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RESEARCH AND EDUCATION

Relationship between different points on the face and the width of maxillary central teeth in a Turkish population

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ABSTRACT

Statement of problem. Dentists may have difficulty determining the appropriate widths of the maxillary central incisors (CW) when restoring teeth for patients with edentulism. Anthropological measurements can help.

Purpose. The purpose of this observational study was to evaluate the relationship between different anthropological distances on the face and the CW in a young Turkish population.

Material and methods. A total of 210 Turkish dental students without dental and facial deformities participated in this study. Two different digital photographs of their face (relaxed and smiling) were taken. The intercommissural width (ICW), intermedial canthus width (MCW), interlateral canthus width (LCW), interpupillary width (IPW), interalar width (IAW), and CW were measured. The *t* test, Pearson correlation analysis, and multiple linear regression analysis were performed to determine the relationship between facial measurements and CW (α=.05).

Results. A significant correlation was found between facial measurements (r=0.516[ICW], r=−0.534 [IAW], r=−0.639[MCW], r=−0.599[LCW], and r=−0.683[IPW]) and CW in both sexes. All facial measurements, except ICW and IPW in women and MCW in men, had a significant effect on CW according to the multiple linear regression analysis.

Conclusions. IAW and LCW can be used to determine CW in both sexes. The ICW and IPW can be specific anthropological measurements for men, and the MCW can be a specific anthropological measurement for women to determine CW. (J Prosthet Dent 2019;122:63-8)

The face is considered by many to be the most important factor in determining the physical appearance of individuals, and the smile is an important component of the face.[1] An esthetically successful complete denture may be achieved by evaluating both facial hard and soft tissues.[2] One of the most important phases in the fabrication of complete dentures is the selection of maxillary central artificial incisors because they are the most visible when viewed frontally.[3,4] Photographs or records of patients which show their dentate status can be used to select teeth for complete dentures. However, if the patient is not satisfied with the esthetics, or if earlier photographs are not available, different anthropological points on the face should be evaluated.[5,6]

More than one facial measurement should be used simultaneously to determine the width of maxillary anterior teeth. The intercommissural width (ICW) in a rest state, the interalar width (IAW), intermedial canthus width (MCW), interlateral canthus width (LCW), and the interpupillary width (IPW) are different anthropological measurements on the face.[5-9] Clinicians should ensure that the sizes of the maxillary anterior teeth selected to rehabilitate edentulous patients with an esthetic denture are compatible with the available anthropological measurements on the face. The width of the central incisors (CW) remains constant throughout life, whereas their length may change due to wear, making CW a more reliable dimension.[10,11]

The average width of a single maxillary central incisor has been reported to be approximately 1/16 of the interzygomatic width (IZW).[12-14] However, subsequent studies have reported that this IZW/CW correlation is not a reliable predictor of CW.[15,16] The relationship between the MCW and the width of the 2 central incisors has been

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Clinical Implications

Different anthropological distances on the face could be used to determine suitable widths of the maxillary central incisors in edentulous patients of Turkish ethnicity.

reported to be in the golden proportion.[5] The MCW also does not vary by age, sex, or ethnicity[17] and therefore can be used reliably to determine the size of maxillary central incisors. The formula used was CW=(MCW×0.618)/2.[17] Laestadius et al[18] reported that growth in this region reached maturity at between 8 and 11 years of age compared with other eye structures and that the size (28 to 35 mm) was maintained for life.

The IPW also remains stable for life, and like the CW, it shows no significant change with age.[9] Therefore, the ratio between the two is also expected to remain stable. Although it has been suggested[9,19] that the IPW/CW proportion of 6.6 can be used to predict central incisor width,[16,20] it has been found to be unreliable[21] and varies with sex and ethnicity.[8,9]

The IAW is another anthropological measurement that has been used to determine maxillary central tooth size. This distance also varies by sex and ethnicity.[6,22] Hoffman et al[6] reported that the interalar distance is 1.31 of the total width of maxillary anterior teeth, whereas Abdullah[5] reported this ratio as 1.26. Furthermore, the IAW is estimated to average 4 times the width of the maxillary central incisor. Qmamar et al,[23] however, reported that this was not a reliable measurement for determining the size of maxillary anterior teeth.

The ICW is another anthropological measurement that needs to be evaluated in the selection of the maxillary central incisor size. Tooth size should be in harmony with the oral tissues. When the teeth are viewed frontally, they primarily draw attention with respect to their harmony with the surrounding soft tissues and the corners of the mouth. Therefore, this distance also has an effect on the design of an esthetically successful denture. The LCW should be in harmony with the width of the maxillary central teeth, and it is thought that this distance, similar to the MCW, does not change with age and may thus be an effective factor in selecting tooth size.[17]

As most of these anthropological measurements are influenced by ethnicity and sex, studies on the relevant ethnic group should be taken into consideration for maxillary tooth selection. In the Turkish population, Hasanreisoğlu et al[22] compared maxillary tooth sizes with interzygomatic and inneralar distances, concluding that these 2 anthropological measurements may help determine the ideal maxillary tooth size in women. However, as some of the existing studies indicate that the IZW is not reliable in determining the tooth size, the purpose of this study was to evaluate the relationship between different anthropological measurements and the size of the maxillary central incisor.

Facial esthetics can be evaluated from lateral cephalometric films, photographs, or 3D imaging.[24] In the present study, anthropological measurements related to facial esthetics and maxillary central incisors were made from digital photographs.

The authors are unaware of a study evaluating the relationship between the CW size in the Turkish population and several anthropological measurements on the face. For this reason, the relationship between the value to be obtained by (MCW×0.618)/2 and the real CW value, between the value to be obtained by the IPW/CW ratio and the value of 6.6, and between the CW value to be obtained by IAW/4 and the real CW value was evaluated in a sample from a Turkish population. Whether there was a relationship between the ICW and LCW measurements and CW that had not been used so far was also investigated. The study hypothesis was that a relationship would be found between different anthropological measurements on the face and the width of a maxillary central incisor in a Turkish population.

MATERIAL AND METHODS

The study was initiated after the necessary ethics committee approvals were obtained and was carried out on a total of 210 individuals (104 women and 106 men) studying at the Atatürk University Faculty of Dentistry. These individuals indicated that they were from different cities in Turkey and had no history of orthodontic treatment, no facial asymmetry, no restorations, no prosthetic restoration, crowding of or missing anterior teeth, and a normal maxillary-mandibular relationship. Individuals with wear or diastema in their maxillary anterior teeth were excluded from the study.

Two different digital photographs (1 at rest and 1 with an exaggerated smile) were made of each participant showing the entire face. The heads of the participants were stabilized with the head holder of a panoramic radiograph machine (ProMax 3D; Planmeca) with the Frankfurt plane parallel to the ground to ensure standardization. The photographs were made by the same researcher (M.K.) and at the same distance. The settings of the camera (Nikon D7000; Nikon Corp) were fixed, and the face of the participant coincided with the center of the lens (AF-S DX18-200/3.5-5.6; Nikon Corp). If the teeth were not visible in an exaggerated smile, cheek retractors were used (Fig. 1).

The teeth on the photographs were measured using a photo-editing software program (Adobe Photoshop CS3 Extended, v10.0; Adobe System, Inc). The dimensions of the side sections of the panoramic radiograph machine

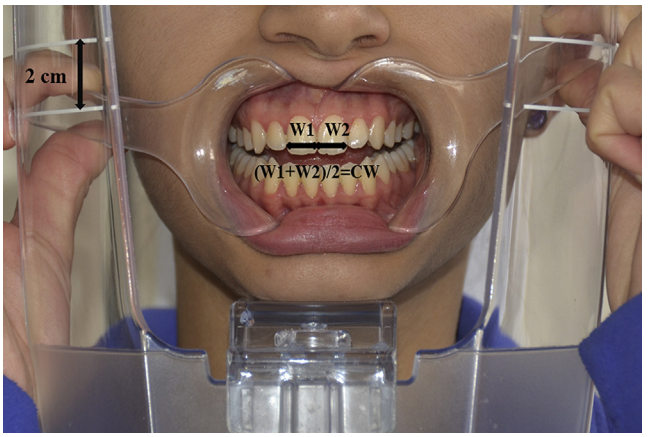

Figure 1. Using mouth retractors to visualize entire width of maxillary central incisors.

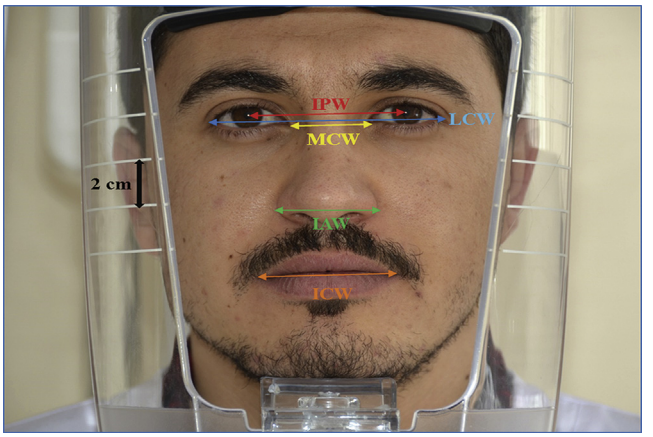

Figure 2. Immobilization of participant's head for photography using radiograph device. IAW, interalar width; ICW, intercommissural width; IPW, interpupillary width; LCW, interlateral canthus width; MCW, intermedial canthus width.

were used to calculate dimensional changes in the photographs. The following measurements were performed on the photographs: CW—the average of mesiodistal widths of the right and left maxillary central incisor; ICW—the width between the right and left oral commissures; MCW—the horizontal line between the right and left medial canthus; LCW—the horizontal line between the right and left lateral canthus; IPW—the horizontal line between the right and left pupils; IAW—the line between the outside corners of the right and left ala nasi (Figs. 1, 2).

The data obtained from the measurements on the photographs were analyzed using a statistical software program (IBM SPSS Statistics, v20.0; IBM Corp). Descriptive statistics and some statistical analyses were obtained separately by total and by sex. The differences of data for the variables studied by sex and the differences in expected and real values of IAW/4 and (MCW×0.618)/2 were examined using the independent sample *t* test. The difference between the values of IPW/CW and the standard 6.6 value was examined using the 1-sample *t* test, the relationships between the CW and facial measurements were examined using the Pearson correlation analysis, and the effect of the variables studied on the CW was examined using the multiple linear regression analysis (α=.05 for all tests).

RESULTS

The mean facial dimensions of these young Turkish participants are given in Figure 3. Women had significantly smaller values (ICW: 4.32 ±0.24 cm, LCW: 10.77 ±0.88 cm, IPW: 5.92 ±0.44 cm, IAW: 3.05 ±0.33 cm) in all measurements than men (ICW: 5.25 ±0.31 cm, LCW: 11.25 ±0.77 cm, IPW: 6.30 ±0.66 cm, IAW: 3.54 ±0.50 cm) except for MCW (2.85 ±0.25 cm in women and 2.92 ±0.30 cm in men) (P<.001). The mean CW values were significantly smaller in women (0.82 ±0.05 cm) than in men (0.86 ±0.08 cm) (P<.001) (Fig. 3).

The expected value of the IPW/CW ratio (6.6) was found to be statistically significantly higher than the real values calculated (7.24 ±0.87 cm in women and 7.43 ±1.55 cm in men) for both sexes (P<.001) (Table 1). The CW values calculated with the equation (MCW×0.618)/2 (0.88 ±0.08 cm in women and 0.90 ±0.09 cm in men) were found to be statistically significantly higher than the CW values (0.82 ±0.05 cm in women and 0.86 ±0.08 cm in men) measured in both sexes (P<.001) (Table 2). The CW value calculated from the IAW/4 ratio (0.76 ±0.08 cm in women and 0.89 ±0.12 cm in men) was found to be statistically significantly higher than the CW value measured in men (0.86 ±0.08 cm) and statistically significantly lower than the CW value measured in women (0.82 ±0.05 cm) (Table 3).

According to the Pearson correlation coefficient between the CW and facial measurements, a statistically significant negative correlation (P<.05) was determined between the CW and ICW in both sexes, whereas a statistically significant (P<.001) negative correlation was determined between the CW and other facial measurements (Table 4). The results of the multiple linear regression analysis performed to determine the effect of facial measurements in women on the CW are presented in Table 5. Although the effects of the IAW, MCW, and LCW variables on the CW value were found to be statistically significant ($P\leq$.001), the effect of ICW and IPW measurements on the CW was not statistically significant (P>.05).

The results of the multiple linear regression analysis performed to determine the effect of facial measurements in men on the CW are presented in Table 6. While the effect of the ICW and IAW and the effect of the LCW and IPW variables on the CW value were found to be statistically significant—P<.05 and $P\leq$.001, respectively—only the effect of the MCW variable on the CW was not statistically significant (P>.05).

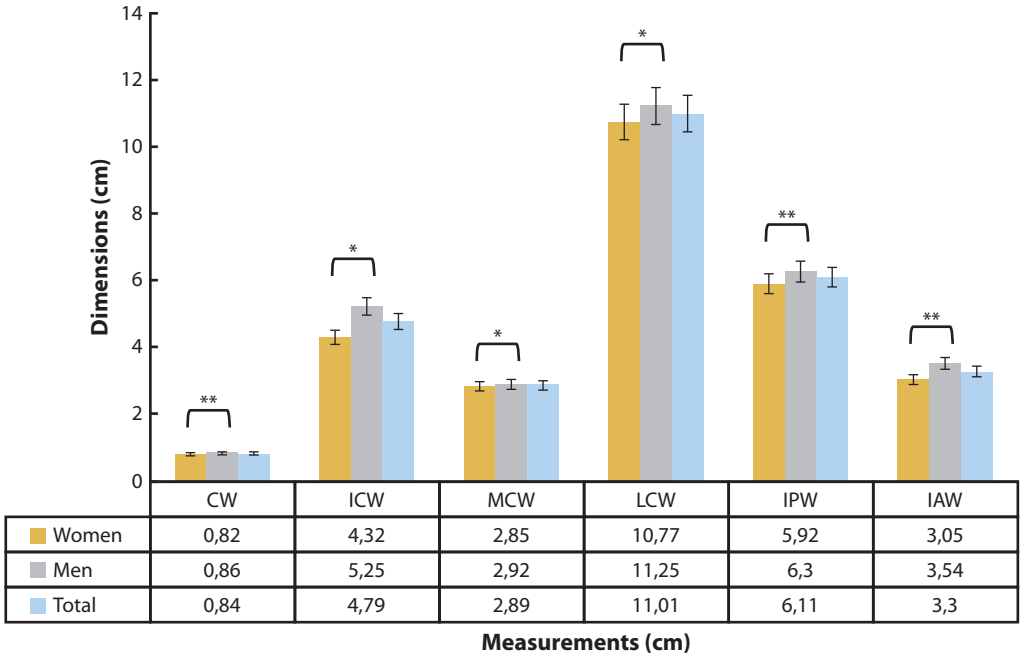

Figure 3. Mean and standard deviation values of CW (width of maxillary central incisors), ICW (intercommissural width), MCW (intermedial canthus width), LCW (interlateral canthus width), IPW (interpupillary width), and IAW (interalar width) in total sample and according to sex. *P<.05 and **P<.001 independent t test, men versus women.

Table 1. Mean and standard deviation real values of IPW/CW and predicted value (6.6) with t test results in total sample and according to sex

	95% Confidence Interval			Real Value			
Sex	Lower Bound	Upper Bound	Mean Difference	Mean	±SD	t test	P
Women	0.475	0.812	0.643	7.24	0.87	7.58	<.001
Men	0.537	1.133	0.835	7.43	1.55	5.55	<.001
Total	0.568	0.911	0.740	7.34	1.26	8.53	<.001

CW, width of maxillary central incisors; IPW, interpupillary width; SD, standard deviation.

DISCUSSION

The purpose of this study was to evaluate any relationship between different points on the face and the width of the central incisor. The obtained data partially supported the study hypothesis. The CW values calculated using the equation (MCW×0.618)/2 (0.88 ±0.08 cm in women and 0.90 ±0.09 cm in men) and the measured real CW values (0.82 ±0.05 cm in women and 0.86 ±0.08 cm in men) were found to be statistically significantly different from each other in both sexes. The IPW/CW value (7.24 ±0.87 cm in women and 7.43 ±1.55 cm in men) was found to be statistically significantly different from the esthetically accepted value of 6.6 in both sexes.[16,20] The value obtained from the IAW/4 result (0.76 ±0.08 cm in women and 0.89 ±0.12 cm in men) was found to be significantly different from the CW value measured. Based on the results obtained, the use of these anthropological measurements on the face in the determination of CW is not very reliable in a Turkish population. According to the results of the regression and correlation analyses, statistically significant relationships were determined between the anthropological measurements on the face and the CW.

In edentulous patients, determining the appropriate anterior tooth size can be difficult, especially if there is no preextraction cast or photograph. A consensus on tooth size selection is lacking.[25] Because tooth size and anthropological measurements vary by the ethnicity of the population,[8,9] participants were recruited from 1 ethnic group to determine the appropriate anterior tooth size. All individuals included in the study had well-arranged, completely erupted permanent maxillary teeth. In accordance with previous studies,[10,18,19,21,26-28] individuals with completed musculoskeletal development were selected for the study.

Hasanreisoğlu et al[22] reported that the IPW/CW value in a Turkish population was statistically significantly different from the value of 6.6 in both sexes. In this study, the IPW/CW values were found to be statistically significantly higher than the value 6.6 in both sexes and similar to those reported by Hasanreisoğlu et al.[22] Therefore, IPW could not be used to determine the CW in a Turkish population. Also, Turkish men had a significantly wider IPW than Turkish women.

Al-Kaisy and Garib[25] reported that the IPW could be used to determine the anterior tooth size in a Kurdish population and found that the mean IPW was 5.86 ±0.38 cm and the mean MCW was 3.59 ±0.25 cm. The IPW and

Table 2. Mean and standard deviation real and predicted values of (MCW×0.618)/2 with *t* test results in total sample and according to sex

	95% Confidence Interval			Predicted Value		Real Value			
Sex	Lower Bound	Upper Bound	Mean Difference	Mean	±SD	Mean	±SD	*t* test	*P*
Women	-0.076	-0.040	-0.058	0.88	0.08	*0.82*	*0.05*	-6.37	<.001
Men	-0.062	-0.015	-0.038	0.90	0.09	*0.86*	*0.08*	-3.17	.002
Total	-0.064	-0.033	-0.048	0.89	0.09	*0.84*	*0.07*	-6.21	<.001

MCW, intermedial canthus width.

Table 3. Mean and standard deviation real and predicted values of IAW/4 with *t* test results in total sample and according to sex

	95% Confidence Interval			Predicted Value		Real Value			
Sex	Lower Bound	Upper Bound	Mean Difference	Mean	±SD	Mean	±SD	*t* test	*P*
Women	0.041	0.078	0.060	0.76	0.08	*0.82*	*0.05*	6.33	<.001
Men	-0.050	-0.007	-0.022	0.89	0.12	*0.86*	*0.08*	-1.48	<.001
Total	-0.001	0.038	0.019	0.82	0.12	*0.84*	*0.07*	1.91	<.001

IAW, interalar width.

Table 4. Pearson correlation coefficient (r) between width of maxillary central incisors and facial measurements

	Sex	ICW	IAW	MCW	LCW	IPW
CW	Women	-0.219[a]	-0.812[b]	-0.858[b]	-0.779[b]	-0.620[b]
	Men	-0.195[a]	-0.841[b]	-0.659[b]	-0.785[b]	-0.959[b]
	Total	0.156[a]	-0.534[b]	-0.639[b]	-0.599[b]	-0.683[b]

CW, width of maxillary central incisors; IAW, interalar width; ICW, intercommissural width; IPW, interpupillary width; LCW, interlateral canthus width; MCW, intermedial canthus width. [a]*P*<.05 [b]*P*<.001.

Table 5. Multiple linear regression model of facial measurements for width of maxillary central incisors in women

Variables	Coefficient (β)	Standard Error	95% CI		*t* test	*P*
Constant	1.379	0.037	1.305	1.453	36.967	<.001
ICW	0.010	0.008	-0.006	0.026	1.278	.204
IAW	-0.056	0.008	-0.071	-0.040	-7.093	<.001
MCW	-0.088	0.011	-0.110	-0.066	-8.040	<.001
LCW	-0.012	0.003	-0.018	-0.005	-3.378	.001
IPW	-0.009	0.005	-0.020	0.001	-1.712	.090

CI, confidence interval; CW, width of maxillary central incisors; IAW, interalar width; ICW, intercommissural width; IPW, interpupillary width; LCW, interlateral canthus width; MCW, intermedial canthus width; SE, standard error. Adjusted R^2 ±SE=0.87 ±0.018, Y=1.379+0.010ICW-0.056IAW-0.088MCW-0.012LCW-0.009IPW, Y=CW is dependent variable.

Table 6. Multiple linear regression model of facial measurements for width of maxillary central incisors in men

Variables	Coefficient (β)	Standard Error	95% CI		*t* test	*P*
Constant	1.810	0.051	1.709	1.910	35.645	<.001
ICW	-0.017	0.007	-0.031	-0.003	-2.458	.016
IAW	-0.021	0.008	-0.036	-0.006	-2.809	.006
MCW	-0.010	0.009	-0.029	0.009	-1.044	.299
LCW	-0.018	0.004	-0.026	-0.009	-4.196	<.001
IPW	-0.088	0.007	-0.103	-0.073	-11.976	<.001

CI, confidence interval; CW, width of maxillary central incisors; IAW, interalar width; ICW, intercommissural width; IPW, interpupillary width; LCW, interlateral canthus width; MCW, intermedial canthus width. Adjusted R^2 ±SE: 0.94 ±0.021, Y=1.810-0.017ICW-0.021IAW-0.010MCW-0.018LCW-0.088IPW, Y=CW is dependent variable.

MCW were reported to be 6.11 ±0.6 cm and 2.89 ±0.28 cm, respectively. Therefore, differences do exist between the Turkish and Kurdish populations. Furthermore, the researchers reported that the CW values obtained using the equation (MCW×0.618)/2 were compatible with the real CW value in men and smaller than the real CW value in women. Kumar et al[29] evaluated the relationship between the MCW and the width of anterior teeth and reported that the MCW could be used to determine the size of anterior teeth. In the present study, the CW values obtained using the equation (MCW×0.618)/2 were found to be statistically significantly higher than the real CW values in both sexes. Therefore, MCW could not be used to determine the CW values in a Turkish population. Also, there was no statistically significant difference between MCW values in both sexes.

Sinavarat et al[28] reported no correlation between the measurements performed on canine teeth and the IAW but did find a strong correlation with the ICW in a Thai population. In the present study, the actual CW value was statistically significantly lower than the CW value calculated from the IAW/4 ratio in men and statistically significantly higher in women. A significantly negative correlation was found between the CW and ICW and between the CW and IAW. Also, Turkish men had a significantly wider IAW and ICW than Turkish women.

In a study evaluating the relationship between the CW and MCW, IPW, ICW, and IAW in Aryans and Mongoloids, Mishra et al[30] reported that the IAW, IPW, and ICW measurements could be used in Aryans and that the IPW measurement could be used in Mongoloids to determine the CW value.

Mistakes in dimensions made during photography or when making measurements on the photographs are the limitations of this study. Further studies should be performed to evaluate the relationship between different anthropological distances on the face and the width of maxillary lateral incisors, the width of maxillary canines, and the total width of maxillary anterior teeth.

CONCLUSIONS

Based on the findings of this observational study, the following conclusions were drawn:

1. No relationship was found between real CW values and calculated CW values using the (MCW×0.618)/2 and IAW/4 equations in a young Turkish population of both sexes.
2. No relationship was found between real IPW/CW values and a ratio of 6.6 of IPW/CW in a young Turkish population of both sexes.
3. Statistically significant negative correlations were found between CW and measured anthropological distances on the face in a young Turkish population of both sexes.
4. MCW, LCW, and IAW have a statistically significant effect on CW in women, and ICW, IPW, LCW, and IAW have a statistically significant effect on CW in men.

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