Facial Measurements and Maxillary Anterior Teeth Mesio-Distal Dimensions, Is There A Relationship?

Haider M. A. Ahmed,
B.D.S., M.Sc. Assistant Lecturer. Department of Orthodontics. College of Dentistry. University of Baghdad.
Yasir R. A. Al-Labban
B.D.S., M.Sc. Lecturer. Department of Orthodontics. College of Dentistry. University of Baghdad.
Mohammed Nahidh
B.D.S., M.Sc. Lecturer. Department of Orthodontics. College of Dentistry. University of Baghdad.

ABSTRACT

Background: This study aimed to find out a relation between facial measurements and maxillary anterior teeth mesio-distal dimensions.

Materials and methods: Seventy one adult subjects (34 males and 37 females), with Class I skeletal and dental relation, were chosen for this study. The mesio-distal dimensions of the maxillary anterior teeth were measured with digital caliper and certain facial measurements were determined on the subjects' photographs using AutoCAD 2008 software. The relation between facial measurements and maxillary anterior teeth mesio-distal dimensions was assessed for both genders.

Results and Conclusions: The results showed that there was a significant genders difference in most of the variables measured (higher in males) and there were weak significant relations between incisors width with the facial height in males and with facial width in females. Other facial measurements showed no correlation with dental measurements. Generally, the faces differ in their shapes and the teeth affected by the genetic factor that plays a role in their dimensions and not always the dental and facial measurements have a relation.

Key words: Facial analysis, mesio-distal tooth dimension, anthropometry.

INTRODUCTION

Clinical facial analysis is the method utilized by physicians for evaluating and judging the patient's face; to define its proportions, volume, appearance, symmetry and visible deformities. It is based on direct examination, clinical photographs, and conventional and computerized x-ray imaging. It is essential for many specialists, such as plastic surgeons, facial plastic surgeons, maxillofacial surgeons, ophthalmic plastic surgeons, otorhinolaryngologists, head and neck surgeons, cosmetic surgeons, orthodontists, rehabilitative dentists, and dermatologists, and, generally, for any physicians dealing with facial aesthetics and functions [1].

Facial proportion was defined as the comparative relation of facial elements in profile [2]. The golden proportion has been well known for hundreds, perhaps thousands, of years, but Ricketts [3,4] might have been the first orthodontist to apply it to the composition of facial hard and soft tissues. He also used the term "golden sectioning." Applying a divider, the divine proportion is the length of the longer side in 2 linear measurements, at 1.618, and the short side is 1.

Proffit *et al.* [5] stated that the vertical facial proportions in the frontal and lateral views are best evaluated in the context of the facial thirds, which the Renaissance artists noted were equal in height in well proportioned faces. In modern Caucasians, the lower facial third often is slightly longer than the central third. The lower third has thirds: the mouth should be one third of the way between the base of the nose and the chin.

Many studies tried to relate the mesio-distal dimension of central incisors or the anterior maxillary teeth to the transverse facial measurements to get benefit in selection of the artificial teeth for complete dentures. They used the inter-canthal, inter-alar, inter-pupillary, inter-zygomatic and mouth width and their findings conflicted about the relation between the mesio-distal dimension of anterior maxillary teeth and these variables [6-12].

In orthodontics, facial esthetic is not concentrated on the teeth or jaws separately, but it involves dental and maxillofacial portions. This study aimed to find out the relation between some transverse and vertical facial measurements and maxillary anterior teeth mesio-distal dimensions.

MATERIALS AND METHODS

Sample

The sample included 71 Iraqi Arab subjects (34 males and 37 females). Those subjects were chosen from the undergraduate students of the College of Dentistry, University of Baghdad. All of them had full permanent dentition regardless the wisdom teeth, Class I skeletal and dental relations [13] with no history of craniofacial malformation or surgeries.

Methods

Firstly, the subjects were examined clinically both intra-orally and extra-orally to be sure that they fulfilled the inclusion criteria, then they were subjected to facial photographs and taking dental impression.

Standardization of the facial photographs

The digital camera (Sony Cyber Shot H 50, 9.1 Mega pixels, 15 X optical zoom, Sony Corporation, Nagoya, Japan) was fixed in position and adjusted in height to be at the level of subject 'eyes with a height adjustable tripod. The distance from the camera to the subject was fixed at a distance of about 1.01m measured from the tripod's column to the ear rods [14] that were fit in the external auditory meatus in order to avoid the forward, backward, and tilting of the subject head (Cephalostat based head position). The subject was asked to look to the center of the lens of the camera during taking the photograph.

Photographic analysis

Every frontal facial photograph was analyzed by AutoCAD program 2008. Once the picture was imported to the AutoCAD program, it will appear in the master sheet on which the points were determined then the measurements were obtained. The measurements were divided by scale for each picture to overcome the magnification.

The facial measurements [15] included: Inter-canthal distance (ICD), Mouth width (MW), Nasal width (NW), Upper lip vermilion (ULV), Lower lip vermilion (LLV), Inter-zygomatic distance (IZD) and Anterior facial height (N-GN).

Dental cast production

Impressions were taken for every subject with Alginate impression material then poured with a prepared amount of stone. After setting of the dental stone, Plaster of Paris was prepared and put in the rubber base mold and the poured cast was inverted over it. After the final setting of the gypsum, the cast was opened from the mold and made ready for the measuring procedure.

Measurement of the teeth dimensions

The mesio-distal dimensions of the maxillary anterior teeth were measured according to Hunter and Priest [16] method. The anatomic mesial and distal contact areas of each tooth were marked by a fine marker on the dental cast and then the greatest mesio-distal crown width was measured for all the maxillary anterior teeth (from the right to the left canine) by means of an electronic digital caliper (Mitutoyo, Japan, with a sensitivity of 0.01 mm.) held parallel to the occlusal plane.

The sum of the width of the six maxillary anterior teeth was obtained by summation the mesio-distal dimensions of these teeth.

Statistical analysis

All the data of the sample were subjected to computerized statistical analyses using SPSS computer program. The statistical analysis includes: descriptive statistics (means and standard deviations) and inferential statistics (independent sample t-test: for the comparison between males and females and Pearson's correlation coefficient (r) to determine the relation between facial measurements and maxillary anterior teeth mesio-distal dimensions).

In the statistical evaluation, the following levels of significance are used:

Non-significant	NS	$P > 0.05$
Significant	*	$0.05 \geq P > 0.01$
Highly significant	**	$0.01 \geq P > 0.001$
Highly significant	***	$P \leq 0.001$

RESULTS AND DISCUSSION

The results in table 1 showed that the mesio-distal dimension of the maxillary anterior teeth was larger in males than females; that means males have significantly wider anterior teeth than females especially for canines (both sides) and central incisors (right side) and the combined teeth width. The exact reason laying behind this difference is not well understood; however sex-linked inheritance and sex-hormonal influences were suggested [17]. Garn *et al.* [18] advanced the hypothesis that sexual dimorphism has a genetic basis, but till now this hypothesis is not proved.

Regarding the facial measurements (table 2), all these measurements were significantly higher in males than females. This is because males have larger skeletal, cranial, facial and dental arch dimensions than females.

Table 3 and 4 showed the relation between the facial and dental measurements. The results showed that there was weak significant relation between the facial height and the width of right incisors, left central incisor and the combined width in male group, while there was weak significant relation between the facial width with the width of central incisors in female group. On the other hand, there were no significant relations between facial and teeth measurements. Many authors [6-9] found no relation between bi-zygomatic width and central incisor width. Al Wazzan *et al.* [9] found no significant relationship between inter-alar width, inter-commisural width and the dimension from distal of canine to distal of canine. While in other study, Al Wazzan [10] found a significant relationship between inter-canthal dimension and the maxillary teeth dimensions. The relationship between the inter-pupillary distance and mesio-distal width of maxillary central incisors was suggested and

evaluated by Cesario and Latta [11]. Al Wazzan *et al.* [9] showed no such correlations. In addition to that Al-El-Sheikh and Al-Athel [12] found no correlation between the maxillary anterior teeth width with inter-alar and inter-pupillary distances in males group while significant correlation was found in females group.

Table 1: Descriptive statistics and genders differences for mesio-distal dimensions of maxillary anterior teeth

Variables		Sex	Descriptive statistics		Genders difference	
			Mean	S.D.	t-test	P-value
Right	3	M	7.99	0.52	4.50	0.000 ***
		F	7.47	0.45		
	2	M	6.73	0.65	1.54	0.129 (NS)
		F	6.53	0.46		
	1	M	8.79	0.58	2.05	0.044 *
		F	8.55	0.38		
Left	1	M	8.80	0.50	1.49	0.141 (NS)
		F	8.64	0.43		
	2	M	6.67	0.50	1.10	0.277 (NS)
		F	6.54	0.48		
	3	M	7.86	0.51	4.04	0.000 ***
		F	7.43	0.39		
Sum		M	46.84	2.70	3.00	0.004 **
		F	45.15	2.01		

1= Central incisor, 2= Lateral incisor, 3= Canine M= Males, F= Females

Table 2: Descriptive statistics and genders differences for anthropometric facial measurements

Variables	Sex	Descriptive statistics		Genders difference	
		Mean	S.D.	t-test	P-value
ICD	M	34.34	1.69	3.23	0.002 **
	F	33.25	1.14		
MW	M	57.52	1.91	-0.99	0.03 *
	F	56.47	1.90		
NW	M	34.68	2.34	2.39	0.02 *
	F	33.44	2.04		
ULV	M	8.26	0.77	2.29	0.025 *
	F	7.87	0.66		
LLV	M	10.01	0.99	3.81	0.000 ***
	F	9.25	0.66		
IZD	M	135.40	3.54	2.10	0.039 *
	F	133.58	3.73		
N-GN	M	119.19	4.74	1.21	0.000 ***
	F	117.91	4.18		

1= Central incisor, 2= Lateral incisor, 3= Canine M= Males, F= Females

Table 3: Correlation between facial measurements and mesio-distal dimensions of maxillary anterior teeth in male group

Variables			NGN	IZD	LLV	ULV	NBW	MW	ICD
Right	3	r	0.208	0.103	0.086	-0.048	0.077	0.071	0.101
		P	0.238	0.561	0.630	0.786	0.665	0.690	0.572
	2	r	0.378	0.238	-0.011	-0.076	0.195	0.203	0.290
		P	0.028 *	0.175	0.950	0.669	0.270	0.249	0.096
	1	r	0.341	0.201	0.116	0.034	0.173	0.234	0.142
		P	0.048 *	0.255	0.515	0.847	0.328	0.183	0.424
Left	1	r	0.410	0.169	0.194	0.209	0.189	0.204	0.002
		P	0.016 *	0.339	0.272	0.236	0.284	0.246	0.989
	2	r	0.238	0.066	0.002	-0.255	0.038	0.067	0.224
		P	0.175	0.711	0.989	0.145	0.831	0.706	0.203
	3	r	0.128	0.200	0.002	0.090	0.068	0.136	0.139
		P	0.469	0.257	0.993	0.611	0.704	0.443	0.433
Sum		r	0.349	0.202	0.076	-0.012	0.154	0.189	0.188
		P	0.043 *	0.252	0.671	0.948	0.384	0.284	0.287

Table 4: Correlation between facial measurements and mesio-distal dimensions of maxillary anterior teeth in female group

Variables			NGN	IZD	LLV	ULV	NBW	MW	ICD
Right	3	r	-0.098	0.116	0.032	-0.125	-0.237	-0.004	0.228
		P	0.565	0.493	0.850	0.460	0.158	0.981	0.175
	2	r	0.155	0.139	0.038	-0.133	0.115	0.103	0.085
		P	0.360	0.412	0.821	0.432	0.496	0.545	0.616
	1	r	0.046	0.362	-0.072	-0.190	0.209	0.342	0.088
		P	0.787	0.028 *	0.671	0.261	0.214	0.081	0.605
Left	1	r	-0.040	0.343	-0.031	-0.097	0.247	0.218	0.063
		P	0.815	0.038 *	0.857	0.569	0.140	0.195	0.711
	2	r	0.070	0.309	-0.067	-0.031	0.164	0.139	0.196
		P	0.682	0.063	0.695	0.857	0.332	0.412	0.244
	3	r	-0.120	0.165	0.246	-0.123	-0.236	-0.083	0.014
		P	0.480	0.330	0.142	0.470	0.160	0.624	0.934
Sum		r	0.008	0.307	0.027	-0.147	0.061	0.152	0.151
		P	0.965	0.064	0.874	0.387	0.720	0.368	0.374

CONCLUSION

Generally, the faces differ in their shapes and the teeth affected by the genetic factor that plays a role in their dimensions and not always the dental and facial measurements have a relation.

REFERENCES

1. Meneghini F. Clinical facial analysis elements principles techniques. 1st ed. Berlin Heidelberg New York: Springer-Verlag; 2005.
2. Peck H, Peck S. A concept of facial esthetics. Angle Orthod 1970; 40(4): 284-317. **(IVSL).**
3. Ricketts RM. The golden divider. J Clin Orthod 1981; 15(11): 752-9.
4. Ricketts RM. Divine proportion and Fibonacci series. Am J Orthod 1982; 81(5): 351-70.
5. Proffit WR, Fields HW, Sarver DM. Contemporary orthodontics. 5th ed. St. Louis: Mosby Elsevier; 2013.
6. Scandrett FR, Kerber PE, Umrigar ZR. A clinical evaluation of techniques to determine the combined width of the maxillary anterior teeth and the maxillary central incisor. J Prosthet Dent 1982; 48(1): 15-22.
7. LaVere AM, Marcroft KR, Smith RC, Sarka RJ. Denture tooth selection: an analysis of the natural maxillary central incisor compared to the length and width of the face. Part I. J Prosthet Dent 1992; 67(5): 661-3.
8. LaVere AM, Marcroft KR, Smith RC, Sarka RJ. Denture tooth selection: an analysis of the natural maxillary central incisor compared to the length and width of the face. Part II. J Prosthet Dent 1992; 67(6): 810-12.
9. Al Wazzan KA, Al Haidan A, Al Madi EM, Al Murfarj A. The relationship between facial references and mesio-distal width of maxillary anterior teeth among Saudi patients. Alexandria Dent J 1995; 20(4): 39-45.
10. Al Wazzan KA. The relationship between inter-canthal dimension and the widths of maxillary anterior teeth. J Prosthet Dent 2001; 86(6): 608-12.
11. Cesario VA Jr, Latta GH Jr. Relationship between the mesio-distal width of the maxillary central incisor and inter-pupillary distance. J Prosthet Dent 1984; 52(5): 641-3.
12. Al-El-Sheikh HM, Al-Athel MS. The relationship of inter-alar width, inter-pupillary width and maxillary anterior teeth width in Saudi population. Odontostomatol Trop1998; 21(84): 7-10.
13. Foster TD. A textbook of orthodontics. 3rd ed. Oxford: Blackwell scientific publications; 1990.
14. Al-Ramahi SCA. Evaluation of buccal corridor in posed smile for Iraqi adults sample with class I normal occlusion. A master thesis, Department of Orthodontics, University of Baghdad, 2009.
15. Farkas LG. Anthropometry of the head and face in medicine. 1st ed. New York: Elsevier Science Publishing Co.; 1981.
16. Hunter WS, Priest WR. Errors and discrepancies in measurement of tooth size. J Dent Res 1960; 39(2): 405-14.
17. Garn SM, Lewis AB, Kerewsky RS. X-Linked inheritance of tooth size. J Dent Res 1965; 44(2): 439-41.
18. Garn SM, Lewis AB, Swindler DR, Kerewsky RS. Genetic control of sexual dimorphism in tooth size. J Dent Res 1967; 46(2): 963-72.