Prediction of mesio–distal crown diameter of the unerupted lower premolars

Khidair A Salman
BDS, CES, DSO (Prof)

Hind T Jarjees
BDS, MSc (Assist Lect)

Department of Pedod, Orthod and Prev Dent
College of Dentistry, University of Mosul

ABSTRACT

The purpose of this study was to determine the more accurate method for predicting the width of unerupted mandibular premolar of mixed dentition patients, whether by the multiple regression analysis method or by radiographic measurements of deciduous molars width method.

Multiple regression analysis method was performed on data derived from 108 children (62 females and 46 males) aged 9–12 years old. These children were selected from primary schools located in different areas of Mosul City. All subjects had normal Class I molar relationship with mixed dentition (the right and left permanent centrals, laterals and first molars, and right and left primary canines and first and second molars). The data were statistically analysed using Statistical Package for Social Statistics.

The results revealed that there were no significant differences in mesio–distal crown diameter between right and left sides of both unerupted premolars and deciduous molars. All the teeth in males were larger in mesio–distal crown diameter than females. Also, the results of the present study indicated that there was a positive correlation between most of the teeth, individual teeth and groups of teeth. There was a difference in the means between the mesio–distal crown diameter of deciduous molars and unerupted premolars.

The present results used to generate a formula "linear regression equation" that can be used clinically to affect prediction depending on the mesio–distal width of individual deciduous molars.
Key Words: Prediction, regression analysis, unerupted premolars, periapical radiograph.

الخلاصة

هدفت الدراسة الحالية إلى تحديد أعلى مستوى من الدقة للتنبؤ بالبعد الإنسي الوحشي للضواحك السفلى والتي لم تظهر بعد للمرضى ذوي الأسنان المختلطة سواء باستخدام طريقة التحليل الانحداري المتكرر أو بطريقة قياس أبعاد الطواحن اللبنية المأخوذة بالأشعة السينية .

تم تطبيق طريقة تحليل الانحدار على ١٠٨ طفل (٦٢ أنثى و ٤٦ ذكر) تراوحت أعمارهم بين ٩–١٢ سنة. تم اختيار هؤلاء الأطفال من المدارس الابتدائية لمناطق مختلفة من مدينة الموصل . إن كل نماذج البحث هم من الصنف الأول الطبيعي مع التسنين المختلط (أي وجود القواطع الدائمية، الأنياب والطواحن اللبنية ، الطواحن الدائمية الأولى). تم تحليل البيانات إحصائياً باستخدام نظام الحقيبة الإحصائية للعلوم الاجتماعية.

أظهرت النتائج عدم وجود اختلافات معنوية لمعدل البعد الأنسي الوحشي للأسنان بين جانبي الفك الأيمن والأيسر ولكلا الضواحك غير الظاهرة والطواحن اللبنية لكلا الجنسين. كما أن قياسات البعد الأنسي الوحشي في الذكور أكبر من الإناث. كذلك بينت نتائج الدراسة الحالية وجود ارتباط إيجابي بين معظم الأسنان سواء كانت الأسنان فردية أو بشكل مجاميع لكلا الجنسين. كما وجد أن هناك فرقاً بين المتوسطات بين حجم الطواحن اللبنية والضواحك غير الظاهرة.

استخدمت نتائج الدراسة لاستخراج صيغة "المعادلة الخطية الانحدارية" والتي يمكن استخدامها سريرياً.

INTRODUCTION

The determination of the mesio–distal diameters of crown of unerupted canines and premolars has great importance in determining the choice of therapy during the mixed dentition.[1]

Along with the development of serial extraction diagnosis and treatment, clinicians have been interested in methods for predicting the mesio–distal crown widths of the unerupted mandibular premolars in mixed–dentition patients. The successful clinical management of arch length deficiency problems in mixed–dentition patients depend on an accurate estimate of the crown widths of unerupted canines and premolars for early interruption of potential malocclusion.[2, 3]

One of the goals in comprehensive orthodontic treatment is to obtain an optimal final occlusion, over bite and over jet.[4]

Early attempts of estimation of the mesio–distal crown widths of unerupted canines and premolars were based on tables of average widths, for example, those of black, which are seldom clinically useful because of the variation between individuals. Subsequently, three major approaches have been used as suggested by Staley and Hoag,[3] and Abe *et al*.:[5]

1. Use of measurements from radiographs.
2. Use of measurements from erupted teeth.
3. Use of a combination of measurements.

Specific method for estimating from radiographs have been suggested by many workers.[6–9] The mean absolute errors were 1.1 mm for the radiograph method and 1.8 mm for the regression equation method. The radiograph method always over predicted the size of teeth due to radiographic magnification.[3] This method had considerable accuracy, but they were time–consuming technique. On the other hand, the patient/parent are unwilling to allow for the needed radiographs.[10]

The purpose of this study was to determine the more accurate method for predicting the width of unerupted mandibular premolar of mixed dentition patients, whether by the multiple regression analysis method or by radiographic measurements of deciduous molars width method.

MATERIALS AND METHODS

The sample size of this study comprised 108 children (62 females and 46 males). Their age ranged between 9–12 years old and selected from examination of 1297 children (652 females and 645 males). It was carried out during two months period, distributed over 6 primary schools randomly selected from different areas of right and left banks of Tigris river in center of Mosul City.

Regarding the criteria for selecting the sample, the first step started by examining all children of both sexes on the daylight. In the second step, we started selecting the children who show specific criteria applied to the children in this study. These include:

1. All children were of Iraqi origin at age 9–12 years their parents and grand parents were born in the center of Mosul.
2. The sample of class I molar occlusion was selected according to Angle's specification.[11] The mesiobuccal cu-sp of the maxillary permanent first molar occludes in the buccal groove of the mandibular permanent first molar when the teeth are approxima-ted in centric occlusion.
3. The full teeth complement of the mixed dentition were the lower right and left permanent centrals, laterals and first molars, and lower right and left primary canines and first and sec-ond molars.
4. Good alignment of lower teeth with-out crowding or spacing.
5. No history of orthodontic treatment, maxillofacial surgery or extensive re-storative dentistry.[12, 13]
6. Individuals free of local factors that disturb the integrity of dental arches (congenital missing teeth, retained deciduous teeth, supernumerary tee-th).
7. Subjects with gross dental abnormalities, apparent loss of teeth subs-tance due to attrition,

trauma, frac-ture, massive caries or restoration or artificial crown on teeth were exclu-ded.

History and clinical examination inc-luded information about name, age and origin. History of facial trauma, orthodon-tic treatment and medical history were tak-en.

The procedure was divided into two steps: The first step included impression, construction of study models, and measur-ing the mesio–distal crown diameter of teeth.

Measurements were carried out on the lower casts (deciduous molars) by using modified sliding caliper with a vernier scale permitting reading to 0.1 mm (Figure 1).

The second step included: The radio-graphic technique (two periapical radio-graphs were taken for each subject for ri-ght and left sides of the lower deciduous molars), the processing technique, and measurement technique.
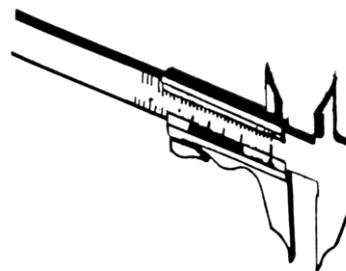

Figure (1): Sliding caliper with vernier scale

This examination includes the mea-surements of the greatest mesio–distal dia-meter of deciduous molars (first and sec-ond) unerupted permanent premolars from the anatomic mesial contact area to the anatomic distal contact area which was taken to a nearest 0.1 mm by means of sharp end calipers with the sharpened beaks of the calipers parallel to the long axis of the crown.

A simple proportional relation can then be set up:

$$\frac{\text{True width of primary molar}}{\text{Apparent width of primary molar}} = \frac{\text{True width of unerupted premolar}}{\text{Apparent width of unerupted premolar}}$$

The data were analyzed using statistical descriptive; Means, minimum, maximum, range and standard deviation. t–test was used to determine the sex effect.

Simple correlation coefficient "r val-ue" was done for all variables for males, females and total sample. Also, the corre-lation was done for right, left and total sample between individual teeth as well as between the groups of teeth. "r" value was considered significant at 0.05 level and highly significant at 0.01 level.

Linear regression equation for decidu-ous and permanent mandibular

posterior teeth (y = a + b x) were used for predict-ion.

RESULTS

Table (1) for the males and Table (2) for the females show the comparison bet-ween the individual and grouped teeth in the right and left sides in males and fe-males.

Table (3) shows the mean values of both individual teeth and combined distan-ces for both sexes were carried out.

Table (1): Comparison of means between the right and left mesio–distal crown diameter of males teeth

Tooth	Mean		F–value	*p*–value	Significance
	Right	Left			
4	7.31	7.32	0.02	0.90	NS
5	7.57	7.47	0.73	0.40	NS
D	7.86	7.85	0.006	0.94	NS
E	9.85	9.85	0.001	0.93	NS
4, 5	14.88	14.69	1.19	0.28	NS

D, E	17.70	17.70	0.0001	0.99	NS

NS: not significant ($p > 0.05$).

D,E: Deciduous molars; 4, 5: Unerupted premolars.

Table (2): Comparison of means between the right
and left mesio–distal crown diameter of females teeth

Tooth	Mean		F–value	p–value	Significance
	Right	Left			
4	7.08	7.06	0.06	0.81	NS
5	7.33	7.23	1.42	0.24	NS
D	7.75	7.69	0.45	0.50	NS
E	9.54	9.51	0.34	0.60	NS
4, 5	14.41	14.44	0.04	0.85	NS
D, E	17.19	17.20	0.00	0.99	NS

NS: not significant ($p > 0.05$).

D,E: Deciduous molars; 4, 5: Unerupted premolars.

Table (3): Comparison of means between the males and females mesio–distal
crown diameter of right and left mandibular deciduous molars and premolars

Tooth	Side	Mean		F–value	p–value	Significance
		Male	Female			
4	Right	7.31	7.08	6.79	0.010	S**
	Left	7.32	7.06	6.71	0.011	S*
5	Right	7.57	7.33	5.72	0.019	S*
	Left	7.47	7.23	7.10	0.009	S**
D	Right	7.86	7.75	1.37	0.244	NS
	Left	7.85	7.69	3.36	0.070	NS
E	Right	9.85	9.45	10.03	0.002	S**
	Left	9.85	9.51	9.36	0.003	S**
4, 5	Right	14.88	14.41	8.66	0.004	S**
	Left	14.69	14.44	2.67	0.105	NS
D, E	Right	17.70	17.19	8.57	0.004	S**
	Left	17.70	17.20	8.13	0.005	S**

NS: Not significant ($p > 0.05$), *S: Significant ($p \leq 0.05$), **S: Significant ($p \leq 0.01$).

D,E: Deciduous molars; 4, 5: Unerupted premolars.

Table (4) and Figure (2) show the linear regression equation for predicting mesio–distal crown dimension for total males and females of lower premolars. The dependent variables are first and second premolars for both sides. The indepen-dent variables are primary first and second molars for both sides. The standard error ranged between 0.29–0.36 mm for single tooth prediction. Figure (2) also shows a strong correlation between radiographic measurements and the predicted model ($r = 0.57$ –0.79).

Table (4): Linear regression equation used for predicting mesio–distal crown diameter
of the mandibular premolars for total males and females

Dependent Variable	Independent Variable	Side	Regression Equation	r	SE
4	D	Right	4 = 1.68 + 0.71 (D)	0.73	0.29
		Left	4 = 2.41 + 0.61 (D)	0.66	0.30
5	E	Right	5 = 3.43 + 0.41 (E)	0.57	0.36
		Left	5 = 0.61 + 0.71 (E)	0.76	0.34
4, 5	D, E	Right	4, 5 = 3.49 + 0.64 (D, E)	0.73	0.53

SE: Standard error.

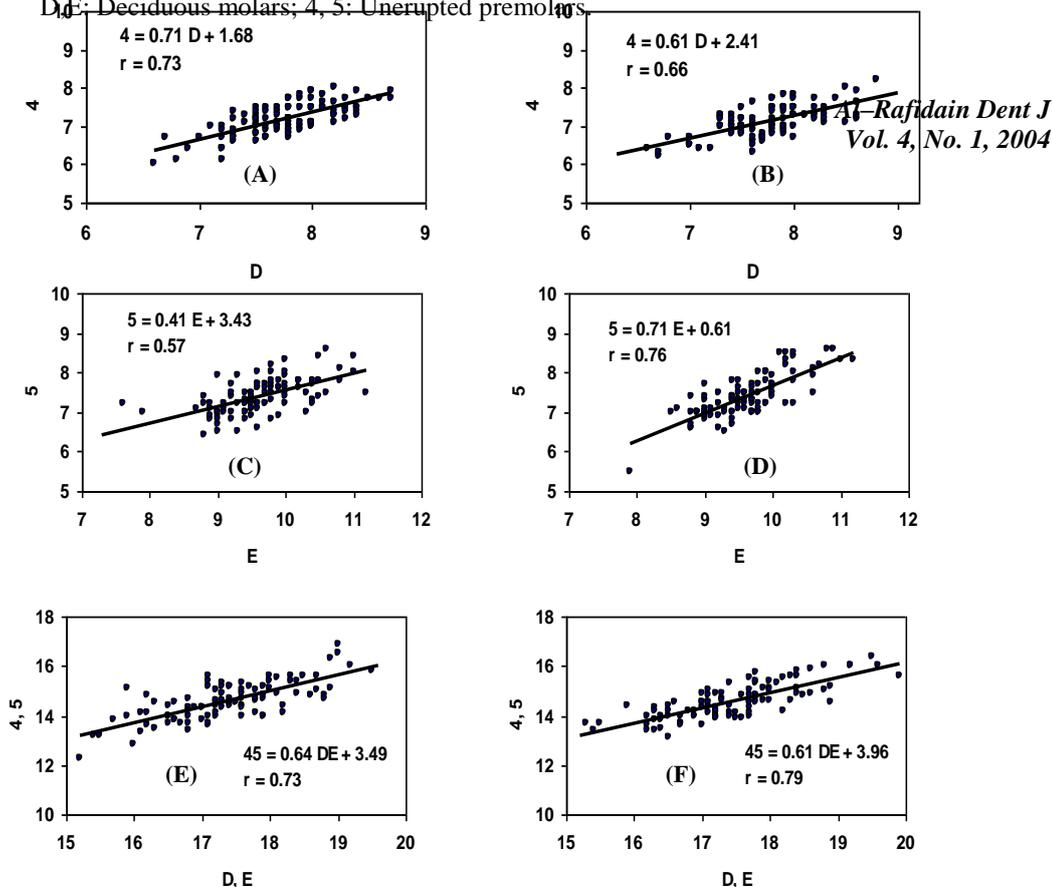D,E: Deciduous molars; 4, 5: Unerupted premolars.

Figure (2): Regression analysis models between mesio–distal crown diameter of the lower deciduous molars (D, E) and unerupted premolars (4, 5) for male and female

(A) Male (4 x D), (B) Female (4 x D), (C) Male (5 x E), (D) Female (5 x E), (E) Male 4, 5 x D, E and (F) Female (4, 5 x D, E)

DISCUSSION

Size differences between the mean values obtained for corresponding right and left teeth were noticed. The difference between the means of any two antimers was in agreement with other studies.[8,14]

These differences are very small in magnitude and are clinically not significant ($p > 0.05$). This is due to the fact that on individuals as the same factors that affect a tooth will affect its antimer.

In general, the results indicated the presence of sexual dimorphism, that is, all the teeth in males were larger in mesio–distal crown diameter than in females in lower arch for individual teeth and groups of teeth ($p \leq 0.05$), except the lower first deciduous molar which showed no significant difference between sexes. These results were in agreement with those of other studies.[8, 10, 14] Multiple regression analysis revealed that combinations of the two radiographic measurements and two cast measurements produced very high correlation coefficients in males and females.

The moderately positive correlation that exists between the mesio–distal crown diameters of posterior deciduous molars and combined mesio–distal crown diameters of the premolars in either sides of the dental arches is high enough to make it possible to measure the total mesio–distal dimensions of the unerupted premolars. The analyses which treat the sexes separately were better predictors than those methods which do not discriminate between the sexes. This agreed with the find-

ings of Staley *et al.*[8]

The present data were used to generate formulae "linear regression equations" of the form $y = a + bx$. The regression coefficients or the constants that were calculated in the present study.

CONCLUSIONS

Differences between the mean values obtained for corresponding right and left teeth were noticed, but none of the differences were statistically significant.

In this study, sexual dimorphism was observed. All the teeth in males were larger in mesio–distal crown diameters than females in both premolars and deciduous second molars, while there is no significant difference between first deciduous molars for both sexes.

The positive correlation that exists between the mesio–distal crown diameter of deciduous molars and unerupted premolars is enough to make it possible to measure total mesio–distal crown diameter of deciduous molars in the lower dental arch in order to predict the mesio–distal crown diameters of unerupted premolars

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