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CORRELATION OF VERTICAL FACIAL MORPHOLOGY AND DENTAL ARCH WIDTH IN UNTREATED PAKISTANI ADULTS

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ABSTRACT:

Introduction: One of the methods to asses vertical facial morphology is to correlate it with the angle formed between the mandibular plane and the SN plane. This study was conducted to determine if there is any relation between dental arch width and vertical facial morphology as determined by the SN-MP angle.

Methods: Lateral cephalogram and dental casts were obtained from 100 untreated Pakistani adults (24 males and 76 females) above 18 year old with no cross bite, minimal crowding and spacing. The angle between the anterior cranial base and the mandibular plane was measured on lateral cephalogram of each patient. Dental casts were used to obtain maxillary and mandibular inter canine, inter premolar and inter molar widths, as well as amount of crowding or spacing.

Results: The results showed that male arch widths were significantly larger than those of females and there was a significant decrease in inter arch width as the MP-SN angle increased.

Keywords: Facial morphology,SN plane.

INTRODUCTION:

Facial morphology is unique to every individual in the world. The proportional relationship between facial height and width is the first step in facial evaluation during orthodontic diagnosis. The facial pattern of an individual can be taken into consideration as an important factor that aids in the treatment selection and protocol.

Since each individual's face has a proportion unique to it, so do the dental arches. The question is whether the shape of the dental arch corresponds to the facial morphology and vice versa.

Ricketts [1], Enlow and Hans [2], and Wagner and Chung [3] have established that a long-face individual usually has narrower transverse dimensions (dolichofacial) and a short-face individual has wider transverse dimensions (brachyfacial). Although facial

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proportions, angles and contours vary with age, and race, one wonders if there is any difference between male and female and whether this correlates to the dental arch width. Several researches have been carried out using different parameters to determine a relationship between these two variables. One of the first studies was carried out by Howard V Meredith et al [4]. No strong association was found between transverse dimensions of the head or face and widths of the dental arches.

Luca Lombardo et al [5] reported the dental and alveolar arch forms in a Caucasian population and compared it with commercially available archwires. Souichiro Oda [6] reported the same relationship in the Japanese population.

In terms of the difference in arch width between males and females, Wei [7] evaluated PA cephalograms of Chinese adults and noted gender differences in maxillary and mandibular intercanine widths. Eroz et al [8] reported that in children, males had significantly larger intermolar widths when compared with females. C. Matthew Forster [9] compared the relationship between dental arch width and vertical facial morphology.

Understanding the facial proportion can be the key to both diagnosis and treatment of an orthodontic patient. Renowned artists and architects have used the "golden ratio" to map out their master pieces. With the increased use of arch wires to correct transverse dimensions of the dental arches the increased knowledge of a link between facial proportion and dental arch width can be of immense help to orthodontists.

This study was conducted to examine and probe the relationship between dental arch width and the vertical facial pattern as determined by the steepness of the mandibular plane. Correct Facial and vertical examination will lead to avoidance of potential orthodontic error due to use of correct preformed arch wires and enhances diagnosis, treatment planning, treatment, and quality of results.

The objectives of this study were to investigate the correlation between dental arch width and the vertical facial pattern. Also, to investigate the differences in dental arch dimensions between male and female subjects.

MATERIAL AND METHODS:

The study carried out was quantitative and the study design was cross-sectional. Samples were collected by simple random sampling method. The data was collected over a period of one month.

Data was collected from the patients who reported to Department of Orthodontics at Ishrat ul Ibad Institute of Oral Health Sciences.

One hundred (74 females and 26 males) untreated adults, age 18-35 years, whose initial orthodontic records were taken at Ishrat ul Ibad Institute of Oral Health Sciences were selected for this study. The following inclusion and exclusion criteria were used for the selection of the subjects for this study:

Inclusion criteria were that all permanent teeth should be present except third molars. There should be no history of previous orthodontic treatment. Pre-treatment lateral cephalogram and maxillary and mandible dental casts should be available.

Subjects with history of trauma, anterior and posterior cross bites, edentulous spaces and severe crowding (>9mm) or spacing (>9mm). Those with extensive restorations or prosthetics, craniofacial anomalies like cleft lip and palate, TMJ abnormality and syndromes were not included.

The lateral cephalogram of the selected subjects were taken using the standard technique at Ishrat ul Ibad Institute of Oral Health Sciences. Study models were made from high quality orthodontic impressions and orthodontic plaster. Dental cast measurements were performed using a vernier caliper with an error of .01mm and the following dimensions were measured:

The MP-SN angle was measure as SN angle (Figure 1) reported by Riedel[10].

Mesiodistal width of the crown at the greatest mesiodistal diameter of each tooth, intercanine width (from most Buccal aspect), first interpremolar and first intermolar width (from most Buccal aspect and mesiobuccal cusp tip respectively). Arch length (from the contact point between the permanent central incisors to the line joining the mesial surface of the permanent first molar), (Figure 2).

Maxillary and mandibular study models were used for measurement of arch width of male and female subjects. Descriptive statistics, including the mean and standard deviation values, were calculated for all measurements. Linear Regression analysis was carried out to determine the degree to which dental arch width varies with the MP-SN angle. R-square values and the p-value (significance) were calculated for each hypothetical parameter using SPSS version 16.

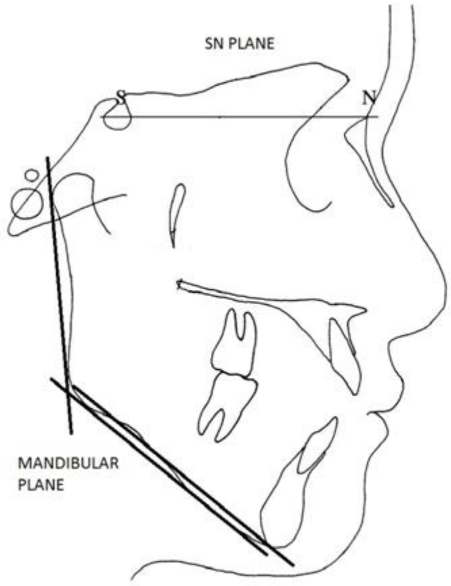


Figure 1: Lateral cephalometric landmarks used in the study.

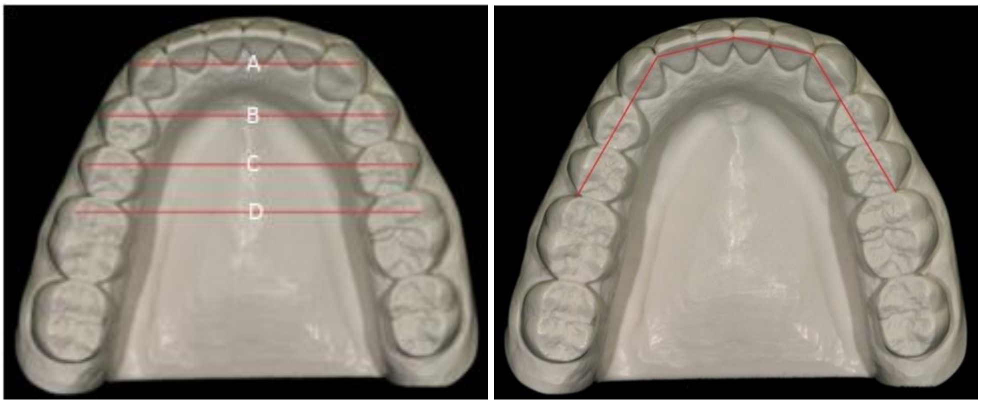
RESULTS:

Table 2 shows the mean and standard deviation values of arch dimension measurements of male and female subjects respectively. As seen, males have larger means for dental arch width as compared to the female subjects. The arch width measurements of low, average and high MP-SN angle groups of males and females are presented in table 3 and 4 which show that in majority cases the high-angle group had smaller arch widths while the low-angle group had larger arch widths showing a co relationship between the SN-MP angle and total arch width.

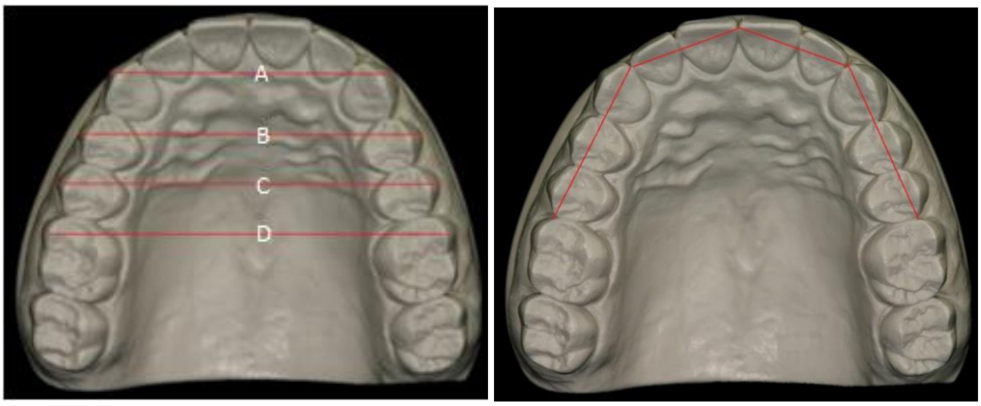
Table 5 shows the regression analysis of MP-SN versus hypothetical predictors. Regression analyses of males showed statistically significant correlations between MP – SN angle and the dental arch width (Table 5). R-square values of both maxilla and mandible were significantly small. In females, a significant correlation was found between MP – SN angle and arch width measurements. Their R-square values were also small.

TABLE 1: Description Of The Sample

	Male (n=24)		Female (n=76)	
	Mean	SD	mean	SD
Age (years)	21.25	3.12	21.14	2.50
MP-SN (degrees)	30.96	6.02	34.19	6.81
Crowding spacing (maxilla)	0.15	3.35	-0.96	-2.09
Crowding spacing (mandible)	-1.29	3.03	3.40	3.19



A: inter canine width, B: first inter premolar width, C: second inter premolar width, D: inter molar width



A: inter canine width, B: first inter premolar width, C: second inter premolar width, D: inter molar width

FIGURE 2: Measurements for arch length available by summing the distances from the mesial contact point of the left first molar to the distal contact point of the left lateral incisor, the distal contact point of the left lateral incisor to the mesial contact point of the left central incisor, the mesial contact point of the left central incisor to the distal contact point of the right lateral incisor, and the distal contact point of the right lateral incisor to the mesial contact point of the right first molar.

Table 2: Maxillary and Mandibular arch width measurements (millimeters)

	Male (n=24)		Female (n=76)	
	mean	SD	Mean	SD
Maxilla				
Intercanine width (most buccal)	35.83	3.44	33.44	4.01
First premolar width (most buccal)	43.48	4.12	40.42	2.87
Second premolar width (most buccal)	46.33	3.87	45.18	2.75
Intermolar width (mesiobuccal cusp tip)	49.52	3.38	47.41	2.93
Mandible				
Intercanine width (most buccal)	28.72	5.33	27.12	3.15
First premolar width (most buccal))	37.56	4.34	34.28	2.45
Second premolar width (most buccal)	41.18	4.25	39.89	3.36
Intermolar width (mesiobuccal cusp tip)	43.70	3.91	42.27	3.03

Table 3: Arch width measurements for low average and high MP-SN angle males.

	Low MP-SN angle (less than 27)		Average MP-SN angle (27-37)		High MP-SN angle (37 onwards)	
	Mean	SD	Mean	SD	Mean	SD
Maxilla						
Intercanine width (most buccal)	36.70	4.72	35.62	3.24	33.75	1.76
First premolar width (most buccal)	45.10	4.91	43.20	4.12	41.75	1.06
Second premolar width (most buccal)	46.80	3.56	46.38	4.23	44.75	1.06
Intermolar width (mesio buccal cusp tip)	49.30	4.08	49.73	3.40	48.25	2.47
Mandible						
Intercanine width (most buccal)	27.30	3.49	29.00	6.07	30.00	0.707
First premolar width (most buccal)	27.30	3.49	37.67	4.60	36.75	0.353
Second premolar width (most buccal)	38.30	4.22	41.91	4.51	42.25	0.353
Intermolar width (mesio buccal cusp tip)	43.90	3.59	43.61	4.32	44.00	0.707

Table 4: Arch width measurements for low average and high MP-SN angle females

	Low MP-SN angle (less than 27)		Average MP-SN angle (27-37)		High MP-SN angle (37 onwards)	
	Mean	SD	Mean	SD	Mean	SD
Maxilla						
Intercanine width (most buccal)	32.59	4.51	34.20	3.50	32.46	4.75
First premolar width (most buccal)	41.31	2.56	40.47	3.09	39.89	2.58
Second premolar width (most buccal)	45.22	2.13	45.46	2.95	44.63	2.65
Intermolar width (mesiobuccal cusp tip)	47.40	3.33	47.94	3.14	46.56	2.10
Mandible						
Intercanine width (most buccal)	26.68	1.55	26.10	3.64	26.36	2.80
First premolar width (most buccal)	33.86	2.86	33.36	2.67	33.34	1.83
Second premolar width (most buccal)	39.00	3.66	40.57	3.52	38.06	2.71
Intermolar width (mesiobuccal cusp tip)	42.27	3.49	40.01	2.76	40.91	2.94

Table 5: Regression analysis of MP-SN versus hypothetical predictors

	Male (n=24)		Female (n=76)	
	R square	Significance	R square	Significance
Maxilla				
Intercanine width (most buccal)	0.040	0.003	0.004	0.571
First premolar width (most buccal)	0.052	0.002	0.156	0.177
Second premolar width (most buccal)	0.013	0.005	0.009	0.404
Intermolar width (mesiobuccal cusp tip)	0.001	0.873	0.023	0.188
Mandible				
Intercanine width (most buccal)	0.022	0.004	0.068	0.657
First premolar width (most buccal)	0.001	0.009	0.051	0.664
Second premolar width (most buccal)	0.092	0.001	0.003	0.634
Intermolar width (mesiobuccal cusp tip)	0.000	0.009	0.044	0.069

DISCUSSION:

Dentofacial pattern of every individual is different and consists of many variations. Evaluating the relationship between the dental arch and vertical facial morphology is imperative in order to understand the variation in size and shape of the dental arches. Three basic types of facial morphology exist: Short, average and long. Those with long face have excessive vertical facial growth. The short face types have reduced vertical growth. Between the two types lies the average face.

In this study regression analysis was carried out to determine the correlation between dental arch width according to four parameters and the MP-SN angle. The relationship between crowding (spacing) and arch width was also examined. Interestingly, the data suggested that the cant of mandibular plane was not related to maxillary or mandibular crowding for males and females. This is in direct opposition to the findings of Christie [11]. However the results correspond with the finding of C. Matthew Forster [9].

Studies and research has helped us recognize the importance of vertical dimension. In the present study the dental arches of untreated adult males and females were examined. The MP-SN angle was used as the measurement of vertical facial morphology. In previous studies the genders of the observed arch widths were combined Howes, [12]; Isaacson *et al* [13]; Nasby *et al*., [11]; Schulhof *et al* [14]. Secondly in agreement with Eroz *et* al [8], the results demonstrated that the male arch widths were significantly greater than female arch widths.

Moreover also in agreement with C. Matthew Forster [9] the results showed that as as MP – SN angle increased, arch width tended to decrease. The mean arch widths at maxillary canine (cusp tip) for males are 36.70, 43.20 and 41.75. For molars it was 49.30, 49.73 and 48.25 respectively. The mean inter-canine arch widths from cusp tip for males in mandibular arch were 27.30, 29.0 and 30.0. Regression analysis was used to predict arch widths, with known values of MP-SN [Table 5]. β-coefficients for male at canine width was -1.28 and showed that as MP-SN increases, the dental arch widths decreases by 1.28mm. The mean arch widths at maxillary canine (cusp tip for females were 32.59, 34.20, and 32.46.And in mandible 26.68, 27.10, 27.36 respectively. All measurements showed that dental arch width increases significantly with a decrease in MP-SN angle. The β-coefficients for female at canine width were -0.414, meaning for every 10 increase in MP-SN, intercanine width decreased by 0.41 mm. The r-square values of both male and females showed a good fit model when a linear scattered graph was drawn.

The mechanical stress brought about by occlusal bite forces and volume of certain masticatory muscles might influence the size of adjacent craniofacial skeletal regions, This might be another reason for variation in arch widths according to facial pattern. Helkimo *et al* [15] have found that mean bite force values were significantly higher in males than in females. The increased bite force might be a reason for the increased arch width in males when compared to females.

Dental arch width and vertical facial morphology certainly varies with race and ethnicity as well. The data from this study showed an inverse relationship between MP-SN angle and dental arch widths with a strong correlation. Moreover, in agreement with Eroz et al [8], C. Matthew Forster[9] the results demonstrated that the male arch widths were significantly greater than female arch widths.

Christie [11] already proved that the Caucasians with normal occlusion tend to be more brachyfacial than dolichofacial. Compared to Caucasian's, Japanese have a narrower width. Sokamoto *et al* [16] proved that Japanese population has been found to be more retrognathic with a greater vertical direction of facial growth than Caucasians. African-Americans had larger maxillary arch width than Caucasian youths.

CONCLUSIONS:

After in depth analysis of the results and the data collected as well as comparison with the other researches[1,2,9,11,13] the following conclusions were drawn. Firstly, the relationship was found to be an inverse relation in both males and females of untreated Pakistani adults, as MP-SN angle increased, the dental arch widths tended to decrease. Secondly, the dental arch widths of males were found to be wider than females among untreated adults.

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TABLES:

Table 1: Demographic and characteristics of the study subjects (*n* = 304)

Charcteristics	N	(%)	Mean (SD)
Sex			
Male	206	67.8	
Female	98	32.2	
Age (years) mean			42.61
14-39	148	48.7	
40-59	48	15.8	
≥60	108	35.5	
Systemic diseases			
Yes	28	9.2	
No	276	90.8	
Living area			
Urban	244	80.3	
Rural	60	19.7	

Table 2: Proportion of oral risk habits among the subjects by gender N (%)

Oral habits	Male *n* =206	Female *n* =98	Total *n* =304	P-Value
Smoking				0.000
Yes	68 (33.0)	6 (6.1)	74 (24.3)	
No	112 (54.4)	87 (88.8)	199 (65.5)	
Ex	26 (12.6)	5 (5.1)	31 (10.2)	
Waterpipe Smoking				0.017
Yes	10 (4.9)	13 (13.3)	23 (7.6)	
No	187 (90.8)	78 (79.6)	265 (87.2)	
Ex	9 (4.4)	7 (7.1)	16 (5.3)	
Smokeless tobacco				
Yes	22 (10.7)	1 (1.0)	23 (7.6)	0.002
No	178 (86.4)	97 (99.0)	275 (90.5)	
Ex	6 (2.9)	0 (0.0)	6 (2.0)	
Qat chewing				0.000
Yes	143 (69.4)	34 (34.7)	177 (58.2)	
No	48 (23.3)	52 (53.1)	100 (32.9)	
Ex	15 (7.3)	12 (12.2)	27 (8.9)	

Chi-square test

Table 3: distribution of lesions among subjects by gender N(%).

lesions	Male *n* = 206	Female *n* = 98	Total *n* = 304	P-Value
1. OCPL*	12 (5.8)	1 (1.0)	13 (4.3)	0.045
- Shammah Keratosis	7 (3.4)	0 (0.0)	7 (2.3)	NS
- Leukoplakia	2 (1.0)	0 (0.0)	2 (0.7)	NS
- Lichen Planus	1 (0.5)	1 (1.0)	2 (0.7)	NS
- Aktinic chelosis	1 (0.5)	00 (0.0)	1 (0.3)	NS
- Oral cancer	1 (0.5)	00 (00)	1 (0.3)	NS
2. Other lesion				
- Qat-induced lesion	23 (11.2)	4 (4.1)	27 (8.9)	<0.05

*Oral cancer and precancerous lesions

Fisher exact test

Table 4: Oral cancerous/precancerous lesions according to oral risk habit.

Oral habits			Precancerous lesions N	(%)	P-Value
Smoking					0.016
Yes	.a	*n* = 74	6	8.0	
No	.a	*n* = 199	4	2.0	
Ex	.a	*n* = 31	3	9.7	
Water pipe smoking					
Yes	.b	*n* = 23	2	8.7	0.012
No	.b	*n* = 265	8	3.0	
Ex	.b	*n* = 16	3	18.8	
Smokeless tobacco					0.000
Yes	.c	*n* = 23	8	34.8	
No	.c	*n* = 275	5	1.8	
Ex	.c	*n* = 6	0	0.0	
Qat chewing					0.187
Yes	.a	*n* = 177	11	6.2	
No	.a	*n* = 100	2	2.0	
Ex	.a	*n* = 27	0	0.0	

Fisher's exact test.