The selection of maxillary anterior teeth width in relation to facial measurements.

Sulaimani Dental Journal

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Received: *August, 2015*
Accepted: *November, 2015*
Published: *December, 2015*

Abstract

Objectives: This clinical study was carried out to determine the relationships between maxillary anterior teeth width [canine arc distance, central incisor width], and certain horizontal facial parameters which include: [(Interzygomatic, inner and outer canthus and interpupillary) distances, and (interalar, mouth and philtrum of upper lip) widths], to be used as a guide to selection of the maxillary anterior teeth width.

Materials and Methods: The facial measurements were taken directly from (60) under-graduate students in age range (19-24) years old by using an electronic digital vernier caliper. While canine arc distance and central incisor width were measured indirectly on the casts made from impressions of the selected subjects using flexible millimeter ruler. The collected data were analyzed and correlated using statistical package SPSS version 20.

Results: The mean value of all the parameters measured were significantly higher in males than female, for male just a significant correlation was found between canine arc distance and mouth width, CARCD =0.994×MW, while for females significant correlation was found between canine arc distance mouth width, inner and outer canthal distance, and interpupillary distance, but the most significance relation was with the mouth width, CARCD=1.036×MW, and central incisor width was significantly correlated with, mouth width, CIW = MW ÷6.15, CIW = MW ×0.16.

Conclusions: This study demonstrated that certain horizontal facial parameters could be used as a guide in maxillary anterior teeth width selection to achieve an optimal esthetic result for each gender.

Keywords: *Facial measurement, teeth width, teeth selection, and teeth size.*

Cite this article as: Miran FA, Muhamad SR. The selection of maxillary anterior teeth width in relation to facial measurements. Sulaimani Dent J. 2015;2(2):101-107.

Introduction:

Esthetics is of primary concern for patients seeking complete removable prosthesis. The goal of treatment is to have the maxillary anterior teeth restored to optimal dentolabial relations in harmony with the overall facial appearance. To achieve this, the dimension, morphology and arrangement of the anterior teeth must be in proportion to the facial dimension[(1)].

The teeth, as with the other perspectives of dental esthetics, display variance and nuances, showing individuality in a given dentition. For this reason, when restoring or replacing the teeth, dental professionals should also consider useful fundamental guidelines for creating a pleasing aesthetic result. The adequate width: length ratio of the maxillary anterior teeth should be present, and the central incisor should be the dominant element in the anterior dental composition. Also, lateral incisors and canines should be positioned to offer a display in successive decreasing widths. Individual cultural characteristics and perceptions of beauty must be considered. Besides these principles, subtle variations can be introduced that account for gender, race, facial, morpho-psychological, and psychological factors[(2)].

Over the past several decades, various methods and guides for selecting the correct form, shade and size of anterior teeth for edentulous patients have been topics of controversy[(3,4)]. McArthur's rule was: patients' natural teeth are the best guide, and records of these should be obtained whenever possible. These records should include the size, shape and shade of the teeth and any special characteristics, or arrangement[(5)].

Generally, larger people have larger teeth. In addition, men usually have larger teeth than women[(6)], nevertheless, it has been found that the maxillary anterior teeth should be in proportion to the size of the face and head to achieve good esthetics[(7)].

A selection of maxillary anterior teeth for complete dentures can be very challenging especially when there

are no pre-extraction records available. The form, size, color and shape of the maxillary anterior teeth must be in harmony with surrounding orofacial structures[8].

Depending on what's previously mentioned, this clinical study was conducted to evaluate the relationships between maxillary anterior teeth width [canine arc distance, central incisor width], and certain horizontal facial parameters which include: [(Interzygomatic, inner, outer canthus and inter-pupillary) distances, and (interalar, mouth and philtrum of upper lip) widths].

Materials and Methods:

The data for the present study had been collected from both: School of Dentistry in Sulaimani university and School of Basic Education in Chamchamal. Sixty students were selected, thirty males and thirty females after taking their consents verbally whom they met the following criteria:

1. The students should have permanent maxillary anterior teeth with normal canine relation
2. Good alignment of maxillary anterior teeth without spacing, missing, overlapping and with the absence of caries, proximal restorations, abrasion, attrition and crowns that grossly affected their width.
3. They should have no history of previous orthodontic and surgical facial treatments.
4. All of students ages range from 19–24 years, so their facial growth was completed.

Facial measurements

All facial measurements were obtained directly for each student in upright position status while they were in rest vertical dimension, lip relaxed with unsupported head position[9]. The facial parameters that had been measured in this present study were shown in figure (1). The measurements were carried out by using an electronic digital caliper (WORKZONE/Dario / GmbH & Co.KG) with 0.01 mm accuracy.

The measurements were taking as follow:

1. Interzygomatic distance (IZD) from the most prominent part of the arch of the zygoma[10,11,12,13].
2. Inner and outer canthal distances (ICD and OCD) from inner and outer palpebral fissures[14,15].
3. Mouth width (MW) from commissar of the lips[16,12].
4. Nose width (NW) from ala of one side to other[12,13].
5. Interpupillary distance (IPD) from the center of the pupil of the right side to the center of the pupil of the left side[17].

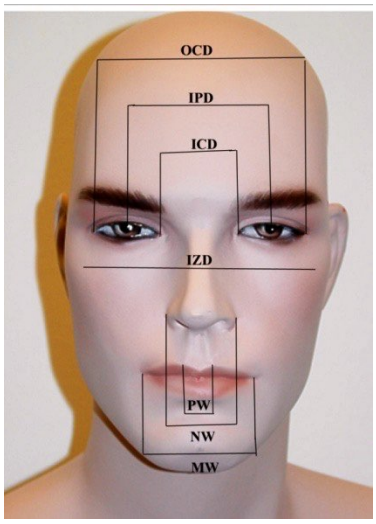

Figure 1:The measured facial parameters were shown are: (IZD) Interzygomatic distance, (ICD) inner canthal distance, (OCD) outer canthal distance, (IPD) interpupillary distance, (NW) nose width, (PW) philtrum width, and (MW) mouth width.

6. Philtrum width (PW)[18]. (from Right Christa Philtri to Left Christa Philtri).

NOTE: Point marking the lateral crest of the philtrum at the vermilion border of the upper lip.

The measurements were taking by keeping the calipers in contact with soft tissue points with minimum pressure the average of two readings for every distance was considered as a final reading[14,12].

Anterior dental segment measurements:

Anterior dental segment measurements which include; Central incisal width (CIW) and canine arc distance (CARCD) were taken indirectly, by taking impressions for the selected subjects with vinyl polysiloxane impression material type A and poured with ultra hard white die stone UD. Both Central incisal width (CIW) and canine arc distance (CARCD) were measured on the cast by flexible millimeter ruler. CIW was determined at incisal angles[12,11] and for the sake of consistency; the right maxillary central incisor will be taken as a guide for measuring in all subjects. While CARCD was measured between the distal surfaces of maxillary canines[5,3,19].

The Pearson Correlation, One sample T-Test, Regression Analysis and the statistical package SPSS version 20 were used in this study for finding out the relations, mean, standard deviation, and significance correlation between them..

Results:

The mean and standard deviations for dental and facial measurements for all participants and each gender are shown in Tables (1), (2).

Table 1: Mean and standard deviation for dental and facial measurements for all participants.

Measurments for all participants	CIW	CARCD	MW	PW	NW	ICD	OCD	IPD	IZD
Mean	8.5642	52.0448	51.2528	14.2878	35.2592	31.3448	94.7305	60.1287	135.2265
Std Deviation	.55131	3.15568	4.03106	2.31073	3.40417	2.93320	5.36162	3.81211	8.01860
Numbers	60	60	60	60	60	60	60	60	60

Table 2: Mean and standard deviation for dental and facial measurements for male and female participants.

Female	CIW	CARCD	MW	PW	NW	ICD	OCD	IPD	IZD
Mean	8.3353	50.7283	48.9647	13.063	33.1963	30.777	92.361	58.618	130.1957
Std Deviation	0.47939	2.93783	3.38863	1.76676	2.02716	2.99324	4.92149	2.97052	5.89686
No.	30	30	30	30	30	30	30	30	30
Male	CIW	CARCD	MW	PW	NW	ICD	OCD	IPD	IZD
Mean	8.7930	53.3613	53.5410	15.5127	37.3220	31.9127	97.1000	61.6393	140.2573
Std deviation	0.52935	2.83609	3.27780	2.15354	3.26542	2.80666	4.75898	4.00248	6.60878
No.	30	30	30	30	30	30	30	30	30

Statistical Analysis Using one sample t-test revealed a significance difference between all the facial and dental parameters ($P<0.05$) for both males and females participants as shown in Table (3).

The Pearson Correlation Coefficient analysis for the entire sample revealed a high significance correlation between canine arc distance with each of central incisor width), mouth width philtrum width inner canthal distance outer canthal distance and Interzygomatic distance. While significant relation was found between canine arc distance with nose width) and no correlation with interpupillary distance, as shown in Table(4).

Also central incisal width revealed a high significant correlation with canine arc distance (and mouth width) and significant relation with philtrum width and Interzygomatic width while no correlation with each of nose width, inner canthal distance, outer canthal distance and interpupillary distance, (Table 4).

Person correlation analysis in the male group showed a high significance correlation only between canine arc distance and mouth width ($r=0.726$, $p<0.01$), and no correlation was found with other facial parameters nor with central incisal width, Table 5.

Applying person correlation analysis in female group revealed high significance correlation between canine arc distance and central incisal with mouth with and outer canthal distance also a moderate significance correlation with inner canthal distance and interpupillary distance, and no significance correlation with each of philtrum width, nose with, and Interzygomatic width. Central incisal width showed high significance correlation just with the canine arc distance and moderate significance correlation with mouth width and interpupillary distance and no significance correlation with each of philtrum width, nose width, inner canthal distance, outer canthal distance, and inter zygomatic distance was found as demonstrated inTable(5).

The mean value of all the parameters measured were significantly higher in males than female, for male just a significant correlation was found between canine arc distance and mouth width, CARCD $=0.994\times MW$, while for females significant correlation was found between canine arc distance mouth width, inner and outer canthal distance, and interpupillary distance, but the most significance relation was with the mouth width, $CARCD=1.036\times MW$, and central incisor width was significantly correlated with, mouth width, $CIW = MW \div 6.15$, $CIW = MW \times 0.16$.

Discussion:

Central incisor width:

The mean of central incisor width for men was significantly greater than the corresponding dimensions of women, and these findings are in agreement with the results of related studies reported by other studies[20-23].

Table 3: One-Sample Test for male(M) and female(F) data.

Measurement		Test Value	T	Df	Sig. (2-tailed) P-Value	Mean Difference	95% Confidence Interval of the Difference	
							Lower	Upper
CIW	M	8.49	3.135	29	.004	.30300	.1053	.5007
	F	8.15	2.118	29	.043	.18533	.0063	.3643
CARCD	M	54.43	2.064	29	.048	-1.06867	-2.1277	-.0097
	F	51.83	-2.054	29	.049	-1.10167	-2.1987	-.0047
MW	M	54.77	2.054	29	.049	-1.22900	-2.4529	-.0051
	F	50.24	-2.061	29	.048	-1.27533	-2.5407	-.0100
PW	M	14.70	2.067	29	.048	.81267	.0085	1.6168
	F	12.24	2.055	29	.049	.66300	.0033	1.3227
NW	M	36.09	2.066	29	.048	1.23200	.0127	2.4513
	F	32.43	2.071	29	.047	.76633	.0094	1.5233
ICD	M	30.86	2.054	29	.049	1.05267	.0046	2.1007
	F	29.65	2.062	29	.048	1.12700	.0093	2.2447
OCD	M	95.31	2.060	29	.048	1.79000	.0130	3.5670
	F	90.51	2.060	29	.048	1.85100	.0133	3.6887
IPD	M	60.14	2.052	29	.049	1.49933	.0048	2.9939
	F	57.5	2.061	29	.048	1.11800	.0088	2.2272
IZD	M	137.78	2.053	29	.049	2.47733	.0096	4.9451
	F	127.98	2.058	29	.049	2.21567	.0137	4.4176

Table 4: The Pearson Correlation Coefficient test between horizontal facial measurements and dental segment measurements of whole all participant.

Measurements of all participants		CIW	CARCD	MW	PW	NW	ICD	OCD	IPD	IZD
CIW	Pearson Correlation	1	.603**	.422**	.312*	.134	.134	.252	.195	.288*
	Sig. (2-tailed)		.000	.001	.015	.306	.308	.052	.135	.026
	No.	60	60	60	60	60	60	60	60	60
CARCD	Pearson Correlation	.603**	1	.704**	.334**	.326*	.423**	.404**	.203	.331**
	Sig. (2-tailed)	.000		.000	.009	.011	.001	.001	.120	.010
	No.	60	60	60	60	60	60	60	60	60

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 5: The Pearson Correlation Coefficient test between horizontal facial measurements and dental segment measurements of males and females participants.

Measurements of Males and female participants			CIW	CARCD	MW	PW	NW	ICD	OCD	IPD	IZD
Male	CIW	Pearson Correlation	1	.`258	.082	.128	-.227	-.191	-.154	-.216	-.021
		Sig. (2-tailed)		.169	.666	.501	.229	.311	.416	.251	.910
		N	30	30	30	30	30	30	30	30	30
	CARCD	Pearson Correlation	.258	1	.726**	.178	.111	.310	.028	-.274	-.047
		Sig. (2-tailed)	.169		.000	.347	.558	.095	.884	.142	.806
		N	30	30	30	30	30	30	30	30	30
Female	CIW	Pearson Correlation	1	.798**	.420*	.098	-.074	.318	.331	.405*	.101
		Sig. (2-tailed)		.000	.021	.605	.698	.087	.074	.026	.596
		N	30	30	30	30	30	30	30	30	30
	CARCD	Pearson Correlation	.798**	1	.525**	.103	.080	.448*	.490**	.454*	.242
		Sig. (2-tailed)	.000		.003	.588	.672	.013	.006	.012	.198
		N	30	30	30	30	30	30	30	30	30

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Interzygomatic width:

Ratio between mesiodistal width of central incisor and the inter zygomatic width was found to be 1:15.9 for males and 1:15.61 for females that are in agreement with the ratios found out by Berry, and Young reported that the width of maxillary central incisor exists in a ratio of 1:16 to that of the inter zygomatic width[24] and disagree with Horie et al. reported central incisal width (8.54mm) and inter zygomatic width (126.15mm), and they found no correlation between them[25].

Interpupillary Distance:

Pearson correlation showed positive correlation between interpupillary distance and mesiodistal width of maxillary central incisor in female but no correlation in male and population as whole this coincide with [26] results that they conclude absence of correlation with the combined width of maxillary anterior teeth, and it is not reliable parameter Mohamad et al , Cesario and Latta found that a ratio of 6.6 which had previously been proposed, existed between the interpupillary distance and the central incisor width in white men and women, and also in black women[17].

Inner canthal Distance:

According to study, Pearson correlation test showed a positive correlation between inner canthal distance and mesiodistal width of maxillary central incisor. And Gomes et al. reported the same result. According to, Gomes and Bhaskar findings inner canthal distance could be used to select maxillary anterior teeth for edentulous patients but this study showed no significance correlation between inter canthal distance and central incisal width and a weak significance correlation with canine arc distance in whole data, no significance correlation for male data, and moderate significance correlation present in female data therefore it can be used only as preliminary guide with the other methods

Nose Width:

Found high significance correlation and concluded that CARCD can be determined by increasing NW distance by 31% of its value and concluded its reliable parameter and its agree with Hoffman et al.[3], and Gomes et al[27].

Mouth Width:

There is a high significance correlation between inter-canine distance and MW in the present study, and moderate significant for female and also high significance for a male. The results of the present study are not in agreement with the results of the study done by Silverman and Mohhamad et al. [28,26] As they found no relationship between measurement of MW and inter-canine distance in their respective study and no correlation was found when population was divided according to the gender. They have also reported a negative and insignificant correlation value for the MW and inter-canine distance may be this is due to that it is doen in Sulaimanyia city with Kurdish people. . Few studies[28,27,30] have shown a higher mean value of the inter-canine distance than Mohhamad et.al. study and coincide with this study. The present study has shown the mean value for MW of 51.25 mm with age ranging from 60.33 mm to 41.53 mm. These values were higher for males than for females. The correlation coefficient for MW was found to be 0.726** for males and 0.525** for females.

Philtrum width:

Moderate significance correlation was found between philtrum width and central incisal width as whole data but when data separated to genders, no correlations were found. Therefore, it's not a reliable parameter.

John H.Lee, who states that the combined mesiodistal width of both maxillary central incisors was equal to the width of philtrum in English, subjects [31], Navreet et al. reported that combined mesiodistal width of maxillary central incisors was always greater than the width of the philtrum. This difference in findings may be attributed to the possible racial variation [32] regarding the mesiodistal width of maxillary central incisors and width of philtrum located in midline [33].

The result of this study mean central incisor width for male was 8.79 mm and for female was 8.33 mm, also philtrum width for male was 15.51 mm and for female 13.06 mm and it shows that the sex factor has an influence on the size of the teeth as well as width of philtrum also sex is an influencing factor on size of teeth and philtrum. When the width of philtrum decreases the combined mesiodistal width of maxillary central incisor also decreases.

As right central incisor was taken alone in this study it's possible to compare mesiodistal width of both centrals with philtrum after multiplying by two as some authors suppose no significance difference between mesiodistal width of both right and left centrals[34, 29].

Conclusions:

the results of this study indicated that from the investigated facial parameters mouth width can be a reliable guideline for the selection of upper anterior artificial teeth width in both genders by using average multiplying factors for male 0.994 and 1.036for female according to the following formula:

For male; CARCD=MW×0.994

For female; CARCD=MW×1.036

Also for females other parameters such as inner canthal, outer canthal, and interpupillary can be used in combination with other methods for the selection of artificial teeth but the final decision should be made while testing prosthetic denture models and with patient's consent. Finally, selection of artificial anterior teeth should be based on finding a harmonious relationship between the size and shape of teeth in relation to gender and individual constitutional characteristics.

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