International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

The Association between the Facial and Dental Arch Forms

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Abstract: ***Background: This study aimed to find out the association between the facial forms and the dental arch forms in a sample of Iraqi adults with normal dental, sagittal and transverse jaws relations. Materials and Methods: Eighty dental students participated in this study. Standardized frontal photographs for the face were taken to determine the facial taper angle. Maxillary and mandibular dental casts were obtained to classify the dental arch forms. The association between the facial forms and dental arch forms was determined by Pearson's Chi square test. Results and Conclusions: There was no significant association between the facial and dental arch forms except in females between the mandibular dental arch and face.***

Keywords: Facial taper angle, facial forms, dental arch forms

1. Introduction

Appraisal of the facial types or forms is a vital aspect in orthodontic diagnosis, treatment planning and prognosis. Many factors play role in establishing the facial morphology like the shape of pharyngeal air space [(1)], anatomy of masticatory muscles [(2,3)], the anatomy of dento-alveolar complex [(4)] and the types of occlusion [(5,6)].

The craniofacial complex growth direction is determined by the facial types [(7,8)] and this is important in choosing the type of biomechanics used to treat orthodontic cases [(9)].

The facial index is a term used to express the facial proportions. It can be determined by many methods. Firstly, by dividing the facial height (measured from Nasion to Gnathion) by the bizygomatic width (measured from the right to the left Zygion). The other method is by calculating the ratio of the bizygomatic width to the anterior face height. The word *Prospon* in Greek means face [(10)]. Either method can be used to describe the facial types as euryprosopic, mesoprosopic and leptoprosopic [(11)].

Graber [(12)] classified the individuals according to their facial types into: dolichocephalic, brachycephalic and mesocephalic. Viazis [(13)] used the facial taper angle to verify the different facial types in term of normal, square and long facial types.

Dental arch form, on the other hand, is so important to be preserved during orthodontic treatment to get stable final results. Many have tried to establish a classification for the arch forms since 1887 when Bonwill postulated his triangle using anatomical landmarks in the mandible and tried to recognize the size, shape, and absolute position of each tooth with reference to this primary triangle. Since then, many researchers [(14-31)] developed their own methods to determine the dental arch forms using the dental casts, the computer and complex mathematical formulas.

The relation between the facial forms and the dental arch forms had been studied by different authors. Tsunori *et al.* [(4)] found that the long-face pattern included a narrow dental arch, while the short face pattern had wide arch. Graber [(12)] found that leptoprosopic (dolichocephalic) individuals have narrow dental arches, while euryprosopic (brachycephalic) individuals have broad, round dental arches. Mesoprosopic (mesocephalic) individuals fit somewhere in between these two.

Schulhof *et al.* [(32)] stated that a wide dental arch is generally associated with wide face type. On the other hand, Al-Shalabi [(33)] concluded that there is weak relation between facial forms and arch forms.

Salem [(34)] found an association between mid arch form with mesoprosopic and euryprosopic facial form in males while in females there was an association of mid arch form with mesoprosopic facial form.

Al-E'nizy [(31)] found a high association between the mid arch form and the average face type and between the narrow arch form with the long face type and the wide arch form with the short facial type.

Ahmed and Ali [(35)] concluded that the relation between facial type and dental arch form is a direct one, and as the facial type graduated from leptoprosopic to mesoprosopic to euryprosopic the maxillary dental arch form increases from narrow to mid to wide.

Al-Taee and Al-Joubori [(36)] found an association between the mid arch form and the mesoprosopic facial type in maxillary dental arch of both gender and the mandibular dental arch in female in a group of Class II division 1 patients with overjet 3-6 mm. and no clear association between coordinate dental arch form and facial type in Class II division 1 patients with overjet 6-10 mm. and Class III patients.

Paranhos *et al.* [(37)] concluded that the facial type was not associated with mandibular dental arch forms in individuals with normal occlusion; moreover, Nayar *et al.* [(38)] failed to find a significant relation between the facial and arch forms.

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Most of the listed studies used the ratio between the facial height and width as a measure to classify the facial forms with different methods to assess the arch form. In this study, the facial taper angle was used for the first time to classify the facial types and relate them to the dental arch forms.

2. Materials and Methods

Sample

The sample consisted of eighty students from the College of Dentistry, University of Baghdad (33 males and 47 females) with an age ranged between 19-23 years old. All of them had normal dental, sagittal and transverse jaws relations with no history of orthodontic treatment and /or orthognathic surgery. Their teeth were sound with no large or proximal fillings or attrition.

Methods

After taking a consent form for all participants, full extra and intra-oral examinations to fulfill the inclusion criteria, frontal facial photograph was obtained for each participant in a cephalostat based head position using digital camera (Sony CyberShot H 50, 9.1 Mega pixels, 15 X optical zoom, Sony Corporation, Nagoya, Japan) [35].

Maxillary and mandibular dental impressions were taken using alginate impression materials (Alginmax, Italy) and poured with dental stone (Elite Model thixotropic, Italy). After setting, the impression was inverted on a plastic mold containing Plaster of Paris (Al-Ahleea, Iraq) to get a base for the cast. The casts were photographed using a photographic apparatus described by Ahmed and Diab [39-40] (Figure 1), which provided a constant distance between the digital camera and the occlusal teeth surfaces through a clear plastic plate for standardization of position and orientation.

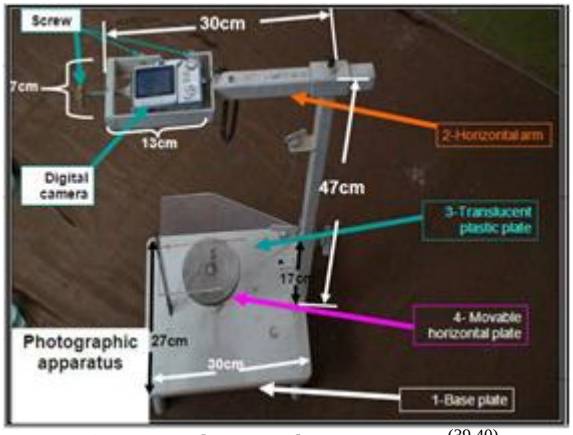


Figure 1: Photographic apparatus. [39,40]
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Facial taper was measured on the frontal facial photograph using AutoCAD software (version 2016, AutoDesk inc., California, USA) according to the method of Viazis [13]. Facial taper angle formed by the intersection of two lines (one on each side) connecting the most lateral points of the orbits and the junction of the upper and lower tips at the corners of the mouth (Figure 2). The mean plus or minus one standard deviation (± SD) is 45 degrees ± 5 degrees indicated a normal facial form (Mesoprosopic). Larger values of this angle would indicate a wider more square face (Euryprosopic) whereas lower ones indicate a longer, narrower face (Leptoprosopic).



Figure 2: Facial taper angle [13]

According to the method of Al-E'nizy [31] and Ahmed and Ali [35], the dental arch forms were classified into narrow, mid and wide using three ratios (Figure 3) namely anterior arch length / inter-canine distance, molar vertical distance / inter-first molar distance and total arch length / inter-second molar distance.

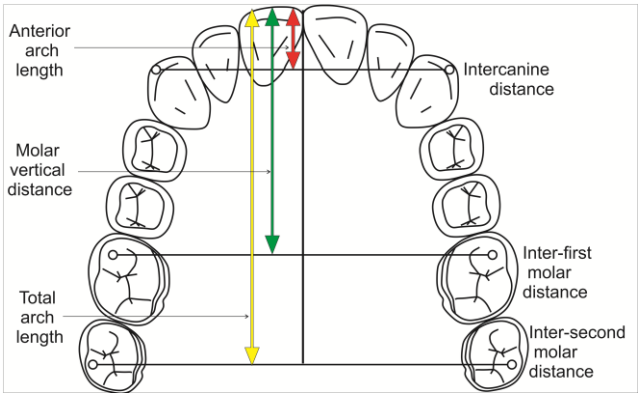


Figure 3: Dental arch measurements

For each ratio, a standardized number was calculated and the mean of these standardized numbers was used to classify the dental arch forms into:

1) Narrow form; the mean of standardized number > +1.
2) Mid form; the mean of standardized number between (+1 and -1).
3) Wide form; the mean of standardized number < -1.

Statistical analyses

The data were analyzed using SPSS program (version 21). The statistical analyses included the descriptive analysis (frequencies and percentages) and inferential statistics (Pearson's Chi square).

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

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Non-significant	NS	P > 0.05
Significant	S	0.05 ≥ P > 0.01
Highly significant	HS	P ≤ 0.01

3. Results

Tables 1-6 showed the frequency distributions and percentages of facial forms in relation to dental arch forms in both genders and total sample.

The results revealed non-significant associations between the facial and dental arches forms except in females when a high significant association was reported between mandibular dental arch form and facial form (Table 4).

Table 1: Frequency distribution and percentages of maxillary arch forms against facial forms in male group

Arch forms		Facial forms			
		Eury	Lepto	Meso	Total
Mid	No.	9	8	9	26
	%	34.62	30.77	34.62	100
Narrow	No.	1	1	1	3
	%	33.33	33.33	33.33	100
Wide	No.	2	2	0	4
	%	50	50	0	100
Total	No.	12	11	10	33
	%	36.36	33.33	30.30	100

X^2=3.14, d.f.=4, p-value=0.535 (NS)

Table 2: Frequency distribution and percentages of mandibular arch forms against facial forms in male group

Arch forms		Facial forms			
		Eury	Lepto	Meso	Total
Mid	No.	9	10	8	27
	%	33.33	37.04	29.63	100
Narrow	No.	1	0	1	2
	%	50	0	50	100
Wide	No.	2	1	1	4
	%	50	25	25.00	100
Total	No.	12	11	10	33
	%	36.36	33.33	30.30	100

X^2=2.134, d.f.=4, p-value=0.711 (NS)

Table 3: Frequency distribution and percentages of maxillary arch forms against facial forms in female group

Arch forms		Facial forms			
		Eury	Lepto	Meso	Total
Mid	No.	14	10	13	37
	%	37.84	27.03	35.14	100
Narrow	No.	1	3	1	5
	%	20	60	20	100
Wide	No.	2	2	1	5
	%	40	40	20	100
Total	No.	17	15	15	47
	%	36.17	31.91	31.91	100

X^2=2.476, d.f.=4, p-value=0.649 (NS)

Table 4: Frequency distribution and percentages of mandibular arch forms against facial forms in female group

Arch forms		Facial forms			
		Eury	Lepto	Meso	Total
Mid	No.	12	6	15	33
	%	36.36	18.18	45.45	100
Narrow	No.	2	6	0	8
	%	25	75	0	100
Wide	No.	3	3	0	6
	%	50	50	0	100
Total	No.	17	15	15	47
	%	36.17	31.91	31.91	100

X^2=17.397, d.f.=4, p-value=0.002 (HS)

Table 5: Frequency distribution and percentages of maxillary arch forms against facial forms in total sample

Arch forms		Facial forms			
		Eury	Lepto	Meso	Total
Mid	No.	23	18	22	63
	%	36.51	28.57	34.92	100
Narrow	No.	2	4	2	8
	%	25	50	25	100
Wide	No.	4	4	1	9
	%	44.44	44.44	11.11	100
Total	No.	29	26	25	80
	%	36.25	32.5	31.25	100

X^2=3.708, d.f.=4, p-value=0.447 (NS)

Table 6: Frequency distribution and percentages of mandibular arch forms against facial forms in total sample

Arch forms		Facial forms			
		Eury	Lepto	Meso	Total
Mid	No.	21	16	23	60
	%	35	26.67	38.33	100
Narrow	No.	3	6	1	10
	%	30	60	10	100
Wide	No.	5	4	1	10
	%	50	40	10	100
Total	No.	29	26	25	80
	%	36.25	32.5	31.25	100

X^2=8.135, d.f.=4, p-value=0.087 (NS)

4. Discussion

Evaluation of the facial form has important effect on the treatment planning because it may exaggerate or alleviate the treatment outcomes and may interfere with final esthetic and stability of treatment.

There are many methods determining the facial types. Some from frontal other from profile and 3D assessment is also possible. In this study, facial taper angle was used for the first time to determine the facial forms.

Tables 1-6 showed that mid arch form is associated with all facial forms but mostly the europrosopic type. The same was true for other arch forms. No absolute association between the facial form and dental arches form in any genders and total sample was reported, this may be due to the method of determining the facial form as it depended on the width of the mouth and eyes, which may differ among people, not the facial length and width.

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The results of the present study revealed a non-significant association between dental arch forms and facial forms, this comes in agreement with Ahmed and Ali [35] Paranhos *et al.* [37] and Nayar *et al.* [38] except in females where there was high significant association between mandibular dental arch form and facial form.

As conclusion; there is no significant association between the facial and dental arches forms.

References

[1] Grauer D, Cevidanes LSH, Styner MA, Ackerman JL, Proffit WR. Pharyngeal airway volume and shape from cone-beam computed tomography: relationship to facial morphology. Am J Orthod Dentofacial Orthop 2009; 136(6): 805-14.
[2] Pepicelli A, Woods M, Briggs C. The mandibular muscles and their importance in orthodontics: a contemporary review. Am J Orthod Dentofacial Orthop 2005; 128(6): 774-80.
[3] Chan HJ, Woods M, Stella D. Mandibular muscle morphology in children with different vertical facial patterns: A 3-dimensional computed tomography study. Am J Orthod Dentofacial Orthop 2008; 133(1): 10e1-13.
[4] Tsunori M, Mashita M, Kasai K. Relationship between facial types and tooth and bone characteristics of the mandible obtained by CT scanning. Angle Orthod 1998; 68(6): 557-62.
[5] Dibbets JMH. Morphological associations between the Angle classes. Eur J Orthod 1996; 18(1): 111-8.
[6] Siriwat PP, Jarabak JR. Malocclusion and facial morphology is there a relationship? Angle Orthod 1985; 55(2): 127-38.
[7] Bishara SE, Jakobsen JR. Longitudinal changes in three normal facial types. Am J Orthod 1985; 88(6): 466-502.
[8] Enlow DH. Facial growth. 3rd ed. Philadelphia: W.B. Saunders; 1990.
[9] Collett AR, West VC. Terminology of facial morphology in the vertical dimension. Aust Dent J 1993; 38(3): 204-9.
[10] Farkas LG, Munro IR. Anthropometric facial proportions in Medicine. 1st ed. Springfield: Charles C Thomas Publisher; 1987.
[11] Rakosi T, Jonas I, Graber TM. Orthodontic diagnosis (Color Atlas of Dental Medicine). 1st ed. New York: Thieme; 1993.
[12] Graber TM. Orthodontics principles and practice. 3rd ed. Philadelphia: W.B. Saunders Company; 1972.
[13] Viazis AD. Atlas of orthodontics. Principles and clinical application. 1st ed. Philadelphia: W.B. Saunders Co.; 1993. p. 49,51.
[14] Hawley CA. Determination of the normal arch and its applications to orthodontia. Dent Cosmos 1905; 47(5): 541-52.
[15] Chuck GC. Ideal arch form. Angle Orthod 1934; 4(4): 312-27.
[16] Lu KH. Analysis of dental arch symmetry. J Dent Res 1964; 43(5): 780.
[17] Currier JH. A computerized geometric analysis of human arch form. Am J Orthod 1969; 56(2):164-79.
[18] Schullof RJ. Diagnostic procedure and aids. In: Graber TM (ed). Orthodontics. Principles and practice. 3rd ed. Philadelphia: W.B. Saunders Company; 1972.
[19] Brader AC. Dental arch form related with intraoral forces: PR=C. Am J Orthod 1972; 61(6): 541-61.
[20] Musich DR, Ackerman JL. The catenometer: A reliable device for estimating dental arch perimeter. Am J Orthod 1973; 63(4): 366-75.
[21] Schulhof R, Gottlieb EL. Rocky Mountain data system. J Clin Orthod 1975; 9(12): 776-93.
[22] White LW. Individualized ideal arches. J Clin Orthod 1978; 12(11): 779-87.
[23] Ricketts RM, Bench RW, Gugino CF, Hilgers JJ, Schulhof RJ. Bioprogressive therapy. Book 1. 1st ed. Denver: Rocky Mountain/ Orthodontics; 1979.
[24] Begole EA. Application of the cubic spline function in the description of dental arch form. J Dent Res 1980; 59(9): 1549-56.
[25] Sampson PD. Dental arch shape: A statistical analysis using conic sections. Am J Orthod 1981; 79(5): 535-48.
[26] Roth RH. Treatment mechanics for the straight wire appliance. In Graber TM, Swain BF. Orthodontics: Current principle and technique. 1st ed. St. Louis: The C.V. Mosby Company; 1985. p. 678.
[27] Ferrario VF, Sforza C, Miani A Jr, Tartaglia G. Mathematical definition of the shape of dental arches in human permanent healthy dentitions. Eur J Orthod 1994; 16(4): 287-94.
[28] Andreiko C. JCO interview on the Elan and Orthos systems. J Clin Orthod 1994; 28(8): 459-68.
[29] Braun S, Hnat WP, Fender DE, Legan HL. The form of the human dental arch. Angle Orthod 1998; 68(1): 29-36.
[30] McLaughlin RP, Bennett JC, Trevisi HJ. Systemized orthodontic treatment mechanics. 1st ed. London: Mosby International; 2001. p.75.
[31] Al-E'nizy JAJ. Association between upper dental arch dimensions and facial type in adult with class I normal occlusion (A computerized study). A master thesis, Department of POP, College of Dentistry, University of Mosul, 2010.
[32] Schulhof RJ, Lestrel PE, Walters R, Schuler R. The mandibular dental arch: Part III buccal expansion. Angle Orthod 1978; 48(4): 303-10.
[33] Al-Shalabi FS. Relation between skeletal facial form and lower dental arch form in an Iraqi sample aged 20-25 years with class I normal occlusion. A master thesis, Department of POP, College of Dentistry, University of Baghdad, 2002.
[34] Salem NM. Facial and arch form and dimensions in a sample of 16-21 years old Palestinians class I occlusion. A master thesis. Department of POP, College of Dentistry, University of Baghdad, 2003.
[35] Ahmed HMA, Ali FA. Dental arches dimensions, forms and the relation to facial types in a sample of Iraqi adults with skeletal and dental Class I normal occlusion. J Bagh Coll Dentistry 2012; 24(sp. Issue 1): 99-107.
[36] Al-Taee HMH, Al-Joubori SK. Dental arches dimensions, forms and its association to facial types in a sample of Iraqi adults with skeletal and dental class II-division 1 and class III malocclusion (A cross sectional study). J Bagh Coll Dentistry 2014; 26(2): 160-6.

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[37] Paranhos LR, Ramos AL, Benedicto E, Maltagliati LÁ, Cardoso M, Filho LC. Is there any association between facial type and mandibular dental arch form in subjects with normal occlusion? Acta Scientiarum 2014; 36(1): 129-34.
[38] Nayar S, Aruna, Santhosh, Manzoor W. Correlation between arch form and facial form: A cross sectional study. J Pharm Bioall Sci 2015; 7(Supp. 1): S85-6.
[39] Ahmed ZSH, Diab BS. The effect of nutritional status on mesiodistal and bucco/ lingual or palatal diameters of permanent teeth among fifteen years old students. J Bagh Coll Dentistry 2016; 28(2):108-14.
[40] Ahmed ZSH, Diab BS. The effect of nutritional status on mesiodistal and bucco-lingual (palatal) diameters of primary teeth among five years old kindergarten children. J Bagh Coll Dentistry 2016; 28(2):152-7.

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