Palatal Dimensions and Its Correlation with the Circumference of Upper Anterior Teeth

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ABSTRACT

Aims: To put a bases for the prediction of the circumference of artificial anterior teeth depending on the palatal dimensions **Materials and methods:** The study sample consists of 30 female and 32 male with class I occlusion aged 19– 24 years .The dimensions of the palatal vault and the circumferences of upper anterior teeth were recorded with digital venire caliper and analyzed with SPSS program (version 11). **Results**: significant correlation was found between the dimension of the palatal vault and the circumference of upper anterior teeth. **Conclusions***:* the angle of circumferences of upper anterior teeth of narrow short and deep palate will be more tapered than those one in the wide, long and shallow palate.
Keyword: Circumferences of upper anterior teeth ,palatal dimensions.

INTRODUCTION

The ultimate support of the maxillary denture is the bone of two maxilla and palatine bone. They form the foundation for the hard palate and provide considerable support for the denture .Hard palate is examined for its shape, height, width and the quality of mucosa and submucosa covering it, high and wide palatal vault will resist lateral displacement of the denture and supply denture support and surface area for retention [1].

Palatal dimensions are statically different between sex and race, [2–5]so that, there is opportunity to establish criteria by which the dentist and forensic physician can predict the race and sex of unknown individual furthermore the palatal dimension may form a basis for identification of many disease like Marfan and Downs syndrome[6,7].

The form of palatal vault give an idea to the original form to the dental arch before the removal of the natural teeth and resorption of residual ridge[1]. Ideal relationship between the denture and facial soft tissue provide the basis for the analyzing the beauty and smile[8–10]. The circumference of upper anterior teeth is significantly affect the position and expression of the lip and the lower part of the face[11],insufficient lip support resulting from the lower teeth locating too far posteriorly is characterized by dropping of the corner of the mouth ,reduction in the visible part of the vermilon border of the lip ,deepings of nasolable groove, wrinkles above the vermilon border ,deepings of sulci and reduction in prominence of philitrum[1] .the purpose of this study was to study the palatal dimensions and to determine the circumference of upper anterior teeth that depends on the palatal dimensions.

MATERIALS AND METHODS

The dimension and shape of hard palatal tissue in 30 male and 32 female age range between (19–24) year,all with complete permanent dentition CI.I molar relation were analyzed ,subject with respiratory problem ,previous history of craniofacial truma, congenital anomalies, surgery or orthodontic treatment were not included in the sample .

The upper dental arch and the hard palatal tissue were reproduced from alginate impression casted in detal stone.The mesial

contact point of two central incisor and the palatal and mesiopalatal cusp tip of posterior teeth were identified with line lead pencil to facilitate identification .All the measurements were carried out using electronic digital vernier caliper (LEZACO, ART, 27710–150 MM accuracy, China) .The measurements were recorded with two decimals .The dimension of hard palatal tissue were identified by analyzing the following measurements:

A–palatal width

The width of palate is measured between the palatal cusp tip of the two selected teeth. the buccal cusp is not included in the study to exclude the possible variation of the width of the of the teeth that found in and between the two sex which may be source of bias in the measurements [12–15]. It include the following distances (Figure 1):

    1–Inter first premolar width (4–4)
    2– Inter second premolar width (5–5)
    3– Inter first molar width (6–6)
    4– Inter second molar width (7–7)
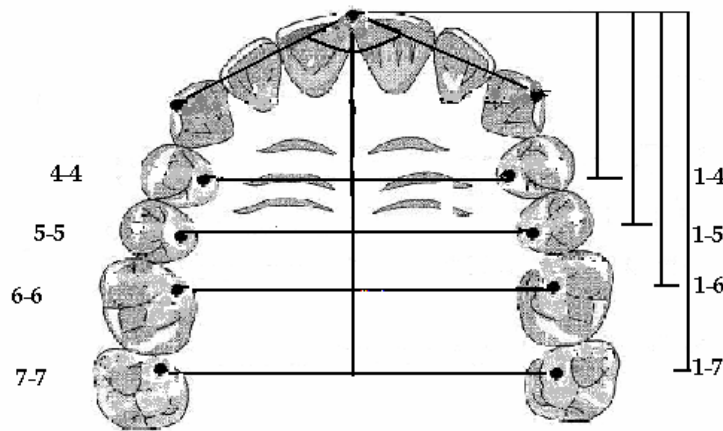
Notes: 4–4: inter first premolar width, 5–5: inter second premolar width, 6–6: inter first molar width, 7–7: inter second molar width,1–4: inter first premolar length,1–5: intersecond premolar length ,1–6: inter first molar length ,1–7: inter second molar length, circum: angle of circumference of upper anterior teeth.

Figure (1): Width and length of palatal vault and anterior arch circumference.

B–Length of the palate

It is represented by the linear distance from mesial contact point of upper central incisor to the mid point of linear distance between the two selected teeth ,it include the following distance (Figure 1):

    1–Inter first premolar length (1–4)
    2– Inter second premolar length (1–5)
    3– Inter first molar length (1–6)
    4– Inter second molar length (1–7)

C–palatal depth :

The palatal depth is represented by vertical distance from the mid point of the linear distance between the palatal cusp of the two selected teeth to the deepest point of the mid palatal suture measured by the vertical traveling arm of the venire ,it include the following linear measurements (Figure 2) :

    1–Inter first premolar depth (4–p)
    2– Inter second premolar depth (5–p)
    3– Inter first molar depth (6–p)
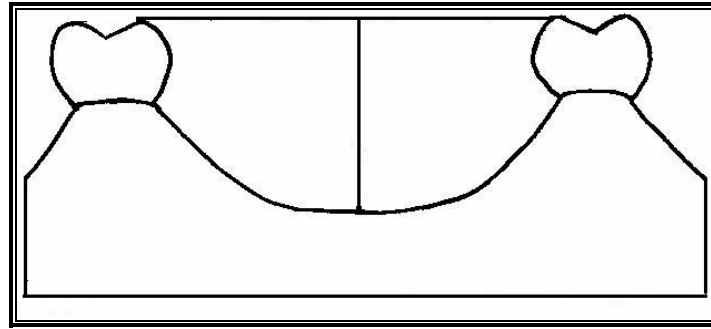   4– Inter second molar depth (7–p)

Figure (2): Depth of the palatal vault

D–Circumferences of upper anterior teeth

The width of upper anterior teeth and the canine arc distance is significantly different in and between the two sexes[16–18] ,so the circumference of upper anterior teeth was measured as the angle formed between the linear distance from the point mid way between the two central incisors to the cusp tip of right and left canine, the angle(which represents the circum) was drawn on graphic paper and measured using protractor, (Figure 1).

The measurements of the palatal arch dimensions were analyzed with statistical package for social science (spss, version 11)

for production of means, standard division, t– test and the coefficient of correlation between the recorded variable.

RESULTS

The descriptive statistics of the palatal arch dimensions (width, length and depth) and the circumference of upper anterior were obtained, Tables (1,2). The width of palatal vault anteriorly is 32.32 mm, 15.38 mm ,13.29 mm (width ,length and depth) and increasing to 41.47,36.23 and 20.1 mm posteriorly adjacent to first molars. The average circumference of upper anterior teeth was 126.1 degree.

Table (1) : Descriptive statistics of palatal dimensions

Varibles	Minimum	Maximum	Mean	Std. Deviation
4–4	25.68	39.44	32.3203	2.57721
5–5	28.75	46.00	36.9275	2.95600
6–6	36.00	47.25	41.4767	2.35906
7–7	36.32	54.01	47.1364	3.00150
1–4	12.72	18.96	15.3881	1.71857
1–5	17.11	25.92	21.6362	2.03743
1–6	31.00	44.22	36.2320	2.34436
1–7	36.18	52.19	44.8219	2.85609
4–p	6.25	19.05	13.2911	2.96025
5–p	11.25	24.79	18.0919	2.98049
6–p	14.91	26.14	20.1025	2.59635
7–p	15.05	25.50	19.4083	2.44822

4–4:Inter first premolar width, 5–5: Inter second premolar width, 6–6: Inter first molar width, 7–7: Inter second molar width, 1–4: Inter first premolar length , 1–5: Inter second premolar length, 1–6: Inter first molar length, 1–7: Inter second molar length, 4–p: Inter first premolar depth, 5–p: Inter second premolar depth , 6–p: Inter first molar depth , 7–p: Inter second molar depth.

Table (2) : Descriptive statistics of circumference of anterior teeth

Variables	Minimum	Maximum	Mean	Standard Deviation
Circum	110.00	145.00	126.1094	7.34656

Circum: Angle of circumference of upper anterior teeth.

Tables (3,4) reveled that the collected measurements of the palatal dimesions and the angle of circumference of upper anterior teeth in the males group is larger than those measurements in the females group this difference is not significant except the palatal depth of males is significantly higher than females.

Table (3) : Paired –sample T test for the palatal dimensions (male, female)

Variables	Sex	Mean	Standard Deviation	T– value
4–4	male	32.5293	203872	1.378
	female	31.6661	2.7665	
5–5	male	37.9118	3.6660	3.162
	female	35.6768	2.6820	
6–6	male	42.1818	2.0746	3.246
	female	40.3914	2.0647	
7–7	male	47.8521	3.263	2.684
	female	45.9825	2.0763	
1–4	male	15.5223	1.76099	0.025
	female	15.0220	2.45132	
1–5	male	22.1937	2.10109	0.025
	female	21.3796	1.86717	
1–6	male	36.5639	1.39963	2.3444
	female	36.0254	1.55707	
1–7	male	45.1100	2.10109	2.8561
	female	44.9000	1.86717	
4–p	male	14.1997	3.08715	2.008*
	female	12.5623	2.71583	
5–p	male	19.4653	2.84811	3.444*
	female	16.8330	2.71896	
6–p	male	21.3867	2.65394	3.884*
	female	18.7823	1.97354	
7–p	male	20.5880	2.45132	4.287*
	female	18.0830	1.85126	

4–4: Inter first premolar width, 5–5: Inter second premolar width, 6–6: Inter first molar width, 7–7: Inter second molar width, 1–4: Inter first premolar length , 1–5: Inter second premolar length, 1–6: Inter first molar length, 1–7: Inter second molar length, 4–p: Inter first premolar depth, 5–p: Inter second premolar depth, 6–p: Inter first molar depth, 7–p: Inter second molar depth, ,*:significant difference.

Table (4) : Paired –sample T test for the anterior arch circumference(male ,female)

variables	sex	Mean	Std. Deviation	T– value
circum	male	126.3000	8.08639	0.240
	female	125.8333	7.02745	

Circum: circumference of upper anterior teeth

The palatal arch dimensions is positively correlated to palatal length except in the area adjacent to first molars is significantly reversed Table (5) while the width of palate is mainly reversely correlated to the depth especially in the area adjacent to first molars and this depth is diagonally correlated to palatal length.

The correlation between the palatal arch dimensions and the circumferences of upper anterior teeth in both sexes shown in Tables (6–8). The circumferences of upper anterior teeth is transversally correlated to the width of the palatal vault at the area adjacent to first molar, while it inversely correlated to the length and depth of palatal vault.

Table (5) : Correlations of palatal arch dimensions to each other

Variables	Sex	4–4	5–5	6–6	7–7
1–4	female	0.227	0.075	–0.014	0.249
	male	0.395(*)	0.714(**)	–0.472(**)	0.660(**)
	total	0.200	0.302(*)	0.288(*)	0.004
1–5	female	0.670(**)	0.794(**)	–0.574(**)	0.548(**)
	male	0.736(**)	0.492(**)	–0.375(*)	0.519(**)
	total	0.317(*)	0.151	0.342(*)	0.050
1–6	female	0.714(**)	0.557(**)	–0.187	0.875(**)
	male	0.578(**)	0.704(**)	–0.283	0.851(**)
	total	0.383(**)	0.366(**)	0.427(**)	0.267(*)
1–7	female	0.670(**)	0.794(**)	–0.574(**)	0.548(**)
	male	0.736(**)	0.492(**)	–0.375(*)	0.519(**)
	total	0.431(**)	0.347(**)	0.436(**)	0.258(*)
4–p	female	0.414(*)	0.481(**)	–0.457(*)	0.409(*)
	male	0.279	0.464(**)	–0.590(**)	0.164
	total	–0.109	0.061	0.200	0.221
5–p	female	0.216	0.346	–0.416(*)	0.241
	male	0.143	0.373(*)	–0.530(**)	0.013
	total	–0.116	0.069	0.085	0.163
6–p	female	0.293	0.362(*)	–0.474(**)	0.196
	male	0.241	0.486(**)	–0.594(**)	0.156
	total	–0.054	0.098	0.167	0.211
7–p	female	0.214	0.139	–0.247	–0.022
	male	0.170	0.512(**)	–0.605(**)	0.159
	total	–0.105	0.085	0.110	0.147
Variables	**sex**	**1–4**	**1–5**	**1–6**	**1–7**
4–p	female	–0.110	–0.222	–0.184	–0.089
	male	0.464(**)	0.373(*)	0.486(**)	0.512(**)
	total	.349(**)	0.233	0.265	0.248
5–p	female	0.361	0.036	0.077	0.090
	male	0.480(**)	0.267	0.419(*)	0.355
	total	0.447(**)	0.206	0.316(*)	0.283(*)
6–p	female	0.296	0.133	0.137	0.017
	male	0.150	0.161	0.218	0.232
	total	0.357(**)	0.152	0.283(*)	0.229
7–p	female	0.361	0.036	0.077	0.090
	male	0.480(**)	0.267	0.419(*)	0.355
	total	0.318(*)	0.153	0.222	0.154

4–4: Inter 1st premolar width, 5–5: Inter 2nd premolar width, 6–6: Inter 1st molar width, 7–7: Inter 2nd molar width, 1–4: Inter 1st premolar length, 1–5: Inter 2nd premolar length, 1–6: Inter 1st molar length , 1–7: Inter 2nd molar length, 4–p:inter 1st premolar depth, 5–p: Inter 2nd premolar depth, 6–p: Inter 1st molar depth , 7–p: Inter 2nd molar depth , **Correlation s is significant at the 0.01

Table (6): Correlations of palatal width to anterior arch circumference

Variables	Sex	4–4	5–5	6–6	7–7
4–4	female				
	male				
	total				
5–5	female	0.594(**)			
	male	0.461(**)			
	total	0.637(**)			
6–6	female	–0.352	–0.830(**)		
	male	–0.256	–0.785(**)		
	total	0.678(**)	0.702(**)		
7–7	female	0.633(**)	0.584(**)	–0.203	
	male	0.628(**)	0.698(**)	–0.303	
	total	0.339(**)	0.435(**)	0.670(**)	
circum	female	–0.352	–0.830(**)	1.000(**)	–0.203
	male	–0.256	–0.785(**)	1.000(**)	–0.303
	total	0.221	0.154	0.029	–0.108

4–4: Inter first premolar width, 5–5: Inter second premolar width, 6–6: Inter first molar width, 7–7: Inter second molar width, Circum: Angle of circumference of upper anterior teeth, **: Correlation is significant at the 0.01 level , *: Correlation is significant at the 0.05 level.

Table 7 : Correlations of palatal length to anterior arch circumference

Variables	Sex	1–4	1–5	1–6	1–7
1–4	female				
	male				
	total				
1–5	female	0.200			
	male	0.403(*)			
	total	0.561(**)			
1–6	female	0.187	0.612(**)		
	male	0.573(**)	0.434(*)		
	total	0.703(**)	0.484(**)		
1–7	female	0.200	1.000(**)	0.612(**)	
	male	0.403(*)	1.000(**)	0.434(*)	
	total	0.761(**)	0.504(**)	0.836(**)	
circum	female	–0.014	–0.574(**)	–0.187	–0.574(**)
	male	–0.472(**)	–0.375(*)	–0.283	–0.375(*)
	total	–0.432(**)	–0.500(**)	–0.291(*)	–0.336(**)

1–4: Inter first premolar length , 1–5: Inter second premolar length, 1–6: Inter first molar length , 1–7: Inter second molar length, Circum: Angle of circumference of upper anterior teeth, ** : Correlation is significant at the 0.01 level, *: Correlation is significant at the 0.05 level

Table (8) : Correlations of palatal depth and anterior arch circumference

Variables	Sex	4–p	5–p	6–p	7–p
4–p	female				
	male				
	total				
5–p	female	0.834(**)			
	male	0.765(**)			
	total	0.801(**)			
6–p	female	0.689(**)	0.856(**)		
	male	0.666(**)	0.832(**)		
	total	0.686(**)	0.864(**)		
7–p	female	0.474(**)	0.663(**)	0.823(**)	
	male	0.526(**)	0.758(**)	0.866(**)	
	total	0.541(**)	0.768(**)	0.887(**)	
circum	female	–0.457(*)	–0.416(*)	–0.474(**)	–0.247
	male	–0.590(**)	–0.530(**)	–0.594(**)	–0.605(**)
	total	–0.511(**)	–0.425(**)	–0.461(**)	–0.381(**)

4–p: Inter first premolar length, 5–p: Inter second premolar length, 6–p: Inter first molar length, 7–p: Inter second molar length, Circum: Angle of circumference of upper anterior teeth. **: Correlation is significant at the 0.01 level, *: Correlation is significant at the 0.05 level.

DISCUSSION

In this study it was obvious that the measurements taken for the dimensions of anterior palatal vault is smaller than the posterior palatal vault this confirm the natural view that the posterior palatal segment is wider and deeper than the anterior one.

T– test revealed that there is appreciable sex difference in the dimensions of the palatal vault ,the size of palate is larger in males group than females and the average difference in the palatal depth is significantly higher in males than females this simply reflect the greater overall breadth of male skull in any given ethnic group [19],these results is in agreement with the result of other previous studies[20–24]. Table (2) revealed that the angle of the circumferences of upper anterior teeth in females (123 degree) is smaller than those in males group (126 degree), this result come in accordance with the natural view that the feminity is characterized by curved surfaces roundness and softness in the form of dentition while the masculinity is characterized by boldness ,vigor and squrness in dentition[1].

Different correlations were found among the palatal arch dimensions (Table 5) ,generally the correlation between the palatal width and length is significantly positive except at the inter first molar distance the is significantly negative i.e as the palatal arch length increase the width is also increase until the inter first molar the width is no longer increase. The directly propotional correlation between the width and length of palatal vault anteriorly until the first molar were the correlation was reversed, this result give rise to the accepted natural view that the shape of palatal arch is U shape palatal vault[1] other wise the shape of palate will be semicircular.

The width of palate as measured from the palatal and mesiopalatal cusp tip of teeth is mainly negatively correlated to palatal depth specially at the inter first molar area i.e the wide palate is characterized by shallow palatal vault. The result indicated also that the

increase length of palate is accompanied by increasing palatal depth . On other hand the angle of circumference o f upper anterior teeth is positively correlated to the width of posterior palatal vault and reversely correlated to the length and depth of palate these result confirm the accepted view that the broad and shallow edentulous palatal vault indicated that the dental arch form originally been square and a high V shape edentulous vault indicated a tapering dental arch form , rounded vault of average height may indicate an ovoid dental arch [1], these finding is of practical importance to prosthodontist as it form the basis for the arrangements of artificial upper anterior teeth so that they can previously predict the circumferences of anterior teeth by observing the dimensions of palatal vault i.e the arc of circumferences of the artificial anterior teeth of the narrow edentulous arch as measured from the crest of residual ridge will be more tapered than those of the wide edentulous arch.

CONCLUSIONS

The anterior palatal vault is smaller than the posterior one

The dimensions of the palatal vault in males is larger than females especially the palatal depth

The angle of circumference of upper anterior teeth as measured from the measial contact point of the two central incisors and the cusp tip of canines in females is more tapered than males

Wide palatal vault as measured from the palatal and mesiopalatal cusp tip of teeth is mainly characterized by long and shallow palate.

The angle of circumferences of upper anterior teeth of the wide ,long and shallow palate will be less tapered than those one in the narrow short and deep palate .

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