Comparing Different Methods to Estimate the Combined Mesiodistal Widths of Maxillary and Mandibular Incisors

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ABSTRACT

Objective: This study aimed to develop regression equations to predict the combined mesiodistal widths of maxillary and mandibular incisors from each other and compare them with other methods.

Methods: One hundred pairs of study models from 100 Iraqi subjects with normal occlusion were used in this study. The individualized mesiodistal widths of maxillary and mandibular incisors were measured using electronic digital calipers. The combined mesiodistal widths of maxillary and mandibular incisors were calculated according to Tonn's and Abhi's formulas and from regression equations to be compared with the actual one.

Results: Both sums of the maxillary and mandibular incisors were significantly correlated. There were significantly high differences between the actual and calculated sum widths, and also between the calculated and predicted ones. On the other hand, a non-significant difference was obtained between the actual and predicted sum widths of maxillary and mandibular incisors.

Conclusion: Tonn’s and Abhi’s methods are not reliable methods to calculate the sum widths of maxillary and mandibular incisors. New regression equations are developed to predict the sum widths of maxillary and mandibular incisors from each other.

Keywords: Abhi’s formula, Tonn’s formula, regression

INTRODUCTION

The main purposes of orthodontic treatment are to establish the esthetic harmony, functional efficiency, and structural balance (1, 2), in addition to obtaining straight teeth and stable results. These purposes can be attained by having a good inter-digitation between the maxillary and mandibular teeth with coordinated tooth size materials in the same arch and both arches (3).

The maxillary and mandibular incisors are subjected to many anomalies, such as the difference in size, shape, or number. The most affected tooth is the lateral incisor in both arches. It may be congenitally missed, small in size, and being peg shaped (maxillary) or may be missed (mandibular) (4).

In 1909, Pont established an index to predict the maxillary inter-premolar and inter-molar distances using the combined mesiodistal widths of maxillary incisors (5). This index gave inaccurate prediction in some cases with congenitally missing and abnormally shaped maxillary incisors, especially the laterals (6). To resolve this problem,
Tonn (7) applied a formula to calculate the mesiodistal widths of the four maxillary incisors using the sum of mandibular incisors widths as follows: \( \text{Sum of maxillary incisors} = \left( \text{Sum of mandibular incisors} \times \frac{4}{3} \right) + 0.5. \)

In 2014, Bansal et al. (3) modified the Tonn's formula to estimate the sum of mandibular incisors widths from the sum of maxillary incisors widths and called it Abhi's formula: \( \text{Sum of mandibular incisors} = (\text{Sum of maxillary incisors} - 0.5) \times 0.75. \) This formula was used to predict the mesiodistal width of impacted or missed lower incisor teeth.

To the best of author knowledge, until now, no study has been published to determine the reliability of the two mentioned methods, so the aim of the present study was to compare the sum mesiodistal widths of the maxillary and mandibular incisors using Tonn's and Abhi's methods with the actual mesiodistal widths and, at the same time, to formulate regression equations to predict the sum mesiodistal widths of the maxillary and mandibular incisors and compare them with the actual and previous methods.

**METHODS**

**Sample**

One hundred pairs of study models belonging to 50 male and 50 female subjects were used in this study. All subjects were of Iraqi Arab origin, aged between 17 and 22 years, with full permanent dentition regardless of the third molars. The teeth were in normal occlusion with no caries, fillings, or signs of attrition or abnormal anatomy.

**Methods**

After signing the consent form, the subjects were examined to fulfill the inclusion criteria. Then, alginate impressions were taken for the maxillary and mandibular teeth using the Hydrogum alginate impression material (Zhermack, Italy) and poured with Type IV dental stone (Navy blue, Zhermack, Italy) according to the manufacturer instructions. The individual mesiodistal width of maxillary and mandibular incisors was measured from the anatomical contact points using electronic digital calipers (Mitutoyo, Japan) with 0.01 mm sensitivity, held parallel to the occlusal plane (1), and the sum of mesiodistal widths of maxillary and mandibular incisors was obtained to be considered as the actual sum of widths, while the calculated widths were obtained using Tonn's and Abhi's methods. The predicted sum widths were obtained using the regression equations.

**Statistical analysis**

The data were collected and analyzed using the Statistical Package for Social Sciences program version 21 (IBM Corp.; Armonk, NY, USA). The statistical analyses included:

1. Descriptive statistics comprising the Shapiro-Wilk test and the mean and standard deviations
2. Inferential statistics
   a. Intraclass correlation test to test the reliability of the measurements
   b. Independent samples t-test to verify the gender difference for the measurements
   c. Pearson's correlation coefficient (r) to detect the relation between the sum of mesiodistal widths of maxillary and mandibular incisors
   d. Simple regression analysis to establish the regression equations that can be used to predict the sum of mesiodistal widths of maxillary and mandibular incisors from each other
   e. A paired sample t-test to compare the sum of mesiodistal widths of maxillary and mandibular incisors of both genders obtained with different methods

In the statistical evaluation, the following levels of significance were used:

<table>
<thead>
<tr>
<th>Significance Level</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-significant</td>
<td>NS</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Significant</td>
<td>$</td>
<td>0.05\geq p&gt;0.01</td>
</tr>
<tr>
<td>Highly significant</td>
<td>HS</td>
<td>p\leq0.01</td>
</tr>
</tbody>
</table>

**RESULTS**

First, testing the normality of data distribution was performed using the Shapiro–Wilks test, and the results indicated normally distributed data. Intraclass correlation indicated good reliability when repeating measurements after 1 week (more than 0.7).

**Table 1. Descriptive statistics and gender difference of the mesiodistal width of individualized and combined maxillary and mandibular four incisors**

<table>
<thead>
<tr>
<th>Teeth</th>
<th>Males Mean</th>
<th>Males SD</th>
<th>Females Mean</th>
<th>Females SD</th>
<th>Gender Difference Males t-Test</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxillary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RL</td>
<td>6.779</td>
<td>0.530</td>
<td>6.636</td>
<td>0.464</td>
<td>0.143</td>
<td>1.431</td>
</tr>
<tr>
<td>RC</td>
<td>8.899</td>
<td>0.535</td>
<td>8.489</td>
<td>0.438</td>
<td>0.409</td>
<td>4.187</td>
</tr>
<tr>
<td>LC</td>
<td>8.898</td>
<td>0.523</td>
<td>8.533</td>
<td>0.459</td>
<td>0.365</td>
<td>3.705</td>
</tr>
<tr>
<td>LL</td>
<td>6.770</td>
<td>0.561</td>
<td>6.645</td>
<td>0.461</td>
<td>0.125</td>
<td>1.218</td>
</tr>
<tr>
<td>Sum</td>
<td>31.345</td>
<td>1.739</td>
<td>30.304</td>
<td>1.548</td>
<td>1.042</td>
<td>3.164</td>
</tr>
<tr>
<td>Mandibular</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RL</td>
<td>6.014</td>
<td>0.448</td>
<td>5.678</td>
<td>0.319</td>
<td>0.336</td>
<td>4.318</td>
</tr>
<tr>
<td>RC</td>
<td>5.369</td>
<td>0.329</td>
<td>5.167</td>
<td>0.304</td>
<td>0.203</td>
<td>3.196</td>
</tr>
<tr>
<td>LC</td>
<td>5.332</td>
<td>0.373</td>
<td>5.197</td>
<td>0.319</td>
<td>0.136</td>
<td>1.956</td>
</tr>
<tr>
<td>LL</td>
<td>5.987</td>
<td>0.360</td>
<td>5.720</td>
<td>0.318</td>
<td>0.267</td>
<td>3.938</td>
</tr>
<tr>
<td>Sum</td>
<td>22.703</td>
<td>1.332</td>
<td>21.761</td>
<td>1.079</td>
<td>0.942</td>
<td>3.886</td>
</tr>
</tbody>
</table>

RL: Right lateral; RC: Right central; LC: Left central; LL: Left lateral
Table 1 revealed the descriptive statistics and gender difference of the mesiodistal width of individualized and combined maxillary and mandibular four incisors. Generally, the mean values of the measured parameters were significantly higher in males than females except for the maxillary right and left laterals and mandibular left central incisor where there was non-significant gender difference.

The relation between the combined widths of maxillary and mandibular incisors was presented in Table 2 for both genders.

There was a strong direct significantly high correlation between them.

Regression equations to predict the sum of mesiodistal widths of the maxillary and mandibular incisors from each other are presented in Table 3, also for both genders.

In Tables 4 and 5, the actual sum of widths of maxillary and mandibular incisors was compared with that obtained from Tonn and Abhi and with that predicted by regression equations in both genders. There were significantly high method differences between both the actual and the predicted methods with that of Tonn’s and Abhi’s methods, while a non-significant method difference was detected between the actual and predicted one.

**DISCUSSION**

One of the most reliable methods of estimating the width of unerupted teeth is the developing of regression equation utilizing other teeth. Many studies had been conducted in Iraq to estimate the width of unerupted canine and premolars using this method and other methods (8-17).

Pont (5) tried to predict the maxillary inter-premolar and inter-molar distances using the combined mesiodistal widths of...
maxillary incisors, but the problems associated with the presence and absence of lateral incisors made his index inaccurate. To solve this problem, Tonn (7) developed a formula to calculate the mesiodistal width of the four maxillary incisors using the sum of mandibular incisors width. Bansal et al. (3) benefited from this idea and calculated the mesiodistal widths of the four mandibular incisors using the sum of maxillary incisors width. Till now, there was no evidence about the accuracy of these methods, and to the best of the authors’ knowledge, no study had been performed to ensure their accuracy. Hence this study was conducted.

The sample included Iraqi Arab subjects with full permanent dentition and class I occlusal relation. The individualized mesiodistal width of maxillary and mandibular anterior teeth was measured and collected for both genders. Reviewing Table 1 revealed that there was a significantly high difference between the genders for most of the measurements except the width of maxillary laterals and mandibular left central incisor. This difference is in agreement with previous findings indicating significantly wider teeth in males (18, 19). The common finding that the tooth crown sizes in males exceeded, on average, those in females results from a greater thickness of dentin in male teeth. The difference is elucidated by the indorsing effect of the Y chromosome on dentin growth, probably through cell proliferation (20, 21).

The second step was finding the relationship between the sum of maxillary and mandibular anterior teeth widths using Pearson’s correlation coefficient test. The results in Table 2 indicated that there was a direct strong significantly high correlation between the parameters in both genders. Vardimon and Lambertz (22) reported that if the value of the correlation coefficient test is greater than 0.70, the prediction procedures will be more reliable. These results paved the road for the next step, which was developing regression equations to estimate the combined widths of maxillary and mandibular incisors from each other for both genders, as described in Table 3.

The equation was calculated as \( Y = a + bX \), where \( Y \) is the combined mesiodistal crowns widths of mandibular or maxillary permanent anterior teeth, \( X \) is the combined mesiodistal crowns widths of maxillary or mandibular anterior teeth based on which to predict, \( a \) is constant, and \( b \) is the regression coefficient. Now the actual sum widths (measured from study casts), calculated sum widths (calculated from Tonn’s and Abhi’s methods) in addition to the estimated sum widths (gained from applying the regression equations) were compared in both genders (Tables 4 and 5). The results revealed that there was a significantly high difference between the actual width and the calculated width. On the other hand, there was a non-significant difference between the actual and the predicted widths, while a significantly high difference was observed between the calculated and predicted widths. These results confirmed that the sum mesiodistal widths calculated from Tonn’s and Abhi’s methods were not reliable, and hence one cannot rely on these methods to calculate the sum widths of maxillary and mandibular anterior teeth.

Further studies are needed to develop regression equations in different countries as the mesiodistal widths of teeth are not the same in all people.

**CONCLUSION**

The present study is the first to determine the accuracy of the previous methods since no research has been performed to examine these methods statistically. Tonn’s and Abhi’s methods were not reliable in calculating sum mesiodistal widths of maxillary and mandibular incisors.

New regression equations to predict the sum widths of maxillary and mandibular anterior teeth were developed for both genders, and they proved statistically that their results were not different from the actual sum widths.

**REFERENCES**

17. Nahidh M. Predicting the combined widths of unerupted maxillary and mandibular canines and premolars utilizing the widths of maxillary and mandibular central incisors and first molars. IOSR J Dent Med Sci 2016; 15: 80-4. [CrossRef]