Prediction of mesio-distal width of maxillary canines depending on mesio-distal width of mandibular canines by using regression equation

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ABSTRACT

Background: Permanent canines considered to be very important teeth from aesthetic and functional point of view, space deficiency leading to malposition of maxillary canines considered as one of the most common malocclusions. The aim of this research is to predict mesio-distal width of maxillary canines in a valid practical way depending on mesio-distal width of mandibular canines.

Materials and methods: 113 dental cast sets related to patients attended orthodontic department of college of dentistry (61 females and 51 males) their ages were above 14 years, measurement of mesio-distal width of permanent maxillary and mandibular canines bilaterally was done by digital vernier to a nearest 0.1 mm.

Results and discussion: Highly positive correlation was found between mesio-distal width of maxillary and mandibular canines with an establishment of valid clinical prediction of mesio-distal width of maxillary permanent canines depending on their corresponding mandibular canines in each gender.

Conclusions: Mandibular canines can be used as a valid predictor to the mesio-distal width of maxillary canines before their eruption to prevent them from being either impacted or malposed.

Key words: Prediction, maxillary canines and regression. (J Bagh Coll Dentistry 2011;23(1):114-118).

INTRODUCTION

Mesio-distal tooth size is an important factor in orthodontic diagnosis and treatment planning. To achieve optimal balanced occlusion, facial harmony and aesthetic, the maxillary and mandibular teeth must be proportional in size (1). However, it is a critical factor in managing the developing occlusion of a growing child to allow the permanent teeth to erupt freely with good alignment in their respective arches (2). Although, several methods for the tooth size prediction of un-erupted teeth have been suggested in the literature, their applicability and accuracy is varied and still questionable in different ethnic groups (3,4).

Prediction of mesio-distal width of un-erupted tooth methods: Several methods were used as:

1- Radiographic method: proposed the measurement of the mesio-distal widths of un-erupted tooth from an individual’s radiographs (5,6,8,9).

2- Directly from dental cast: The widely used methods to predict the sum of the un-erupted permanent canines and premolars width depend upon the statistical correlation of the sum of the four permanent mandibular incisors width and the sum of the canines and premolars width of both arches (10-14).

3- Combination between radiograph and dental cast (15,17).

The use of several predictors in multiple linear regressions may improve the prediction, though they may be very complicated for clinical use. However, if an appropriate predictor is chosen for simple linear regression analysis, accuracy can still be acceptable (18,19).

No any attempt presented by others to predict the mesio-distal width of un-erupted maxillary permanent canines depending on the mesio-distal width of erupted mandibular permanent canines and as orthodontists we know the importance of maxillary permanent canines from aesthetic and functional point of view so it is intended to obtain a valid, simple and clinically applicable regression equation to predict the mesio-distal width of maxillary permanent canines before their eruption.

MATERIALS AND METHOD

Sample

The sample of this research composed of 113 dental cast sets (upper and lower) related to orthodontic patients (of different types of malocclusion) that attended orthodontic department of college of dentistry of Baghdad University, (61) of them were females, while the others (52) were males, these patients pooled from different geographic area of Baghdad and other neighbouring governorates, the sample collected after good examination of more than 260 dental cast sets according to the following criteria: The presence of completely erupted permanent canines in both arches bilaterally, therefore the age of the patients including in the sample was over 16 years (to ensure the complete eruption of maxillary and
mandibular permanent canines), however the following dental cast sets were excluded:
1- Fractured or damaged dental cast sets.
2- Dental casts related to partially erupted permanent canines cases.
3- Dental casts of patients with obviously malformed teeth like peg lateral incisors or teeth with extra or deficient cusp.
4- Dental casts of patients with fractured permanent canine tooth.

The measuring procedure
Before starting any measuring procedure it is important to examine the dental cast set thoroughly to be sure that it fit the inclusion criteria, the measuring procedure for the mesio-distal width of canines is done by using digital vernier (fig.1) to a nearest 0.1 mm, this was done by measuring the widest mesio-distal width of canines from anatomical contact point of permanent canines to neighbouring teeth measured from buccal surface and should be parallel to occlusal plane (20), however for rotated or malposed canines, the measurement was taken between the points on the approximate surface of the crown, where it was judged that normal contact should have occurred with the neighbouring tooth (21), for the suspected and difficult measurement more than one measurement were taken then the average was registered. Usually the measuring procedure was done in sessions according to the availability of cast sets and before starting, standardization of digital vernier should be done by closing it to a zero distance and pressing the zero button present in the digital vernier to give it a zero value (to ensure that the zero reading that appear in the digital vernier display coincide precisely with the zero distance of the two calipers of the digital vernier).

Statistical analysis
The data obtained from measuring procedures were arranged in tables and by the use of spss programme /version 15; the following statistical analyses were done:

a- Descriptive analysis: To find minimum, maximum, means and standard deviations of different variables included in the research.
b- Paired t-test: To compare between the means of right and left mesio-distal width of canines of same subject.
c- Independent t-test: To compare between the means of mesio-distal canine width in both sexes.
d- Pearson Correlation Coefficient test (r): To find if there is positive or negative significant correlation among different variables.
e- Regression equation: To find if there is a valid regression equation among different variables (depending on r-value, the regression equation considered to be valid if r-value more than 0.7). This equation based on the following formula: \( Y = A + B \times X \)
X, the value of the independent (predictor) variable which is the lower permanent canines of an Iraqi sample; and Y, the value of the dependent variable which is the upper permanent canines of an Iraqi sample, while The estimated regression constants ‘A’ and regression coefficient ‘B’ were calculated.

RESULTS AND DISCUSSIONS
Table 1 showed the means of mesio-distal width of permanent canines were higher in maxilla than mandible for both gender, in addition to that they were higher in male than females for both arches.

By using paired t-test, no significant differences were found between right and left mesio-distal width of permanent canines of both arches and of both genders (table 2), while by using independent t-test, highly significant differences were found between mesio-distal width of maxillary and mandibular canines of both genders (table 3).

Pearson’s correlation test among mesio-distal width of permanent canines, showed, highly significant positive correlation was found between maxillary and mandibular canines in both genders (table 4), and the following regression equation were obtained to predict the mesio-distal width of maxillary permanent canines depending on the mesio-distal width of mandibular canines:
1-Male (M): \( Y=2.406 + 0.796 \times X \)
2-Female (F): \( Y=1.788 + 0.882 \times X \)
The importance of maxillary canines from an aesthetic and functional point of view is very well known, specially regarding the effect of normal eruption of canines into their normal positions to get class I canine relation that protect both anterior and posterior teeth from being malposed or crowded, as we know crowding or mal-position of teeth usually affect the last tooth or group of teeth erupted in specific segment because the teeth usually erupt in sequence, therefore any factor that lead to space deficiency in specific segment will affect the last tooth that erupt in this segment and usually the upper permanent canine considered to be the last tooth to erupt in upper buccal segment while the eruption of lower permanent canines usually erupts 1.5-2 years before the normal eruption of upper permanent canines, therefore we realize the importance of valid prediction of mesio-distal width of maxillary canines depending on the width of lower permanent canines to provide a good environment for normal eruption of maxillary canines and establishment of normal occlusion.

REFERENCES


7- Houston WJB. Walthers orthodontic notes. 3rd edit., John Wright & Sons Ltd., 1976. Bristol.


Table 1: Distributions of mesio-distal width of permanent canines by gender.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Arch</th>
<th>No.</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Maxilla</td>
<td>52</td>
<td>7.2</td>
<td>9.1</td>
<td>8.2</td>
<td>0.426</td>
</tr>
<tr>
<td></td>
<td>Mand.</td>
<td></td>
<td>6.4</td>
<td>8.2</td>
<td>7.3</td>
<td>0.398</td>
</tr>
<tr>
<td>Female</td>
<td>Maxilla</td>
<td>61</td>
<td>6.8</td>
<td>9.2</td>
<td>7.8</td>
<td>0.482</td>
</tr>
<tr>
<td></td>
<td>Mand.</td>
<td></td>
<td>6.0</td>
<td>7.7</td>
<td>6.8</td>
<td>0.409</td>
</tr>
</tbody>
</table>

All measurements are in mm

Table 2: Comparison between right and left mesio-distal measurements of permanent canines in both genders and arches

<table>
<thead>
<tr>
<th>Gender</th>
<th>Arch</th>
<th>Side</th>
<th>No.</th>
<th>Mean</th>
<th>S.D</th>
<th>df</th>
<th>t-test</th>
<th>P value</th>
<th>Sig.</th>
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<tbody>
<tr>
<td>Male</td>
<td>Maxilla</td>
<td>R</td>
<td>52</td>
<td>8.2</td>
<td>0.43</td>
<td>51</td>
<td>-0.076</td>
<td>0.940</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>52</td>
<td>8.2</td>
<td>0.43</td>
<td>51</td>
<td>-1.864</td>
<td>0.068</td>
<td>NS</td>
</tr>
<tr>
<td>Mandible</td>
<td>R</td>
<td>52</td>
<td>7.2</td>
<td>0.41</td>
<td>51</td>
<td>-1.800</td>
<td>0.077</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>52</td>
<td>7.3</td>
<td>0.40</td>
<td>51</td>
<td>0.118</td>
<td>0.906</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>Maxilla</td>
<td>R</td>
<td>61</td>
<td>7.7</td>
<td>0.46</td>
<td>60</td>
<td>-1.800</td>
<td>0.077</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>61</td>
<td>7.8</td>
<td>0.50</td>
<td>60</td>
<td>0.180</td>
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<td>6.8</td>
<td>0.43</td>
<td>60</td>
<td>-0.076</td>
<td>0.940</td>
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<td></td>
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<td>61</td>
<td>6.8</td>
<td>0.41</td>
<td>60</td>
<td>0.118</td>
<td>0.906</td>
<td>NS</td>
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</tbody>
</table>

All measurements are in mm

NS: P-value > 0.05

Table 3: Gender difference of M-D canine width in both arches

<table>
<thead>
<tr>
<th>Arch</th>
<th>Gender</th>
<th>No.</th>
<th>Mean</th>
<th>S.D</th>
<th>df</th>
<th>t-test</th>
<th>P value</th>
<th>Sig.</th>
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<tr>
<td>Maxilla</td>
<td>Male</td>
<td>52</td>
<td>8.2</td>
<td>0.426</td>
<td>111</td>
<td>4.853</td>
<td>0.000</td>
<td>000</td>
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<tr>
<td></td>
<td>Female</td>
<td>61</td>
<td>7.8</td>
<td>0.482</td>
<td>111</td>
<td>6.368</td>
<td>0.000</td>
<td>000</td>
</tr>
<tr>
<td>Mandible</td>
<td>Male</td>
<td>52</td>
<td>7.3</td>
<td>0.398</td>
<td>111</td>
<td>6.368</td>
<td>0.000</td>
<td>000</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>61</td>
<td>6.8</td>
<td>0.409</td>
<td>111</td>
<td>6.368</td>
<td>0.000</td>
<td>000</td>
</tr>
</tbody>
</table>

All measurements are in mm

000: Highly significant.

Table 4: Correlations among upper and lower canines in both genders

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male lower canine</th>
<th>Female lower canine</th>
<th>Female upper canine</th>
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</thead>
<tbody>
<tr>
<td>Male Upper canine</td>
<td>r = 0.844**</td>
<td>r = 0.746**</td>
<td>r = 0.708**</td>
</tr>
<tr>
<td>Female Upper canine</td>
<td>r = 0.738</td>
<td>r = 0.749**</td>
<td>r = 0.735</td>
</tr>
<tr>
<td>Female Lower canine</td>
<td>r = 0.045</td>
<td>r = 0.048</td>
<td>r = 0.048</td>
</tr>
<tr>
<td>P = 0.000</td>
<td>P = 0.000</td>
<td>P = 0.000</td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed)
Prediction of mesio-distal width

Figure 2: Scattered diagram of linear relation between mesio-distal width of maxillary and mandibular permanent canines in males.

Figure 3: Scattered diagram of linear relation between mesio-distal width of maxillary and mandibular permanent canines in females.