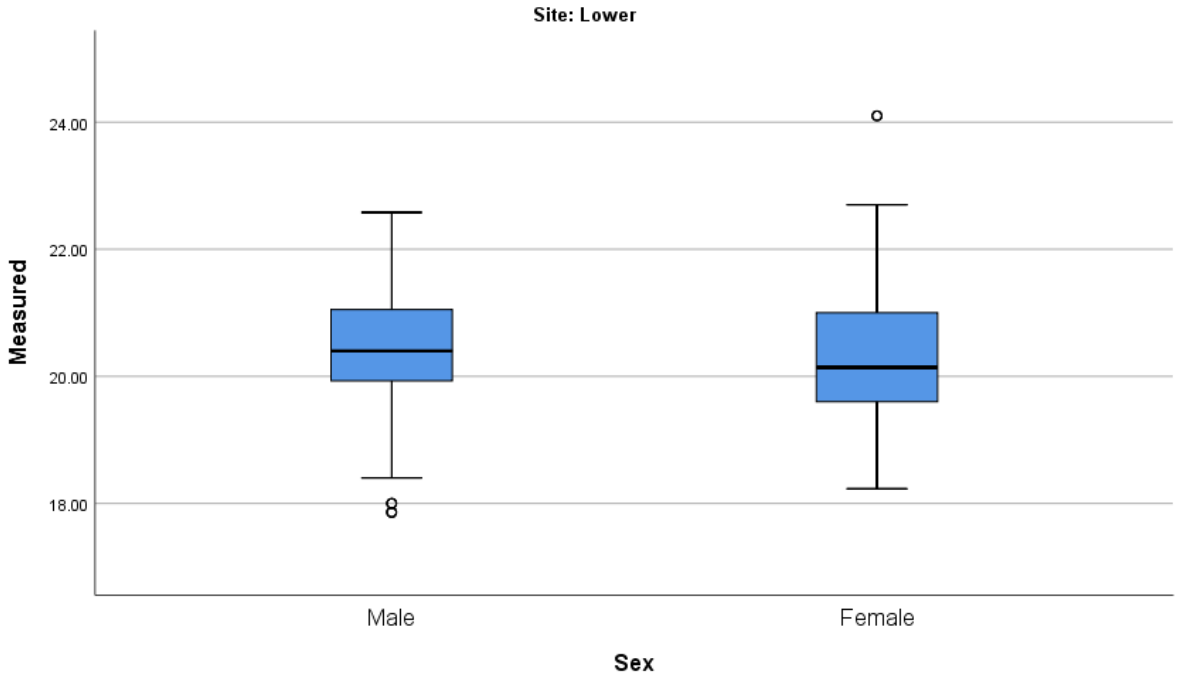

Figure 3 (b): Comparison of the mesio-distal width of LCPM in both genders

Discussion

Based on data from certain ethnic group, it is doubtful that estimation of the mesio-distal dimensions of unerupted teeth for other ethnic groups will be accurate.[22, 23] This could be explained by the fact that there is major variations regarding teeth size in different racial groups.[24, 25]

High-quality dental casts formed of dental stone and a digital calliper, which could significantly help decrease eye strain and the potential of reading Error, were employed in an effort to increase the reliability of the measurements conducted in this investigation. In order to lessen the effects of tooth loss and proximal wear on the dimensions of the teeth, a maximum age limitation of 22 years was used in this study.[26, 27] Mesiodistal dimensions of lower permanent incisiors were found to be the best predictors for mixed dentition analysis as they erupt early with minimal variations regarding mesiodistal dimensions[28, 29]

The teeth of men are often larger than those of women. The upper canines and central incisors have the most sex differences in both the deciduous and permanent dentitions.[26] in contrast to other studies,[16, 30] Our results showed no significant difference between both males and females regarding the mesaured mesiodistal dimensions of upper and lower canine and premolars. This could be explained by the fact that premolar teeth have minimal sex differences.

Regarding males, Our results showed significant differences between the measured and predicted values using Moyer prediction tables at 35th, 50th, 75th percentile. This is in agreement with many studies and indicated that there is variations in canine and premolar tooth width between races and ethnic groups.[5, 31]

Regarding females, statistically significant differences existed between the measured and predicted values using Moyer prediction tables at 35th, 50th, 75th percentile, except for the 50th percentile in the mandibular arches. This results is similar to conclusions of other studies that indicated inacuracy of moyer prediction tables for females.[32, 33] Further studies are reguired to test the accuracy of prediction tables at 50th percentile for the egyption population

Conclusions:

1- The mixed dentition prediction approach developed by Moyer has limitations when applied to the Egyptian population.

2. Not all racial groupings can be predicted using Meyer's mixed dentition prediction table.

3. To be clinically approved for the Egyptian population, new prediction tables are necessary.

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