Original Article

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THE RELATIONSHIP BETWEEN THE FACIAL TYPE AND THE MORPHOLOGIC ALVEOLAR CHARACTER OF THE ANTERIOR REGION OF THE MAXILLA USING CT SCAN

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ABSTRACT:

The research aim for testing the correlations between the morphology of the anterior region of the maxilla and facial type.The sample consist of 59 patients.They were divided into three groups according to their facial type.the result is three groups ,19 short face type, 20 norm face type, and 20 long face type patients, aged 19 to 40 years.we have measured many measurement that determine the thikness of the bone around the roots of the upper incisors and the inter canine space(between the root apexes). The measurements were processed using analysis of variance Anova .We find that at the upper incisors, In short face type subjects the thikness of the alveolar bone was larger than in the norm face type and long face type and the distance between the apexes of upper canins was the largest in the short face type.

At the central incisors the apex root was larger from the palatal plate in the short face patient and it was larger from the palatal plane in the long face patient.

Key Words: Upper incisors,Inter canine space, Facial type,alveolar bone, Upper jaw morphology

INTRODUCTION:

The thickness of the alveolar bone defines the boundaries of the orthodontic movement and challenging these limits may cause undesirable collateral effects for the periodontal tissues. The most critical orthodontic movement includes dental arch expansion and incisor buccal-lingual movements (Furthermann et al 2002). Such mechanics can decentralize teeth from the alveolar bone envelope, causing bone dehiscences and fenestrations and gingival recession, depending on the initial morphology of alveolar bone as well as on the amount of tooth movement(Garib et al 2010).Edwards(*Edward* et al 1976) studied a large group of individuals with Class II malocclusion and bidental protusion.He noted that despite prolonged palatal retraction and root torqueing of incisors,the width of the anterior palate at the level of the apex remained unchanged.The alveolus can ,however,remodel at the mid- root level and at the alveolar margin when the lingual cortex is approached and passed.He postulated an anatomic barrier against further tooth movement in the higher areas at the anterior palatal

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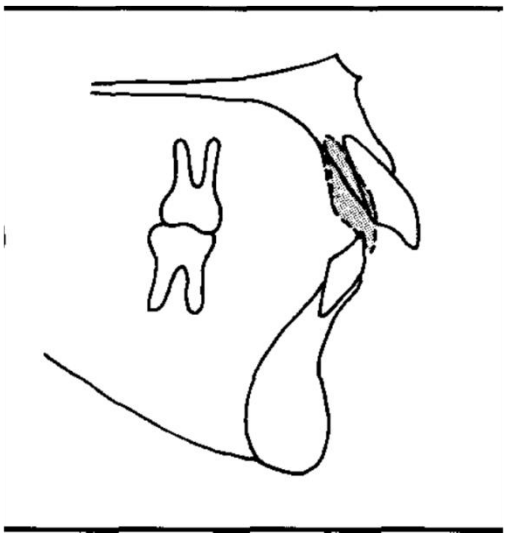
curvature as it approaches the horizontal vault



Edwards also pointed out the great variability in the width of the alveolar process supporting the maxillary incisors and illustrated the limitation placed upon orthodontic treatment by a thin alveolus.He measured the labiolingual width of the anterior portion of the palate and stated that there does not appear to be a statistically significant difference in these measures for groups segregated by mandibular divergence(SN-MP).

Some researchers deem the position of the upper incisors as a fundamental parameter upon which to base an orthodontic treatment plan and define the position to be reached at upon termination of treatment as the (planned incisal position)(Mclaughlin et al 2001)

As regards the correlation between jaw morphology and facial type, (Siciliani et al1990) found that the mandibular symphysis is elongated in long face type patients and thicker in short face type patients.

(Tsunori et al1998)reported that the cortex is thicker at the lower incisors in short face type patients than it is in norm and long face type patients.

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. (Sadia s.et

al; 2014).Ricketts(1982)Enlow and Hans(1996),and Wagener and Chung(2002)have established that a long-face individual usualy has narrower transverse dimensios(brachyfacial).

The aim of our research was to use MSCT to determine whether a correlation exists between the morphologic alveolar character of the anterior region of the maxilla, and facial type.

MATERIALS AND METHODS

Sample's subjects were selected from patients who, anyway, had to have a CT scan for medical purpose, but not especially for this study.

Criteria for selecting the subjects:

1. No history of periodontal diseases.
2. No history of previous orthodontic treatment.
3. Subjects must have fully erupted permanent dentition up to second molar tooth.
4. Subjects must have fully erupted permanent dentition up to second molar tooth.
5. No(root resorption / crowned tooth / missing tooth / endo treated tooth)in the area of study.
6. No history of trauma to the dento-facial structures
7. The sample is random in terms of sex and type of malocclusion and growth pattern.
8. Patients with severe structural variations were excepted.

59 patients from 19 to 40 years of age were selected to be as subjects for this current study.

The CT images were obtained with the patients in centric occlusion (maximum dental intercuspation), and their heads were positioned so that the Frankfort and midsagittal planes were perpendicular to the floor.

A multi-slice helical Light Speed (General Electric Healthcare, USA) scanner was used, generating images at 120kV tube voltage, 120mA tube current, 35sec scan time, 0.5mm slice thickness, to obtain the computed tomography images. Data was stored in DICOM (Digital Imaging and Communications in Medicine) format .

A personal computer Hp ((Pentium(R)Dual-Core CPU) was used, with the Windows 7 operating system.

-The following measurements were assessed on the sagittal plane:

We have measured the thikness of the alveolar bone at 4 level and the levels are

S1:1mm from the apex

S2:2 mm from the apex

S3:3 mm from the apex

M:the middle of the root

The thikness of the alveolar bone was measured perpendicular of the long axis

of the root. We measured the alveolar thikness at all four incisors.

We used U1 for upper right central incisor,U2 for upper left central incisor,u1 for upper right lateral incisor,u2 for upper left lateral incisor

We measured the thickness of the alveolar bone in the sagittal plane perpendicular on the long axis of the upper incisor. The sagittal sections analyzed were those corresponding to the central axis of the four upper incisors.(Gracco et al 2009)

U1-S1:thickness of the alveolar bone at the S1 level of the upper right central incisor

U1-S2: thickness of the alveolar bone at the S2 level of the upper right central incisor etc.

we have measured the distance between the apex root of the central incisor and the palatal plate(UP),the buccal plate (UA),and the palatal plane(L) (Handelman 1996).

U1-UP:the distance between the root apex of the upper right incisor and the palatal plate.

U1-UA: the distance between the root apex of the upper right incisor and the palatal plate .etc

The inter canine space was measured between the apexes of the roots of upper canines.we measured the distance between the right root apex and the midface plane and the distance between the left root apex and the midface plane ,then we add the left distance to the right distance so we have inter canine space between the apexes (CC)

-lateral cephalometric analysis-

The 59 subjects were divided into three groups according to facial growth pattern (short, normal and long) according to Jarabak analysis , Anterior Facial Height (N-Me), Posterior Facial Height(S-Go), Height Ratio (FHR) of Jarabak, Saddle angle (S), Articular angle (AR),Gonial angle (GO), Upper Gonial angle (GO1), Lower Gonial angle (GO2) and Jarabak sum angle (SA), were determined and calculated according to Jarabak's analysis (Jarabak JR and Fizzell JA 1972, Reck KB and Miethke RR 1991). Cephalometrics points and measurements that have been used in this investigation according to Jarabak analysis showed in (Fig 4)

Cephalometric measurements were digitally performed by the same author using software measurement tools, such as land marking and calipers (distance and angular measurements). Linear CT digital measurements accurate to the nearest 0.01 mm. whereas angular measurements were accurate to the nearest 0.01degrees.

Error of method:

All measurements were repeated twice with a month interval, by the same calibrated investigator using the same workstation, the initial measurements and the repeated measurements were compared by using a paired t-test at α=

0.05 to check any systematic error. The t-test did not show any statistical significance.

Statistical method:

All statistical analyses were performed using a software program (SPSS for Windows version 20).

The means and standard deviations of all the measurements were calculated. The one-way analysis of variance (ANOVA) test was used for variance analysis, in which the facial types were initially compared with each other, and then the (incisors-canines) belonging to each group were compared.. paired t test was used for detecting the presence of statistically significant differences in the averages of the variables depending on the different side (right or left). differences at the threshold of significance p value less than or equal to 0.05 were considered statistically significant.

RESULTS

Tables 1 through 4 show the means and standard deviations of the measurements carried out on each.

Regarding the upper right and left central incisors (Table 1and Tabel 2), the ANOVA yielded significant results for the following parameters:

Distance from the apex to the lingual cortex

Thickness of the alveolar bone at S1,S2,S3,M levels

(The mean values for these parameters were significantly greater in short face type patients than in long face type subjects.)

Distance from the apex to the palatal plane.

(The mean values for these parameters were significantly greater in long face type patients than in short face type subjects.)

Regarding the upper right and left lateral incisors (Table 3 and Tabel 4), the ANOVA yielded significant results for the following parameters:

Thicknesses of the alveolar bone at S1,S2,S3,M levels

(The mean values for these parameters were significantly greater in short face type patients than in long face type subjects.)

Regarding the upper right and left canines (Table 5), the ANOVA yielded significant results for the following parameter:

Inter canine space at the apical level.

(The mean values for these parameters were significantly greater in short face type patients than in long face type subjects.)

DISCUSSION

In contrast with conventional teleradiography, in which the images are often characterized by magnification and distortion MSCT yields three-dimensional images that are much more

accurate and have a 1:1 relationship between the real and reproduced image. Consequently, the study of the labio-lingual bony incisor support using teleradiography can be plagued by projection errors.

The results of our study indicated differences among the three facial types in alveolar thickness and inter canine space. At the two upper central incisors, the short face type group showed a greater bone thickness than the long face type group, both at 1,2,3 mm from the root apex and at middle of the root. The distance from the root apex to the lingual cortex was

also found to be greater in short face type patients with respect to long face type subjects, and the norm face type subjects yielded an intermediate value. The distance from the root apex to the palatal plane was also found to be greater in long face type patients with respect to short face type subjects, and the norm face type subjects yielded an intermediate value. No differences among three facial types were found for the distance from the root apex to the buccal cortex.

At the two upper lateral incisors, the short face type group showed a greater bone thickness than the long face type group, both at 1,2,3 mm from the root apex and at middle of the root.

In previously cited research dealing with the posterior teeth and lower incisors, some studies confirm our observation that the alveolar bone is thicker in short face type subjects than in long face patients(Masumoto T et al 2001)(Tsunori M et al 1998)(Siciliani G et al 1990).

our study found that short face type and norm face type patients present significantly greater distances from the apex to the lingual cortex than long face type subjects. This was in agreement with(Gracco et al 2009)(Bajracharya et al 2011)(Handelman Cs 1996). This observation is very important during the orthodontic treatment planning that dental movement in the lingual direction can be significantly greater in the short face type group than the long face type group. Kaley and Philips(Kaley J et al 1991) reported a strong correlation between root resorption and impaction of the upper incisor root apex against the palatal cortex during the orthodontic treatment. The dental movement is limited by the cortical walls of the alveolar bone, defined by Handelman as the ‘‘orthodontic walls’’ (Handelman cs 1996)

our study found that long face type patients present significantly greater distances from the apex to the palatal plane than short face type and norm face type subjects. . This was in agreement with (Handelman Cs 1996). Whereas ,this was contrary to (Gracco et al 2009) who found no significant differences in(the distance between the root apex of the central incisor and palatal plane) and facial type.

our study found that short face type and norm face type patients present

significantly greater alveolar bone thickness at upper incisors. This was in agreement with(Gracco et al 2009) (Bajracharya et al 2011)(Sabet et al 2015). Indeed, patients with a thin alveolar bone, such as those with an excessive lower facial height, are at risk of root resorption and loss of periodontal support when subjected to marked dental movement. Therefore, it is necessary to restrict movements in the lingual direction in long face type subjects or, if this is not possible,

orthognathic surgery is required to limit the risks to the periodontium (Gracco et al 2009).

In our study, values corresponding to the four upper incisors in each facial type were also compared. It was noted that the two central incisors were rather similar in all parameters measured,and the tow upper lateral incisors were similar. At the central incisors the alveolar thickness was with respect to the lateral incisors in all three facial types. This was in agreement with(Gracco et al 2009)

our study found that short face type and norm face type patients present significantly greater inter canine space between the apex than the long face patients.And that suggests we can expand the arch in the canine area during orthodontic treatment in the short face patient more than in the long face patient.

CONCLUSION

At the two upper central incisors, short face type patients present a greater alveolar bone thickness than long face type patients. The root apex of the upper incisors is farther away

from the lingual cortex in short face type patients and norm face type patients than in long face type patients. The root apex of the upper incisors is farther away from the palatal plane in long face type patients and norm face type patients than in short face type patients.

No difference emerged between the three facial types concerning the distance between the root apex and buccal plane.

At the two upper lateral incisors, short face type patients present a greater alveolar bone thickness than long face type patients.

At the upper canines, short face type patients present a greater inter canine space(between apexes) than long face type patients.

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FIGURES:

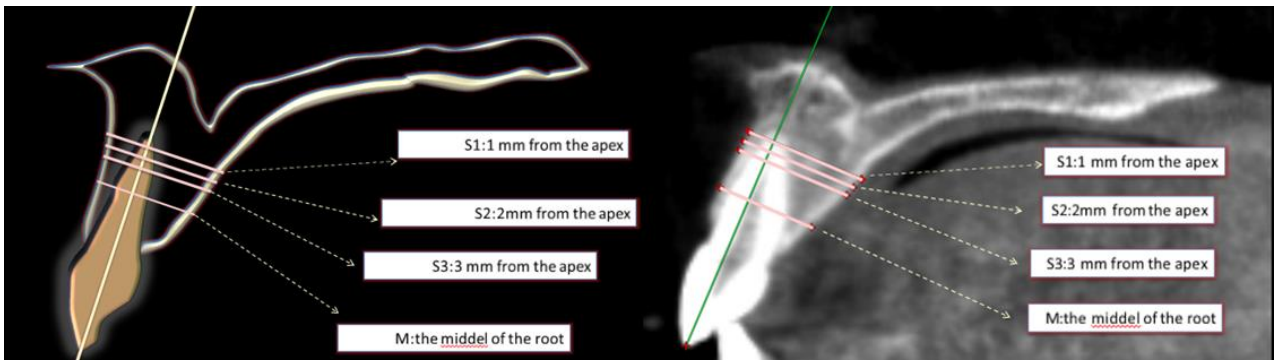

Fig 1. Measurments of alveolar thickness at S1,S2,S3,S4,M levels.the thickness is measured perpendicular on the long axis of the incisor.

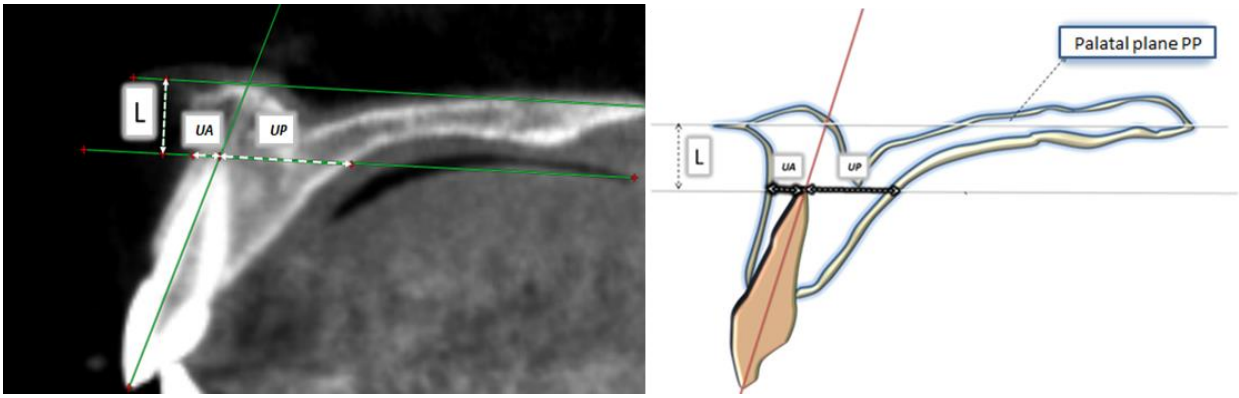

Fig 2.Measurments of distance between root apex of the central incisor and palatal (UP)and buccal(UA) plates and palatal plane(L)

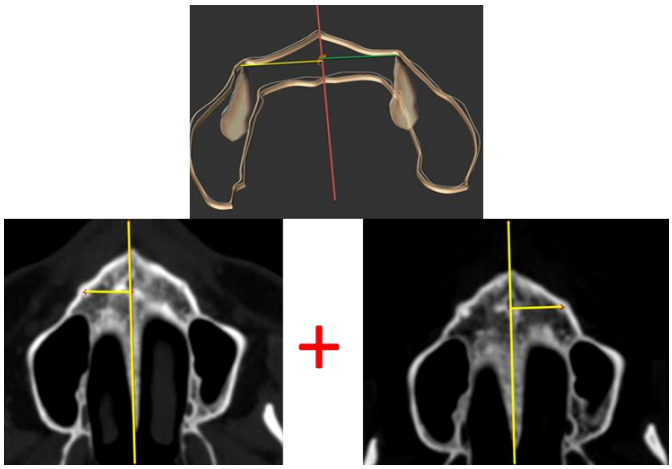

Fig 3. Inter apical upper canine space=distance of left root apex from midline+distance of right root apes from midline.

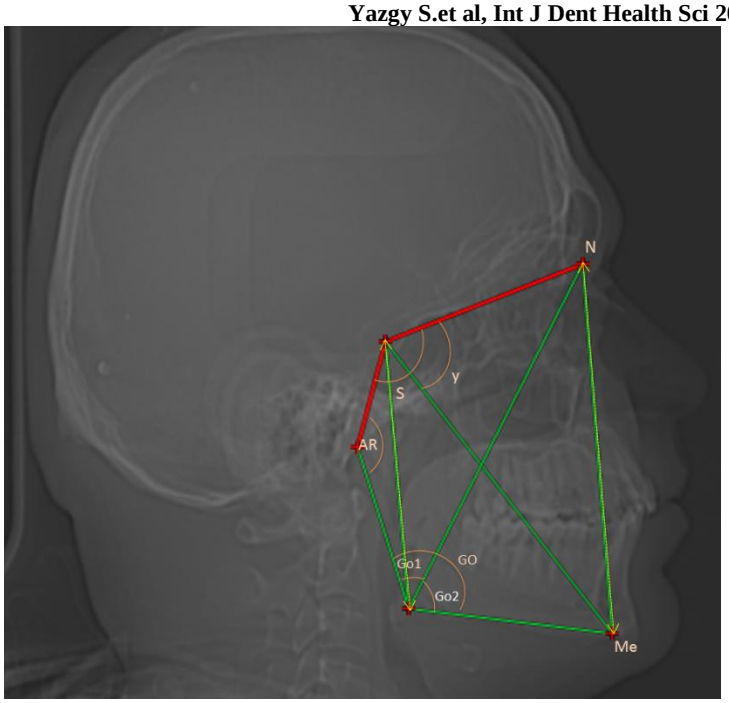

Fig 4: Cephalometrics points and measurements that have been used in this investigation according to Jarabak analysis.

TABLES:

Tabel 1: Means and Standard Deviations (SDs) of the Values Measured at the right Central Incisor, Compared Among Facial Types

	Face Type						
U1	long		norm		short		
	sd	mean	sd	mean	sd	mean	p value
U1-UP	1.20	9.41	2.01	10.00	2.05	11.57	**
U1-UA	0.54	2.83	1.17	2.52	0.76	2.55	-
U1-L	1.29	6.30	1.52	6.19	2.10	4.75	**
U1-S1	0.78	9.99	1.35	10.00	1.51	11.00	*
U1-S2	0.66	9.42	1.17	9.62	1.46	10.56	*
U1-S3	0.56	9.25	1.03	9.33	1.41	10.15	*
U1-M	0.78	8.19	1.14	8.47	1.37	9.15	*

* $P < .05$, ** $P < .01$

Tabel 2: Means and Standard Deviations (SDs) of the Values Measured at the left central Incisor, Compared Among Facial Types

U2	Face type						
	long		norm		short		
	sd	mean	sd	mean	sd	mean	p value
U2-UP	1.20	9.47	1.62	10.33	1.74	11.65	**
U2-UA	0.40	2.76	0.72	2.36	0.88	2.58	-
U2-L	1.40	6.54	1.42	5.79	2.22	4.66	**
U2-S1	0.96	9.50	1.24	9.96	1.49	10.84	*
U2-S2	0.83	9.45	1.17	9.59	1.57	10.33	*
U2-S3	0.74	8.59	1.03	9.29	1.57	10.01	*
U2-M	0.80	8.44	1.11	8.68	1.20	9.44	*

* $P < .05$, ** $P < .01$

Tabel 3: Means and Standard Deviations (SDs) of the Values Measured at the right lateral Incisor, Compared Among Facial Types.

	Face type						
u1	long		norm		short		
	sd	mean	sd	mean	sd	mean	p value
u1-S1	1.09	7.51	1.41	8.56	1.58	9.51	**
u1-S2	0.92	7.27	1.30	8.23	1.45	9.10	**
u1-S3	0.80	7.10	1.18	8.11	1.39	8.73	**
u1-A	0.89	7.20	1.25	8.20	1.44	9.14	**
u1-M	0.76	7.03	1.28	7.67	1.04	8.16	**

* $P < .05$, ** $P < .01$

Tabel 4: Means and Standard Deviations (SDs) of the Values Measured at the leftt lateral Incisor, Compared Among Facial Types

	Face type						
	long		norm		short		
	sd	mean	sd	mean	sd	mean	p value
u2-S1	1.28	8.14	1.50	8.45	1.40	10.06	**
u2-S2	1.14	7.87	1.36	8.16	1.36	9.62	**
u2-S3	1.10	7.51	1.26	7.84	1.38	9.26	**
u2-A	1.11	7.81	1.29	8.11	1.42	9.66	**
u2-M	0.77	7.19	1.03	7.48	1.15	8.45	**

* $P < .05$, ** $P < .01$

Tabel 5- Means and Standard Deviations (SDs) of the Values Measured at the upper canine, Compared Among Facial Types

	Facial type						
	long		norm		short		
	sd	mean	sd	mean	sd	mean	p value
CC	1.09	25.05	2.89	26.67	3.19	27.80	**

* $P < .05$