PREDICTION OF THE PERMANENT CANINE AND PREMOLARS' WIDTH USING THE SUM OF MANDIBULAR PERMANENT INCISORS' WIDTHS FOR SYRIAN COAST POPULATION

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ABSTRACT:

Mixed dentition space analysis are very important in executing early diagnosis and planning for the most appropriate treatment . Most commonly used mixed dentition space analysis in clinical practice such as Moyers' probability tables depend on the sum of the mandibular permanent incisors mesio-distal width as an indicator to predict the un-erupted teeth's width . This study was carried out to determine the correlation between the sum of the mesio-distal crown width of the mandibular permanent incisors and the combined mesio-distal crown width of the maxillary and mandibular permanent canine and premolars and formulate the new regression equation for estimating the width of un-erupted canines and premolars for a contemporary sample of the Syrian Coast population . The sample consisted of 300 students with a mean age of 16.7 years old . Measurements were executed on the dental casts with a digital caliper, proper statistical analysis were preformed (ANOVA) to calculate the correlation and determination coefficients and produce linear regression equations . This study shows moderate correlation between the suggested groups of teeth's dimensions and suggests further studies to determine the best predictor/s for estimating the mesiodistal widths of the permanent canines and premolars

Keywords: Mesiodistal crown width - Mixed dentition - Regression equation

INTRODUCTION

Mixed dentition analysis (MDA) is essential for early diagnosis and timely intervention of arch length discrepancies [1,2], and an important aspect to monitor the development of esthetically, functionally stable occlusion, and treatment planning , for it implies preventive measures that are necessary to avoid the progress of potential irregularity into severe malocclusion. [3,4] It calculates the difference between the available dental arch space and that required to accommodate tooth material in perfect alignment. [5,6] Discrepancies between the space required and space available are common conditions requiring early attention for their fundamental role in determining the treatment plan, that might involve, serial extractions, eruption guidance, space maintenance, space gain, or simple monitoring of the occlusion.[7] While planning a treatment for such cases, it is of utmost importance to predict the mesio-distal width (MDW) of the un-erupted permanent canines and premolars (CPMs) accurately so that the proper procedures can be performed as early as possible.[3,4,31] Many methods of

MDA have been suggested and they can be categorized into three approaches :

(1) Measurement of the MDW of un-erupted teeth on the radiographs [8] ,

(2) Regression equations that relates MDW of erupted teeth to the MDW of unerupted teeth [9,10] ,

(3) A combination of the former methods [11,12].

On reviewing the existing literature on MDA, Moyers' and TJ analyses are observed to be popular, widely employed, and proven to be clinically valid.[5,10,14,15,31] They are based on the predictive capability of permanent mandibular central and lateral incisors; which have been chosen for measuring, since they are first in the sequence of eruption, directly in the midst of most space management problems, can be easily and accurately measured, show less variability in shape and size and high correlation of these teeth with others.[9,13]

A number of researchers have studied the correlative relationships between various groups of teeth in the permanent dentition [9,10,13,16], few are of practical use in treatment planning or prediction; exceptions to this statement are the correlation between the sum of MDWs of the mandibular permanent incisors and the combined MDWs of the CPMs in either arch, which is high enough for acceptable prediction; hence, they were suggested as the best predictor. [9,10,13]

justifications of this study

Nevertheless, the major drawback of these methods is the question of reliability when applied to other populations from which they were derived.[7,17] Studies on various other populations proved that these methods either overestimate or underestimate the actual MDW of CPMs.[7,14,17,18,19,20,21,22,23,31] In addition, there is the matter of relying on the sum of the mandibular permanent incisors MDWs alone as the predictor. Many recent studies proposed better correlation and determination coefficients and a more enhanced predictive capability when combining MDWs of other permanent teeth like maxillary/mandibular first molars, maxillary/mandibular central and lateral incisors and different combinations of all the previous groups as means to determine the MDW of CPMs.[20,23,24,25,26,27,28,29,31,32]

Aim of the study:

This study aims to determine the correlation between the permanent mandibular incisors' MDW and CPMs' and find out the regression equations for predicting the un-erupted teeth width in the Syrian Coast population .

Another important aspect that should not be neglected in this field is the consideration of gender differences in the tooth dimensions, therefore, equations for both the genders separately will be formulated.

Objectives :

1- Calculating the means and standard deviation of the MDW of the mandibular permanent incisors, maxillary and mandibular permanent canines and premolars in the Syrian Coast,

2- Investigating the sex discrepancies in the MDW of the concerned teeth,

3- Assessing the correlation coefficient of the relation between the permanent mandibular incisors' MDW and CPMs',

4- Calculating the linear regression equations for the Maxillary CPMs and the Mandibular CPMs for both sexes respectively .

MATERIALS AND METHODS

Methods :

The present study has been carried out in the Department of orthodontics of Tishreen University after obtaining clearance from the Institutional Ethical Committee.

Sample :

Students of various schools of The Syrian Coast underwent clinical examination to determine their eligibility for this study; those who fulfilled the criteria along with their assent and parental informed consent to participate were included in the study

Inclusion criteria :

- Presence of fully erupted permanent dentition (except third molars) with intact proximal surfaces, marginal ridges, incisal edges and contact points .

- Minimal wear.

Excluding criteria :

- Inter-proximal caries or restorations
- Congenitally missing teeth or supernumerary teeth (abnormalities in number)
- Abnormalities in shape, size, or structure
- previous or current orthodontic treatment.
- Facial disharmony and/or congenital craniofacial anomalies
- Apparent loss of tooth substance due to attrition, trauma, massive caries, or artificial crowns on teeth.

The sample consisted of 300 students (129 males and 171 females) with a mean age of 16.7 years old .

Materials :

Impressions of maxillary and mandibular arches were made with perforated plastic impression trays using Alginate impression material (ABLE INTERNATIONAL GROUP, LTD.) (Fig.1), mixed as per manufacturer's recommendations. The impressions were rinsed in running tap water, disinfected with 2% glutaraldehyde, poured with hard dental stone immediately to avoid any dimensional changes, and vibrated manually. The dental casts (Fig.2) were neither soaped nor waxed; and each model pair was assigned an identification number to ensure examiner masking for gender.

The maximum MDWs of all concerned permanent teeth were measured using electronic digital caliper (0–150 mm with a resolution of 0.01 mm) (Fig.3), following the Moorrees and Reed's standard method. [13] This method measures the distance between anatomic contact points (from mesial to distal) at their greatest inter-proximal distance, with the help of sharp end calipers on the buccal or occlusal side. The MDWs were recorded, transferred to the data sheets, tabulated, and analyzed.

The intra-examiner calibration procedure consisted of the primary investigator (M.C.) measuring 20 randomly selected model pairs twice, separated by 1-week. The inter-examiner calibration was done against a second examiner (R.A.) who also measured the 20 model pairs twice, separated by 1-week.

RESUTS:

Descriptive statistics of the MDW of all concerned teeth are shown in (Table 1 and Table 2) .

The results indicates that the size of permanent canines and premolars are larger in the maxilla than mandible and males than females.

The results of the correlation and determination coefficients of the mandibular permanent incisors with CPMs are shown in (Table 3)

Regression equations of the form Y = A + B (x) was formulated based on the results of ANOVA statistical analysis . In this equation, (Y) represents dependent variable or sum of the MDW of uneruped canine and premolars in each quadrant , (x) represents independent variable or sum of the MDW of the mandibular permanent incisors , While (A) and (B) are constants.
The regression equations (Table 4 and Table 5) are as follows :

FUCPM = Female upper canine and premolars.
MUCPM = Male upper canine and premolars.
FLCPM = Female lower canine and premolars.
MLCPM = Male lower canine and premolars.

MUCPM   =   9.249   +   0.538   X
FUCPM   =   9.931   +   0.499   X
MLCPM   =   9.21   +   0.524   X
FLCPM = 8.458 + 0.539 X

The linear regression equations formulated by this study are of moderate accuracy in prediction as the actual measured CPMs' MDW scatter around the line that represent the regression equations as shown in the graphs (Graph1,2,3,4)

DISCUSSION:

The results of this study showed that the MDW of the permanent canines, premolars, and mandibular incisors is larger in males than females, which agrees with most previous studies [7,8,10,12,14,15,21,24,28,29,30,31] but disagrees with others like [32,33] which is probably

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due to the difference in the studied populations .

The sum of MDW of the CPMs is greater in maxilla than mandible, which is mainly due to larger canines in the maxilla. Results of this study are almost similar to other studies.

In this study, correlation coefficients in the maxilla were r = 0.642 for males and r = 0.608 for females and in the mandible they were r = 0.625 for males and r = 0.623 for females (P < 0.05), which are of moderate significance in comparison with previous studies[35] that evaluated the correlation of the mandibular permanent incisors and CPMs (Table 6) .

Another study on a Syrian population by Norallah et al 2002 [20] , using the sum of MDW of the maxillary permanent first molars and mandibular permanent central incisors as independent variable to predict CPMs widths, shows higher correlation coefficients, as does another study on white Brazilians[34] that utilizes mandibular permanent first molar and incisors' width as predictor of mandiular canine and premolars' width .

CONCLUSION:

The permanent mandibular incisors may not be the best indicators to predict the MDW of the un-erupted CPMs for Syrian children but nonetheless, can be used with acceptable accuracy when employing the regression equations formulated in this study :

MUCPM = 9.249 + 0.538 X
FUCPM = 9.931 + 0.499 X
MLCPM = 9.21 + 0.524 X
FLCPM = 8.458 + 0.539 X

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TABLES:

Table 1 : Descriptive statistics of the measured MDW of the concerned teeth (mm) Males

						The studied variable : MDW	
Max	Min	St. error	St. deviation	mean	number	Tooth	Sex
7.47	5.27	0.03	0.37	6.17	129	32	
6.47	4.88	0.03	0.33	5.58	129	31	
6.75	4.95	0.03	0.35	5.58	129	41	
7.39	4.49	0.03	0.39	6.13	129	42	
8	5.71	0.04	0.44	6.73	129	15	
8	6.14	0.03	0.36	7.05	129	14	
9.21	6.91	0.04	0.46	8.06	129	13	
9.14	6.99	0.04	0.43	8.07	129	23	Male
8.54	6.24	0.04	0.40	7.09	129	24	
8.05	5.92	0.04	0.40	6.75	129	25	
8.83	6.1	0.04	0.45	7.23	129	35	
8.44	6.25	0.04	0.40	7.20	129	34	
8.27	5.72	0.04	0.41	7.12	129	33	
8.32	5.4	0.04	0.45	7.11	129	43	
8.23	6.28	0.03	0.36	7.15	129	44	
8.5	6.26	0.04	0.42	7.21	129	45	

Table 2 : Descriptive statistics of the measured MDW of the concerned teeth (mm) Females

						The studied variable : MDW	
Max	Min	St. error	St. deviation	mean	number	Tooth	Sex
6.92	4.93	0.03	0.35	5.89	171	32	
6.39	4.52	0.02	0.32	5.35	171	31	
6.86	4.48	0.02	0.32	5.34	171	41	
6.94	4.57	0.03	0.36	5.86	171	42	
7.79	5.58	0.03	0.44	6.57	171	15	
8.07	5.95	0.03	0.39	6.88	171	14	
8.68	6.7	0.03	0.40	7.67	171	13	
8.9	6.66	0.03	0.39	7.67	171	23	Female
7.97	5.81	0.03	0.39	6.90	171	24	
7.97	5.57	0.03	0.43	6.55	171	25	
8.21	6.16	0.03	0.44	7.03	171	35	
8.73	5.96	0.03	0.44	6.94	171	34	
7.71	5.08	0.03	0.39	6.62	171	33	
7.79	5.36	0.03	0.39	6.61	171	43	
8.58	5.99	0.03	0.43	6.93	171	44	
8.19	6.15	0.03	0.42	6.98	171	45	

Table 3 : Correlation Coefficient and Determination Coefficients for Estimation of CPMs' width in both gender and jaw separately

Independent Variable : LCPMs' width		Independent Variable : UCPMs' width		Sex	Dependant Variable
r^2	r	r^2	r		
0.391	0.625	0.413	0.642	Male	Mandibular permanent incisors' width
0.388	0.623	0.370	0.608	Female	

Table 4 : Regression Equation for predicting The Sum of MDW of the Upper CPMs for both genders

Independent Variable : UCPMs' width (Y)					
Linear Regression Equation	St. error	Constant Value	Studied Constant	Sex	Dependant Variable
Y = 9.249 + 0.538 X	0.94	9.249	A	Male	Mandibular permanent incisors' width (X)
	0.04	0.538	B		
Y = 9.931 + 0.499 X	0.79	9.931	A	Female	
	0.04	0.499	B		

Table 5 : Regression Equation for predicting The Sum of MDW of the Lower CPMs for both genders

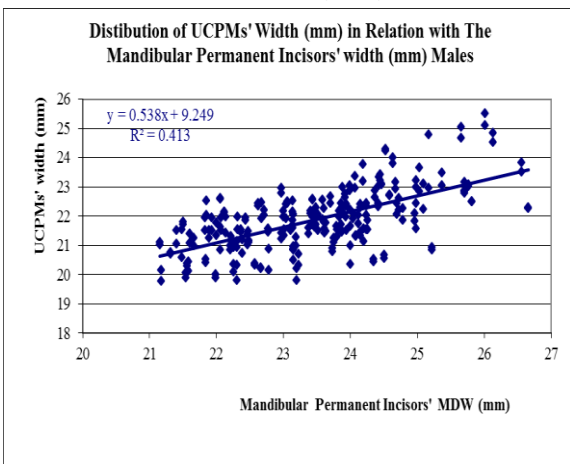| Independent Variable : LCPMs' width (Y)					
Linear Regression Equation	St. error	Constant Value	Studied Constant	Sex	Dependant Variable
Y = 9.210 + 0.524 X	0.96	9.210	A	Male	Mandibular permanent incisors' width (X)
	0.04	0.524	B		
Y = 8.458 + 0.539 X	0.83	8.458	A	Female	
	0.04	0.539	B		

Table 6 : Correlation coefficients for mandibular incisors with mandibular and maxillary canines and premolars in different researches

LCPMs			UCPMs			Ethnic	Year	Study
M	T	F	M	T	F			
-	0.64	-	-	-	-	White American	1947	Ballard, Wylie
-	0.69	-	-	-	-	White American	1958	Hixon, Oldfather
-	0.65	-	-	-	-	White American	1958	Bolton
-	0.58	-	-	0.51	-	White American	1964	Moorrees, Reed
-	0.648	-	-	0.625	-	White American	1974	Tanaka & Johnston
-	0.706	-	-	0.630	-	Black American	1978	Ferguson et al.
-	0.66	-	-	-	-	White	1979	Smith, King, Valencia

|						American		
0.79	-	0.66	0.72	-	0.61	White American	1986	Frankel, Benz
-	0.659	-	-	0.641	-	Asian American	1998	Lee Chan et al.
0.77	-	0.69	0.79	-	0.65	Hongkong Chinese	1998	Yuen et al.
0.7	0.691	0.611	0.686	0.678	0.588	Iran - Ahwaz	2010	Khanehmasjedi et al.
0.625	-	0.623	0.642	-	0.608	Syrian	2017	Present Study

GRAPHS:

Graphs :Graph 1 : Distibution of UCPMs' Width (mm) in Relation with The Mandibular Permanent Incisors' width (mm) Males

Graph 2 : Distibution of UCPMs' Width (mm) in Relation with The Mandibular Permanent Incisors' width (mm) Females

Graph 3 : Distibution of LCPMs' Width (mm) in Relation with The Mandibular Permanent Incisors' width (mm) Males
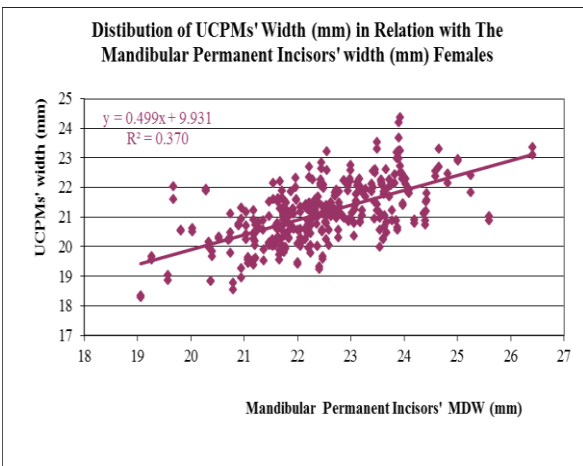
Graph 4 : Distibution of LCPMs' Width (mm) in Relation with The Mandibular Permanent Incisors' width (mm) Females
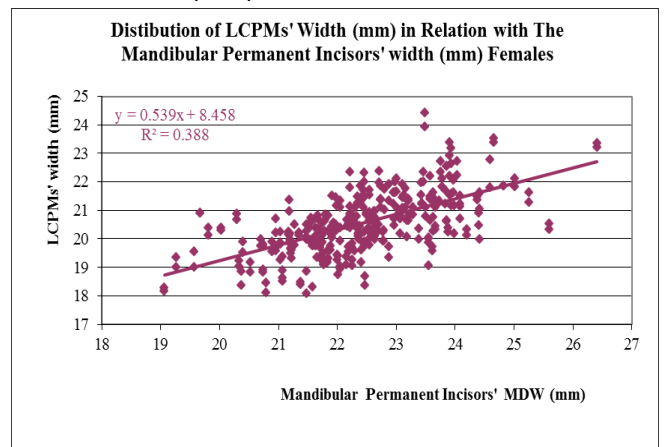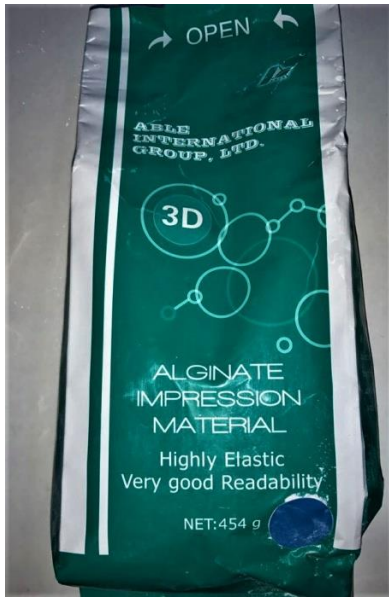
FIGURES :

Fig 1: Alginate Impression Material used in this study

Fig 2 : A Dental Cast Of One Of The Study Subjects