Relation of Maxillary Central Incisors Width to some Facial Measurements

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Abstract

Background Using the extraoral indicators is a common method to determine the size and shape of the artificial teeth. **Aim** This study was conducted to assess the relationship between the mesiodistal width of maxillary central incisors and some facial anatomical landmarks (Bizygomatic and Inter-canthal distance). **Materials and Methods** A prospective cross-sectional study was conducted on 160 adult students, with the age range between 18-25. Mesiodistal widths of maxillary central incisors and two facial widths (bizygomatic and inter-canthal) were marked and measured by digital caliper to the nearest of 0.01mm. Data were analyzed statistically using SPSS (V-18) software. **Results** The statistical Analysis demonstrated the correlation of the mesiodistal width of a right central incisor with bizygomatic and inner-canthal widths was significant at P-Value of (P< 0.05), Spearman›s correlation of bizygomatic for male was 0.358 and female was 0.305, and the spearman›s correlation of inter-canthal for male was 0.318 and female was 0.312. In the male, the correlation of the mesiodistal width of a left central incisor with bizygomatic and intercanthal widths was weak; Spearman›s correlation was 0.043 for bizygomatic and was 0.123 for intercanthal. While for female, it showed a strong correlation, spearman›s correlation was 0.349 for bizygomatic and was 0.298 for intercanthal. **Conclusion** The results proposed that the inter-canthal and bizygomatic widths are both good prognostic factor in determining the mesiodistal width of the maxillary right central incisor. Also concluded that the correlation between maxillary central incisor width and bizygomatic and inter-canthal widths could be differed by gender.

Key words: Esthetics; Anatomic Landmarks; Upper Central Incisors.

Introduction

Much of the information related to treatment planning in dental esthetic were derived from the face and anatomical landmarks of the face could be used to determine the proportions of anterior teeth (Naylor, 2002)). The size of the anterior maxillary teeth is imperative for optimized dental and facial esthetics. Several anatomic landmarks bear fixed positional relationships to some natural teeth. These landmarks serve as reliable guides in replacing natural teeth with artificial teeth (Sellen et al., 2002). A review article by Karunakar et al., (2013) states that Berry were suggest a (1:16)
proportionality ratio between the facial width and mesiodistal width of the maxillary central incisors (Fenn et al., 1986; Engelmeier, 1996; Alwazzan, 2001; Abdullah, 2002; Naylor, 2002; Bozkir et al., 2003; and EL-Sheikh et al., 2010). Authors of many recent studies suggest observing people’s facial measurements in order to obtain objective guidelines for anterior teeth width selection and measuring distances between certain reference points of the face. Considers facial analysis with digital photography as a practical and efficient application were performed by (Gomes et al., 2006; Lucas et al., 2009; and Isa et al., 2010), many authors were performed all measurements by using a digital caliper (Zlataric et al., 2007; Tandale et al., 2007; and Gonçalves et al., 2009).

However pre-extraction records for Iraq population are not available, therefore the selection of proper anterior teeth size for edentulous patients will be very difficult. That is why many anatomical measurements have been suggested, such as inter-canthal distance (I.C.D), inter-pupillary distance, outer-canthal distance, inter-allar width, bizygomatic distance, inter-commissural distance, intra-condyler width, and philtrum. This study was conducted to determine the relation of mesiodistal width of clinical crown of the maxillary central incisor and the several facial widths in 160 dental students with age range between 18-25, 80 males and 80 females of Duhok Polytechnic University/ Duhok Technical Institute and Duhok University/ College of Dentistry.

Materials and Methods
In this prospective cross-sectional study, a 160 students with age range between 18-25, 80 males and 80 females, gathering the inclusion criteria: all maxillary teeth present; no diastemas, Angles Class I relationship, teeth free from filling, no history of orthodontic treatment, severe attrition and caries cases were excluded. The facial width was measured according to two categories:

1- Inter-canthal width was defined as the distance between the right medial canthus and the left medial canthus (EL-Sheikh et al., 2010), figure 1(A).

2- Bizygomatic width the facial width taken between the most lateral points on the external surfaces of the zygomatic (Jafari et al., 2014), figure 1(B).

Figure 1: A) measuring intercanthal distance by digital calipers ruler. B) measuring procedure of bizygomatic distance. C) & D) measuring the mesiodistal width of the maxillary central incisor from the dental cast with digital calipers, hold the digital caliper perpendicular to the tooth long axis during measurements.
The distances were measured three times using a digital caliper with 0.01 mm accuracy (Mitutoyo Crop, Tokyo, Japan), figure (2).

Figure 2: Digital caliper ruler with 0.01 mm accuracy (Mitutoyo Crop, Tokyo, Japan).

Dental casts were prepared by taking impressions, with irreversible hydrocolloid impression material (Alginate Cavex Holland), and then impressions were poured immediately using type 1 dental stone (ZETA Muffle Italy). The mesiodistal width of the maxillary central incisors was measured from the dental cast with a digital caliper. The measurements were repeated three times for accuracy (Jafari et al., 2014), figure 1(C and D).

For this study, a sharp-tipped digital caliper read to the nearest 0.01 mm was used to gauge mesiodistal width of each maxillary central incisor from the labial side using outer edges of caliper positioned between the contact points of teeth, the mean of measurements was then calculated. This process was done for both right and left central incisor teeth. After that, the correlations between the measured distances (the inter-canthal and bizygomatic distances with a mesiodistal width of clinical crown of upper central incisors) were calculated using Pearson correlation coefficient based on the obtained data and considering the age variable (18-25) years old.

Results
Measurements of intraoral landmarks were taken from stone casts of maxillary impressions using digital calipers devices. Each measurement was completed by three assessors to obtain the mean value. Data were statistically analyzed using SPSS version 18 software and followed by post hoc analysis (P ≤0.05). Spearman’s rank-order for correlation was used to determine whether a correlation exists between measurements. In this study, the width was measured three times, then the mean of the three readings was calculated, this to reduce the errors that could be related to the digital caliper device position during the tooth-face measurements, and to be more accurate in results. The descriptive statistical analysis of the mesiodistal width of maxillary central incisors to bizygomatic and inter-canthal widths are shown in figure (3).
In Table (1), the results of the statistical correlation between the mesiodistal width of right central incisor to inter-canthal width were significant at P<0.05. Table (1): Differences in tooth-facial measurements among gender using T-test and Mann-Whitney test at significance level of (P ≤0.05), group A (male) vs. group B (female):

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group A</th>
<th>Group B</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bizygomatic distance (mm)**</td>
<td>111.943</td>
<td>109.05</td>
<td>31.447</td>
<td>30.994</td>
</tr>
<tr>
<td>Intercanalal distance (mm)**</td>
<td>2.925</td>
<td>2.870</td>
<td>1.702</td>
<td>1.855</td>
</tr>
<tr>
<td>MD Width of Right Central Incisor (mm)**</td>
<td>8.569</td>
<td>8.575</td>
<td>0.3709</td>
<td>0.493</td>
</tr>
<tr>
<td>MD Width of Left Central Incisor (mm)**</td>
<td>8.665</td>
<td>8.552</td>
<td>0.499</td>
<td>0.497</td>
</tr>
</tbody>
</table>

The correlation bizygomatic and intercanthal widths with right and left mesiodistal width of central incisors revealed a significant positive correlation for the right central incisor with P<0.05. While it showed non-significant correlation with left central incisor with P>0.05. Table (3) presented the correlation of the measured facial widths.
with the width of right and left central incisor between male and female study groups. It was a significantly positive correlation for the right central incisor with $P < 0.05$ in both genders. While the correlation with left central incisor was small and non-significant for the male student group and significant positive correlation for a female with $P > 0.05$.

Table (2): Correlations between bizygomatic width and inter-canthal width with right vs. left maxillary central incisors teeth:

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mesi-distal Width of Right Maxillary Central Incisor (mm)</th>
<th>$P$-value</th>
<th>Mesi-distal Width of Left Maxillary Central Incisor (mm)</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bizygomatic width (mm)</td>
<td>0.304</td>
<td>$&lt; 0.001^*$</td>
<td>0.002</td>
<td>0.975</td>
</tr>
<tr>
<td>Intercanthal (mm)</td>
<td>0.310</td>
<td>$&lt; 0.000^*$</td>
<td>0.093</td>
<td>0.244</td>
</tr>
</tbody>
</table>

* $P$ value $< 0.05$ is significant
* Spearman's correlation

Table (3): Correlations between bizygomatic width and inter-canthal width with right vs. left central incisors teeth for group A (male) and group B (female):

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mesi-distal Width of Right Central Incisor</th>
<th>$P$-value</th>
<th>Mesi-distal Width of Left Central Incisor</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td></td>
<td></td>
<td>Group A</td>
<td></td>
</tr>
<tr>
<td>Bizygomatic width</td>
<td>0.358</td>
<td>P: 0.001*</td>
<td>0.305</td>
<td>P: 0.006*</td>
</tr>
<tr>
<td>Intercanthal width</td>
<td>0.318</td>
<td>P: 0.004*</td>
<td>0.312</td>
<td>P: 0.005*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mesi-distal Width of Right Central Incisor</th>
<th>$P$-value</th>
<th>Mesi-distal Width of Left Central Incisor</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group B</td>
<td></td>
<td></td>
<td>Group B</td>
<td></td>
</tr>
<tr>
<td>Bizygomatic width</td>
<td>0.349</td>
<td>P: 0.002*</td>
<td>0.305</td>
<td>P: 0.707</td>
</tr>
<tr>
<td>Intercanthal width</td>
<td>0.298</td>
<td>P: 0.007*</td>
<td>0.312</td>
<td>P: 0.276</td>
</tr>
</tbody>
</table>

* $P$ value $< 0.05$ is significant
* Pearson correlation

Discussion
The presented study was undertaken to determine the relation of maxillary central incisor width with that of bizygomatic and inter-canthal, as well as to determine the
correlation between examined parameters and among the gender which could be useful in the clinical treatment of our population. Although this research was carefully prepared, there were some unavoidable limitations. First, the sample size is only limited to 160 students who were attending their semesters at the University. The second limitation was the geographical region that this study be conducted. The samples were only taken from the university students at Duhok city only, thus the samples cannot be the representative of the rest of the population. A third limitation was the inaccuracies common to the making of dental casts. Also the minor positional differences of the digital caliper devices that can occur during readings the variables three times. In earlier studies, measurements were done on extracted teeth (Sterret et al., 1999; Ellakwa et al., 2011); However, recent investigations attempted to measure the clinical tooth dimensions either on casts or using computer-based images or intraoral evaluations (Cesario, and Latta, 1984; Ellakwa et al., 2011; Strajnic et al., 2013; Ahmed, N. et al., 2015 and Mishra et al., 2016).

All these methods were aimed to relate the facial measurements and predict width of maxillary anterior teeth. Although Ahmed et al., (2015); stated that there is no relation between these facial measurements and central incisor width. In this study, a young and healthy sample was evaluated, with no marked alterations in the shape of the face and incisors.

There is a natural and considerable prevalence of facial asymmetry in the population and great variability in face shapes (Severt, and Proffit, 1997). Diseases such as Cushing’s syndrome and lipodystrophy may alter the facial contour (Priscilla et al., 2007). They restrain the perception and determination of a common sense criterion as do several other factors including body-weight, and age. With increasing age, a generalized subcutaneous dehydration occurs that contributes significantly to skin wrinkling and contraction, leading to a reduction of facial volume. In some cases a decrease in the vertical dimension of the face also occurs, giving the face a slightly shorter aspect and making the cheek contour more prominent (Felipe et al., 2010). Furthermore, incisors have anatomic characteristics that vary in accordance with age. The teeth of elderly people present a higher frequency of rotations, inclinations in the mesiodistal direction, deviations from the midline, abrasion and gingival retraction (Rudiger, and Frauke, 2004).

The biometric ratio presented in table (1) showed the actual measurement of the width of the study variables, were compared between male and female groups. The results exhibited no significant difference (P>0.05) in the width of the central incisors, these finding could be not in line with previous studies (Sterret et al., 1999; Alwazzan, 2001; Owens et al., 2002; Hasanreisoglu et al., 2005; and Ahmed, N. et al., 2015), They reported that the width of maxillary central incisor was significantly wider and longer in males than females. Slight gender variations in the width of the bizygomatic have been significantly noted for groups, with men exhibiting wider (median 112.04) than women (median 109.45). However; the inter-canthal width reveals non-significant variations. In the present study, the results showed that the proportional ratio between the width of central incisors and inter-canthal width was 1/3.6 and that with bizygomatic was 1/13. This ratio was commonly used to determine the size of the maxillary anterior teeth.

A previous investigation found the 1:16 ratio of the bizygomatic distance to the central incisor width (Bozkir et al., 2003; Hasanreisoglu et al., 2005; and EL-Sheikh et al.,
This minor variation of the ratio of this study to other studies may be related to genetic variability due to geographical origin and historical background. By conducting statistical analysis of the study population, table (II) showed the significant correlation between the mesiodistal width of right central incisor with bizygomatic and inter-canthal widths (P<0.05), Spearman’s correlation coefficient of bizygomatic =0.304 and inter-canthal =0.310 which is in agreement with the study by (Abdullah, 2002; Alwazzan, 2001), who indicate that the inter-canthal distance could be used to select maxillary anterior teeth for edentulous patients. When the subjects were separated by gender, a significant positive correlation of right central incisor width with measured facial widths in both gender was revealed, (P-value 0.001, 0.006, bizygomatic males and females, respectively) and (P-value 0.004, 0.005, intercanthal males and females, respectively), since P-value is less than (0.05) therefore the width of the central incisor on the cast can be determined from the facial width. For example, if someone has a wide face or high value in facial indicator may be this indicates that his/her central incisors are also wide. The result was agreement with the work of (Abdullah et al., 1997; Abdullah, 2002; EL-Sheikh and Mendilawi, 2003).

It was also proved with the results of the study by Strajnic et al., (2013), who concluded that the static measurements of the low correlation between the inner-canthal distance and the width of anterior teeth were established. It also showed that male subjects have higher values than females, based on the harmonious relationship between the size and shape of teeth in relation to gender and individual constitutional characteristics. Regarding the correlation between the widths of the left central incisor with the measured facial parameters, a highly significant result was observed in females (P-value 0.002, 0.007, bizygomatic and inter-canthal, respectively). While in males, this study did not observe significant correlation (P-value 0.707, 0.276, bizygomatic and inter-canthal, respectively).

This result was proved with Ahmed et al., (2015) who concluded that the comparison of maxillary central incisor width with inter-canthal width was significantly higher for females than males. Considering that no research, including this study, confirms a high correlation between facial and dental parameters, most authors suggested using this method as a guideline in selecting the width of anterior artificial teeth but only combined with other methods.

Conclusion

From the results of the present study, it was concluded that the ratio between investigated inter-canthal and bizygomatic widths and maxillary right central incisor width could be used to assist the clinicians in calculating the maxillary incisor width in the absence of pre-extraction records. While the ratio of examined facial measurements to the maxillary left central incisor width cannot be considered as a reliable guideline in the selection of artificial upper anterior teeth; However, they may be used as a useful additional factor combined with other methods to calculate the dimension of teeth used for the future denture. The results were also concluded that the correlation between maxillary central incisor and facial measurements that have been applied previously could differ by gender.
References


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