Relationship Between Width of Maxillary Anterior Teeth and Interalar Distance

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ABSTRACT There are few guides to estimate the size of denture teeth. The purpose of this observational cross sectional study of Iranian adults was to evaluate the relationship between interalar width compared to intercanine tip distance and to the summed width of the maxillary anterior teeth in adults. The samples were selected from dental students in Isfahan University. Interalar width was measured with calipers. Maxillary inter-canine distance was measured between cusp tips on dental casts. Mesiodistal widths of the six anterior teeth also were measured. Independent t-tests, Pearson's correlation coefficients, and linear regression were used for statistical analysis. Mean interalar width was 36.38 mm (sd = 3.81), intercanine tip distance was 34.15 mm (sd = 2.05), and mean width of maxillary anterior teeth was 48.23 mm (sd = 2.07). There were significant associations between interalar width and summed widths of the maxillary anterior teeth and with intercanine distance. In addition, predictive equations for estimation of tooth sizes using interalar width were calculated by regression. These statistical relationships may also be useful forensically. *Dental Anthropology* 2010;23(2):53-56.

One of the confusing and difficult aspects of complete denture prosthodontics is the selection of appropriately sized maxillary anterior denture teeth (Hoffman *et al*., 1986). The anterior teeth are primarily selected to satisfy esthetic concerns. The esthetic restoration of edentulous patients has an important psychological effect (Sellen *et al*., 1999; Al-Wazzan, 2001; Frush and Fisher, 1955). Patients who receive their dentures expect them to appear similar to their previous natural teeth (Gomes *et al*., 2009). The mesiodistal width of teeth is a harder aspect to estimate than the proper height of the anterior artificial teeth (McArthur, 1985). Various guidelines have been suggested for determining the maxillary anterior teeth when pre-extraction records are not available, but different opinions have been reported regarding their usefulness (Sellen *et al*., 1999; Verjao and Nogueira, 2005). One of the methods for selecting artificial anterior teeth is using certain guides (Keng, 1960). Several anatomic measurements have been suggested, including bizygomatic width (BZW), interpupillary distance (IPD), interalar width (IAW), and intercommisural width (ICW) (Zlatarić *et al*., 2007). Different views have been reported on the significance of the interalar width in selection of anterior tooth sizes. Picard (1958) found that interalar width could be used to estimate widths of the maxillary anterior teeth. This was substantiated by Wehner *et al*. (1967) who suggested extending parallel lines from the lateral margins of the alae of the nose onto the labial surface of the maxillary occlusal rim to estimate positions of the inter-canine cusp tips.

Hoffman *et al*. (1986) stated that there is a correlation of 0.413 between IAW and intercanine tip distance (ICTD). A weaker correlation coefficient of 0.217 was observed between IAW and width of maxillary anterior teeth (WMAT). ICTD was 3% greater than IAW and WMAT was 31% greater than IAW. Aleem *et al*. (1997) reported that WMAT is 26% greater than IAW. Al-El–Sheikh and Al-Athel (1998) found significant associations between IAW with (1) ICTD and (2) WMAT, and WMAT was 56% greater than IAW. Mavroskoufis and Ritchie (1981) found a positive association between nasal width and ICTD, which promotes its use in establishing the width of the anterior teeth. Latta *et al*. (1991) reported significant differences in the IAW and IPD between races and sexes.

The aims of the present study were to compare IAW, ICTD, and WMAT between males and females and to derive predictive equations from a group of Iranian adults.

MATERIALS AND METHODS

This was a cross-sectional study of Iranian young adults. The sample of convenience consists of dental students from Isfahan University. A total of 120 cases were analyzed (60 males; 60 females). Inclusion criteria were: at least 18 years old of Iranian descent; normal nose morphology without a history of rhinoplasty; intact maxillary six anterior teeth without history of orthodontic therapy; a Class I normal occlusion without a diastema, spacing or crowding; and well aligned teeth in the maxillary arch (Al-El–Sheikh and

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Fig. 1. Measurement of interalar width.

Al-Athel, 1998; Hasanreisoglu *et al*., 2005).

Sliding calipers were used with an accuracy of 0.1 mm. Each distance was measured 3 times and the average was recorded (Gomes *et al*., 2009). IAW (Fig. 1) was measured from the widest point on either nostril (Zlatarić *et al*., 2007).

Irreversible hydrocolloid impressions (Cavex CA37, Cavex Holland, BV, Haarlenm, Holland) of the maxillary teeth were made and poured with hard dental stone (Begostone, BEGO, Bremen, Germany). The straight-line distance between canine tips (Fig. 2) was measured (Hoffman *et al*., 1986). The maximum mesiodistal width of each anterior tooth was measured, and these widths were summed (coded as WMAT) (Gomes *et al*., 2009; Hasanreisoglu *et al*., 2005).

Descriptive statistics, independent t-tests, Pearson's correlation coefficient, and linear regression analysis were used for statistical analyses using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA).

RESULTS

Descriptive data are listed in Table 1. Results of independent t-tests show that the values of IAW, ICTD and WMAT were significantly greater in males than females. Pearson's r disclosed significant associations between IAW and ICTD in females ($r = 0.457$; $P < 0.05$) and in males ($r = 0.442$; $P< 0.05$) and between IAW and WMAT in females ($r = 0.473$; $P < 0.05$) and in males ($r = 0.481$; $P < 0.05$). The predictive equations for estimating tooth sizes from interalar width are summarized in Tables 2 and 3.

DISCUSSION

In earlier studies, measurements were made using extracted teeth. Recent studies measured tooth dimensions on casts or using computer-based images or intraoral evaluations (Hasanreisoglu *et al*., 2005). It is generally agreed that selection of the width of anterior teeth should be based on facial measurements and proportions (Al-El–Sheikh and Al-Athel, 1998). It has been reported that the width of the nose may be used for selecting the size of the anterior teeth, for positioning the maxillary canines and for registering the curve of the anterior arch (Hoffman *et al*., 1986).

Sex differences in the dimensions of the anterior teeth have been noted for most racial groups, with men exhibiting mesiodistally wider teeth than women (*e.g*., Hasanreisoglu *et al*., 2005; Strett *et al*., 1992; Lavelle, 1972; Richardson and Malhotra, 1975).

The mean of IAW was 36.37 mm in the present study. It was smaller than the means reported by Mosharraf *et al*. 36.6 mm (2006), Latta and Weaver 43.9 mm (1991), Dharap and Tanuseputro (1997) 39.8 mm and was greater than the mean reported by Hoffman *et al*. (1986) at 34.28 mm and Al-El-Sheikh and Al-Athel (1998) at 33.27 mm.

In the present study the mean of ICTD was 34.15 mm, which is smaller than means reported by Dharap and

Fig. 2. Measurement of straight-line distance between the canine tips (intercanine tip distance)

Fig. 3. Measurement of maximum mesiodistal width of maxillary incisor.

TABLE 1. Descriptive statistics

Sex	n	Mean	Max	Min	sd
		IAW†			
Female	60	34.32	40.4	27.6	2.863
Male	60	38.43	47.5	30.8	3.549
Total	120	36.38	47.5	27.6	3.816
		ICTD			
Female	60	33.25	36.3	29.1	1.735
Male	60	35.05	40.2	31.2	1.962
Total	120	34.15	40.2	29.1	2.052
		WMAT			
Female	60	47.67	52.7	41	2.367
Male	60	48.78	54.6	40	2.873
Total	120	48.23	54.6	40	2.679

†IAW, interalar width; ICTD, intercanine tip distance; WMAT, width of maxillary anterior teeth.

Tanuseputro (1997) 36.7 mm or Hoffman *et al*. (1986) 35.35 mm or Gomes *et al*. (2009) 37.44 mm.

The mean of WMAT in this study 48.23 mm was smaller than the mean reported by Gomes *et al*. (2009) 53.67 and Al-El-Sheikh (1998) 52.22 mm and was greater than means reported by Hoffman *et al*. (1986) 44.85 mm, Al-Wazzan (2001) 45.23 mm and Shillingburg *et al*. (1972) 45.80 mm.

The differences among studies would seem to be due to ethnic differences or, possibly, different measurement techniques. Some studies used digital photography and obtained facial measurement from them, so they may have some errors because of the effect of the third dimension of anteroposterior length (Gomes *et al*., 2009; Hasanreisoglu *et al*., 2005), while others took measurements on the face (Hoffman *et al*., 1986; Al-El–Sheikh and Al-Athel, 1998; Mosharraf *et al*., 2006). Al-El-Sheikh and Al-Athel (1998) and Mosharraf *et al*. (2006) measured dental dimensions intraorally and Hoffman *et al*. (1986) used wax rim indices. Hasanreisoglu *et al*. (2005) and Gomes *et al*. (2009) measured dimensions from dental casts.

Genetic heritage would seem to be the main cause of variation between different groups (McArthur, 1985; Mavroskoufis and Ritchie, 1981). Participants in the current study were Iranian, and this is one source of the observed differences among groups.

There was a significant association between IAW and ICTD in females ($r = 0.457$; $P < 0.05$) and in males ($r = 0.442$, $P < 0.05$), which agrees with the studies of Hoffman *et al*. (1986) ($r = 0.49$, $P < 0.05$), Mavroskoufis and Ritchie (1981), and Dharap and Tanuseputro (1997) ($r = 0.31$, $P < 0.05$).

In the current study there was a significant relation between IAW and WMAT in females ($r = 0.473$; $P < 0.05$) and in males ($r = 0.481$; $P < 0.05$). Hoffman *et al*. (1986), Mosharraf *et al*. (2006), and Al-El-Sheikh and Al-Athel (1998) reported similar associations in their studies ($P < 0.05$).

Concerning the estimation of ICTD from IAW, Hoffman *et al*. (1986) found the ratio of 1.31 between IAW and WMAT, this ratio was 1.30 in Gomes *et al*.'s study (2009) and 1.26 in a study conducted by Aleem *et al*. (1997) and 1.56 in Al-El-Sheikh and Al-Athel's study (1998). Other studies calculated the ratio of means, whereas we provide regression equations for estimating WMAT from IAW, which is more useful. Different results in this study are assumed to be due to different measurement methods, to ethnic differences, and to different methods of analyzing the data statistically.

From a clinical perspective, we promote the predictive equations in Tables 2 and 3 for estimating tooth sizes in Iranians. These equations will help dentists provide Iranian patients the best esthetics relative to their previous natural teeth and in harmony with their facial dimensions.

CONCLUSIONS

Within the limitations of the present study, the following conclusions were drawn:

1. The dimensions of IAW, ICTD and WMAT were larger in males.
2. There were significant relationships between IAW and ICTD and WMAT in each sex.

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TABLE 2. Predictive equation for estimation of ICTD and WMAT from IAW in males ($Y = a + bX$)

Y	X	r	P value	Predictive equation
ICTD	IAW	0.442	<0.0001	ICTD = 26.143 + 0.216 × IAW
WMAT	IAW	0.481	0.0080	WMAT = 43.807 + 0.129 × IAW

TABLE 3. Predictive equation for estimation of ICTD and WMAT from IAW in females (Y = a + bX)

Y	X	r	P value	Predictive equation
ICTD	IAW	0.457	0.016	ICTD = 28.187 + 0.145 × IAW
WMAT	IAW	0.473	0.000	WMAT = 42.194 + 0.159 × IAW

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