The relationship between intercanthal dimension and the widths of maxillary anterior teeth

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Statement of problem. One of the difficult aspects of complete denture prosthodontics is the selection of appropriately sized maxillary anterior teeth. Many attempts have been made to establish methods of estimating the combined width of maxillary anterior teeth and/or central incisors.
Purpose. The aim of this investigation was to determine whether a relationship exists between the intercanthal dimension and 4 mesiodistal width combinations of the maxillary anterior teeth.
Material and methods. The maxillary anterior teeth of 443 adult subjects were examined. Intercanthal distance was measured between the median angles of the palpebral fissure. The mean widths of the 2 central incisors, the combined widths of the central incisors, the combined width of the 4 incisors, and the combined width of the 6 anterior teeth were determined intraorally at their widest dimension. Pearson correlation coefficients were calculated to determine the relationship between intercanthal distance and the 4 measurements of maxillary anterior teeth (α=.05).
Results. Although the Pearson correlation coefficients were relatively small, a significant relationship existed between intercanthal dimension and the 4 maxillary teeth dimensions (P<.0001). It was found that biometric ratios of 1:0.267 and 1:1.426 could be used to estimate the central incisor width and the combined widths of the 6 anterior teeth, respectively.
Conclusion. Within the limitations of this study, the results suggest that intercanthal distance can be used as a preliminary method for determining the width of the maxillary anterior teeth for edentulous patients. (J Prosthet Dent 2001;86:608-12.)

CLINICAL IMPLICATIONS

The results of this study can be used to help dentists select the size of artificial anterior teeth for edentulous patients.

One of the primary concerns in denture esthetics is the selection of maxillary anterior artificial teeth, especially the central incisors. The size, form, and color of the teeth must be in harmony with the surrounding oral and facial structures.[1-5] The width of the teeth is considered by some to be more critical than the length.[3] Several authors have attempted to identify normal tooth dimensions.[6-9]

When no pre-extraction records are available, selecting the proper anterior teeth size for edentulous patients can be difficult. Because a systematic approach is needed in such situations, several anatomic measurements have been suggested, including the bizygomatic width (BZW), interpupillary distance (IPD), interalar width (IAW), and intercommisural width (ICW). The BZW method claims a BZW-to-maxillary central incisor width ratio of 1:16 and a BZW-to-maxillary anterior teeth width ratio of 1:3.3.[10] The design of the Trubyte tooth indicator instrument (Dentsply/York Division, Dentsply International, York, Pa.) was based on the BZW method. However, Yong[10] questioned its validity, and other authors[11-14] found no correlation between BZW and central incisor width.

The relationship between the IPD and mesiodistal width of maxillary central incisors was suggested and evaluated by Cesario and Latta.[15] A ratio of 1:6.6 occurred in 95% of white and black female patients in the sample group tested. In black male patients, the ratio was 1:7. A separate investigation[14] showed no such correlations. Several authors[16,17] have advocated the use of the IAW as a guide in the selection of maxillary anterior teeth. However, Smith[18] found no significant relationship between IAW and intercanine distance (tip to tip). Similar results were reported for the dimension from distal of canine to distal of canine[14] and for the dimension of the 4 maxillary incisors.[19]

The ICW method is based on the hypothesis that the distal surface of the maxillary canines should be

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located approximately at the commissures of the mouth. Silverman[20] found that the distal surface of maxillary canines was ±4 mm from the commissures. Al Wazzan et al[14] found no significant correlation between the ICW and maxillary anterior teeth.

Scandrett et al[11] evaluated BZW, IAW, ICW, sagittal cranial diameter, interbuccal frenum distance, philtrum width, and age as predictors of the width of maxillary anterior teeth and central incisors. The investigators concluded that no single predictor was accurate enough for clinical application. Therefore, it appears that more than one variable is needed to predict the width of maxillary anterior teeth and central incisors.

The variations in the described studies may be the result of ethnic characteristics specific to the populations studied. Accordingly, even if a particular relationship between an anatomic dimension and anterior tooth size can be determined, the results must be tempered by the possibility that the relationship is specific to the ethnic group studied.

The medial junction of the 2 eyelids is called the *medial angle* (medial canthus).[21] The intercanthal distance (ICD) is the distance between the medial angles (canthi) of the palpebral fissure bilaterally. At 5 years of age, 93% of ICD growth has been achieved; maturity is reached between 8 and 11 years.[22,23] The ICD is considered normal at a dimension of 28 to 35 mm.[24] No differences related to sex,[24,25] race[26-28] (black or white), or age[24,29] have been shown in the ICD. This makes ICD a reliable anatomic dimension that may provide a valid approach to anterior tooth selection. Abdullah et al[29] reported the ratio of ICD (32.0 mm) to the width of maxillary anterior teeth (43.0 mm) to be 1:1.35; however, no correlations were calculated to determine the significance of the relationship. Furthermore, the relationship of ICD to the central incisor and interlateral dimension was not determined.

The purpose of this study was to evaluate the relationship between ICD and the mesiodistal width of 4 combinations of maxillary anterior tooth dimensions: (1) the mean mesiodistal width of the central incisors, (2) the combined width of the central incisors, (3) the combined width of the incisors, and (4) the combined width of the 6 anterior teeth.

MATERIAL AND METHODS

A total of 443 adult Saudi subjects of Arab extraction (203 [46%] men and 240 [54%] women) were randomly selected from the outpatient dental clinic of the College of Dentistry and King Abdulaziz University Hospital at King Saud University, Riyadh, Saudi Arabia. They ranged in age from 19 to 55 years. All subjects had maxillary anterior teeth present with no caries, restorations, or severe attrition. Subjects with a history of congenital anomaly, orbital disease, trauma, or facial surgery were excluded.

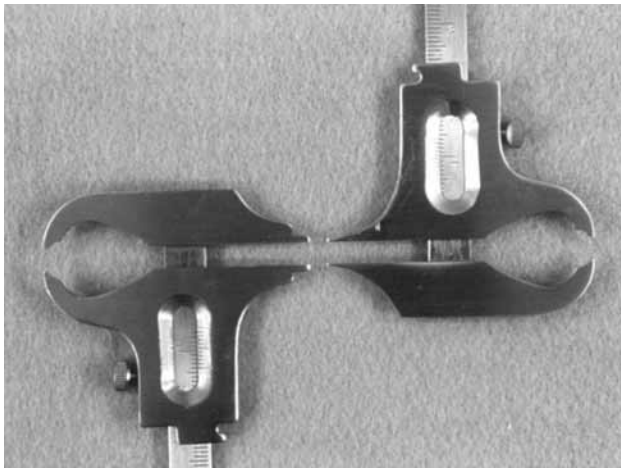

Fig. 1. Modified Boley gauge.

Intercanthal distance was measured with a Boley gauge (Buffalo Dental Manufacturing Co, Brooklyn, N.Y.) to the nearest tenth of a millimeter. The ICD dimension is defined as the distance between the median (inner) angles (canthi) of the palpebral fissure. Measurements of the maxillary anterior teeth were made intraorally with a Boley gauge. The external edges of the gauge beaks were ground down to facilitate proper fit in the embrasures; the internal measuring edges of the beaks remained unaltered (Fig. 1). The mesiodistal measurements were recorded at the widest dimension (contact areas). Three measurements per tooth were made, and the mean was calculated. The 4 dimensions (independent variables) for the maxillary anterior teeth were defined as follows: (1) the mean of the mesiodistal width of the central incisors (MCIW), (2) the combined width of the central incisors (CCIW), (3) the combined width of the 4 incisors (CIW), and (4) the combined width of the 6 anterior teeth (CAW). The latter 3 dimensions were obtained by adding the mesiodistal widths of the individual teeth.

Each of the 2 examiners used a new Boley gauge with an accuracy of 0.1 mm. The accuracy of the gauge was tested with the use of a 3.5-mm steel plate as measured with a digital micrometer (model 293-812; Mitutoyo, Kawasaki, Japan). One examiner trained and calibrated the other examiner. Both examiners evaluated 20 randomly selected subjects. Pearson correlation and a paired *t* test were used to evaluate inter-examiner reliability.

The data were statistically analyzed with the use of descriptive statistics and Pearson correlation coefficients to determine whether any correlation existed between ICD (dependent variable) and the 4 dimensions (independent variables) of the maxillary anterior teeth (α=.05).

Table I. Mean values and range of the ICD and 4 tooth measurement widths

	All subjects (mm)	Minimum (mm)	Maximum (mm)	Men (mm)	Women (mm)	*P* value
ICD	31.92 ± 2.80	25.00	39.00	32.94 ± 2.67	31.91 ± 2.91	.913
MCIW	8.48 ± 0.55	7.00	10.00	8.61 ± 0.50	8.36 ± 0.56	<.0001
CCIW	16.95 ± 1.10	14.00	20.00	17.21 ± 1.01	16.72 ± 1.12	<.0001
CIW	30.02 ± 1.95	24.00	35.00	30.62 ± 1.78	29.52 ± 1.99	<.0001
CAW	45.23 ± 2.74	37.00	52.00	46.06 ± 2.59	44.52 ± 2.67	<.0001

ICD = Intercanthal distance; *MCIW* = mean mesiodistal width of central incisors; *CCIW* = combined width of central incisors; *CIW* = combined width of the 4 incisors; *CAW* = combined width of the 6 anterior teeth.

Table II. Correlation matrix (for all subjects and by sex) for ICD dimensions and the width of 4 maxillary anterior teeth

	MCIW (*P* value)	CCIW (*P* value)	CIW (*P* value)	CAW (*P* value)
All subjects	0.209 (.0001)	0.209 (.0001)	0.253 (.0001)	0.303 (.0001)
Men	0.246 (.0001)	0.246 (.0001)	0.297 (.0001)	0.366 (.0001)
Women	0.190 (.003)	0.190 (.003)	0.230 (.0001)	0.274 (.0001)

Abbreviations listed in footnote to Table I.

Table III. Ratio of ICD to tooth width factors

	MCIW ± SD (95% CI)	CCIW ± SD (95% CI)	CIW ± SD (95% CI)	CAW ± SD (95% CI)
All subjects	0.267 ± 0.026 (0.265, 0.270)	0.534 ± 0.052 (0.530, 0.539)	0.946 ± 0.090 (0.938, 0.955)	1.426 ± 0.128 (1.414, 1.438)
Men	0.271 ± 0.024 (0.268, 0.274)	0.542 ± 0.048 (0.535, 0.549)	0.964 ± 0.083 (0.952, 0.975)	1.450 ± 0.118 (1.434, 1.466)
Women	0.264 ± 0.027 (0.261, 0.267)	0.528 ± 0.054 (0.521, 0.535)	0.932 ± 0.093 (0.920, 0.944)	1.405 ± 0.132 (1.388, 1.422)

Abbreviations listed in footnote to Table I.

RESULTS

A high level of examiner reliability was demonstrated. Pearson correlations for all measurements were high ($0.990<r<0.996$), and the paired t test showed nonsignificant results ($.267<P<667$).

The descriptive statistics (mean, standard deviation, minimum, and maximum) of the recorded measurements are listed in Table I. The values were greater for men than for women, with significant differences ($P<.01$) for the variables tested. No significant differences were found between sexes with respect to ICD ($P=.913$).

Pearson correlation coefficients for the ICD and 4 measurement variables demonstrated a positive correlation (Table II). The relationship was not strong but was significant ($P<.0001$).

The ratios between the mean ICD and the mean of the 4 maxillary teeth measurements are presented in Table III. For the sample population, the ratio was 0.267 for the central incisors, 0.534 for the combined width of the central incisors, 0.946 for all incisors, and 1.426 for the 6 anterior teeth.

DISCUSSION

The subjects were all of Arab extraction. Because the sample was relatively homogeneous, the results of this study are more applicable to the population evaluated. Comparisons with data on Western populations may be undertaken, but ethnic differences should be considered.

In the present study, all tooth dimensions were significantly larger in men than in women (Table I). This is consistent with previous reports.[6,7] The mean mesiodistal width of the central incisors (8.48 mm) is in agreement with the findings of Scandrett et al[11] (8.50 mm) but is 0.5 mm less than the value reported by Woodhead[9] (9.00 mm), who studied extracted teeth. The mean combined width of the maxillary incisors (30.02 mm) marginally supports the findings of Mavroskoufis and Ritchie[19] (31.70 mm). The mean value of the combined width of the 6 maxillary anterior teeth (45.23 mm) supports the findings of Shillingburg et al[8] (45.80 mm) but is greater than the value reported by Abdullah et al[29] (43.00 mm). To some extent, the variations may be explained by differ-

ences in measuring techniques and in the ethnicities of the populations studied.

The mean ICD (31.92 mm) of subjects in the present study was similar to the values reported by Abdullah et at[29] (32.00 mm) and Freihofer[24] (31.20 mm), smaller than the mean value reported by Murphy and Laskin[27] (33.90 mm), and greater than that reported by Laestadius et al[25] (30.00 mm). No significant difference was found between the mean ICD measurements in relation to sex. This finding is in accordance with Laestadius et al[25] and Abdullah et al.[29]

The Pearson correlation coefficients were relatively small but significant for various tooth widths. These findings indicate that the ICD could be used to select maxillary anterior teeth for edentulous patients. The biometric ratios of 1:0.267 and 1:1.426 could be used to estimate the central incisor width and the combined width of the 6 anterior teeth, respectively (Table III). The factor used to estimate the width of maxillary anterior teeth (1.426) was marginally higher than that suggested by Abdullah et al[29] (1.35). The correlation coefficients increased in value from incisors ($r = 0.209$) to canines ($r = 0.303$). This suggests that the ICD can be correlated more reliably with the combined dimension of the 6 anterior teeth than with the incisors. The mesiodistal widths of the incisors are likely to be more variable.

The biometric ratios presented in Table III have questionable predictive value for a given individual because the magnitude of the correlation is small; this indicates a weak relationship between ICD and the 4 tooth measurements. If the correlation between these variables approached 1, the use of these biometric ratios would be justified for prediction. It should be noted, however, that the standard deviation and the 95% confidence interval for these ratios are small, indicating that the margin of prediction error should be relatively low. Accordingly, although ICD does not appear to be a reliable guide for selecting maxillary anterior teeth, it can be used to make a provisional or initial size selection or used in combination with the other means of tooth selection. Scandrett et al[11] suggested that more than one anatomic reference is needed to predict the width of maxillary anterior teeth. Final decisions about tooth selection should be made during the trial insertion stage of the denture and should be confirmed through consultation with the patient.

The ratios in Table III can be used to estimate the mesiodistal width of the anterior teeth. Most manufacturers of artificial teeth provide the width of the central incisors and the combined width of the 6 anterior teeth. Some manufacturers supply the width of the 6 anterior teeth set on a curve, which is expected to be larger than the combined width of the individual teeth. The manufacturers provide the denture teeth mounted on a card. Measuring the width of the denture teeth on the mounting card from distal of canine to distal of canine should give the proper combined width of the anterior teeth.

Table III shows that men may be expected to have wider teeth than women. Even if the width of the anterior teeth is the same for a given man and woman, the tooth form may not be identical. In accordance with the dentogenic concept,[1] tooth molds characterized by rounded features have been adopted to produce delicate forms consistent with typical female characteristics.[5]

Future research should investigate ethnic groups other than the one evaluated in the present study. Studies that compare the dimensions of anterior teeth estimated with the ICD ratio and other anatomic measurements are warranted.

CONCLUSIONS

The correlations between ICD and 4 measurements of maxillary anterior teeth were weak in this study. Nonetheless, ICD ratios may help dentists make an initial selection in the overall width of maxillary anterior teeth for edentulous patients.

I thank Dr E. Al Madi and Dr Nazeer Khan for their valuable help.

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0022-3913/2001/$35.00 + 0. **10/1/119682**

doi:10.1067/mpr.2001.119682

Noteworthy Abstracts of the Current Literature

Reasons for replacement of restorations in permanent teeth in general dental practice
Mjör IA, Moorhead JE, Dahl JE. *Int Dent J* 2000;50:361-6.

Purpose. This article presented reasons for the replacement of 9805 amalgam, composite resin, glass ionomer, resin-modified glass ionomer, and "other" restorations in permanent teeth in a general dental practice in Norway.
Material and methods. A survey of 24,429 restorations (22,391 in permanent and 2040 in primary teeth) placed by 243 Norwegian dentists in general practice was conducted. Forty-nine percent of the restorations were replacements in permanent teeth.
Results. The 3 main reasons for replacement of the 9805 restorations were as follows (in descending order): clinical diagnosis of secondary/recurrent dental caries; fracture (especially bulk fracture), regardless of the patient's age; and bulk discoloration, regardless of gender. Other reasons included discoloration, loss of restoration, poor anatomic form, pain/sensitivity, material change, and "other." Subgroupings of the dentists' sex indicated that female dentists diagnosed secondary dental caries more often than their male counterparts. Otherwise, the reasons for replacement of restorations were the same for male and female dentists. The youngest group of dentists diagnosed relatively more cases of secondary dental caries for both amalgam and composite restorations than older practitioners.
Conclusions. The diagnosis of recurrent/secondary dental caries, although the primary reason for restoration replacement, was considered by most dentists the most difficult and dubious of reasons for replacement. If it is true that as experience in practice is gained, better judgment is made, then more emphasis must be placed on differential diagnosis (specifically, when to replace or repair restorations and when not to intervene operatively) in the teaching of restorative dentistry. 57 References. —*RP Renner*