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Determination of the Anteroposterior Maxillary Central Incisors Position Relative to the Forehead (Iraqi Study)

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ABSTRACT

Background: Evaluating the anteroposterior position of the maxillary incisors is an important step in the diagnosis and treatment planning in order to get better facial and dental esthetics. This study aimed to evaluate and compare the anteroposterior position of the maxillary central incisors in both genders and to find out whether there is a relation between this position relative to the forehead inclination.

Samples and methods: Eighty dental students (40 males and 40 females) having normal dental and skeletal relationships and pleasing profile agreed to participate in this study. Standardized profile photograph on smiling was taken for each student and analyzed by AutoCAD program to assess the anteroposterior position of the maxillary central incisors and the inclination of forehead. Independent sample t-test and Pearson's Chi-square were used to assess the gender difference, while Pearson's correlation coefficient was used to assess the relationship.

Results: Males showed maxillary central incisors positioned significantly more anteriorly relative to the forehead in comparison with females. In most of the studied sample, the maxillary central incisors were located anterior to the point glabella. Moderate to strong, direct, high significant correlations were found between maxillary central incisors position and forehead inclination in both genders.

Conclusions: The forehead is considered as a helpful landmark for assessing the facial profile as it correlated significantly with the anteroposterior position of the maxillary central incisors.

Key words: Facial aesthetics, forehead inclination, Maxillary central incisors position

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INTRODUCTION

One of the most important elements of facial aesthetics is the maxillary central incisors. Treatment with orthodontic approach only or combined with orthognathic surgeries can changed the anteroposterior position (AP) and inclination of these teeth. These changes had great effects on the smiling profile esthetics percept by orthodontists and lay persons [1-3].

Many facial landmarks including nose, lips and chin had a major role in assessing the anteroposterior position of displayed maxillary central incisors in profile. After many studies and observations, Andrews et al. [4] favored the forehead to be a reference landmark used to determine the anteroposterior position of maxillary central incisors. His observations on persons with facial harmony led him to reach a conclusion about the presence of a direct relation between the inclination and prominence of forehead and the anteroposterior positions of the teeth and jaws. Moreover, he considered forehead as a stable landmark in contrast to the internal radiographic landmarks and its relationship with the maxillary incisors can be predictable and repeatable. Schlosser et al.

[1] concluded that trained or untrained people are sensitive to the erroneous anteroposterior relationship of the maxillary incisors to the forehead and this is the way that society instinctively utilizes for determining profile acceptance. Many researches had been done world-wide assessing the anteroposterior position of the maxillary central incisors relative to the forehead on American white and African samples, Chinese and Indians [3-12].

To the best of author's knowledge, there is no Iraqi study performed in this field, so this study aimed to evaluate the position of the maxillary central incisors relative to the forehead by measuring the anteroposterior position of the maxillary central incisors and their location to the forehead in both genders, and to find out whether there is a relation between this position and the forehead inclination in a sample of Iraqi adults with normal dental and skeletal relationships and pleasing facial profile.

SAMPLES AND METHODS

Study design

This prospective study was approved by the ethical and scientific committees in the Department of Orthodontics, University of Baghdad School of Dentistry, Iraq.

Samples

Eighty participants (40 males and 40 females) were recruited according to specific criteria from the students in the College of Dentistry, University of Baghdad between December 2018 and April 2019. The inclusion criteria included:

Were Iraqi Arabs in origin.

Age ranged between 20 to 23 years.

All had balanced facial profile with normal dental and skeletal relationships [13,14].

No one had a history of bad oral habits, orthodontic treatment, dentofacial deformities, plastic and orthognathic surgeries.

Methods

Explanation the purpose of the study was demonstrated by the researcher for each participant and in case of agreement, consent form was signed. History taking and clinical examination were performed on the dental chair and standardized right side profile photographs were captured during smiling in natural head position using mobile I-phone 6 camera with the aid of Planmeca ProMax Dimax3 X-ray unit in the department of Orthodontics, College of Dentistry/ University of Baghdad.

The photographic technique involved establishing the subjects in natural head position like in preparation for image exposure. Standing subjects were initially asked to assume their arms by their sides to establish orthoposition, then instructed to close their eyes and perform a series of neck bending exercises by tilting the head upward and downward until comfortable position of natural balance was achieved. After that, subjects reopened their eyes and looked into their eyes reflection on the mirror mounted on the stand 137 cm in front of the patient's nose [15].

Subjects were then asked to stay still, with teeth lightly together and lips relaxed, then the ear rods of the cephalostat were gently inserted into the external auditory meati and profile facial photographs were then taken with a one meter distance between the camera and patient's head [16]. The most important point was that the maxillary central incisors and forehead must be fully exposed in photographic image; otherwise the photo will be neglected. Every profile photograph was imported and analyzed using AutoCAD computer program to calculate the angular and linear measurements. First of all, the magnification was corrected for each photo using a wooden ruler as a caliper. According to the definitions of Andrew (5), the photographic landmarks were located and lines drawn, then forehead inclination angle and the anteroposterior position of the maxillary incisor were measured directly on the photographs (Figure 1).

Photographic landmarks

The following landmarks were utilized:

Glabella (G'): It is the most inferior aspect of the forehead.

Superion: It is the most superior aspect of the forehead when the forehead is either rounded or angular in contour.

Trichion (Tr'): It is defined as the hairline, and it is the most superior aspect of the forehead when the forehead is of relatively flat contour.

The forehead facial axis (FFA) point: It is

for the measured variables were shown in Table 1. The results revealed that male group had significantly higher mean values for forehead inclination and maxillary central incisors position in comparison with female group. The higher standard deviation values were related to the higher range between the minimum and maximum values.

Regarding the position of maxillary central incisors relative to the forehead; Table 2 and Figures 2 and 3 demonstrated the frequency distribution and percentages of the maxillary central incisors position relative to the points FFA and glabella. In males group, 62.5% of the cases had their maxillary central incisors positioned anterior to glabella and 25% between the glabella and FFA, while 12.5% were posterior to FFA.

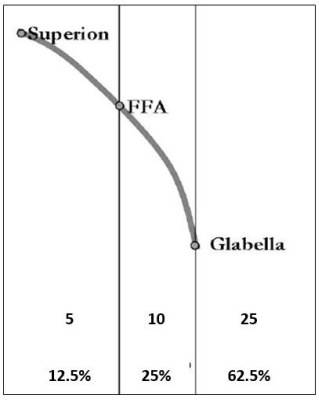

Figure 2: Frequency distribution and percentage of the maxillary central incisors position in male group.

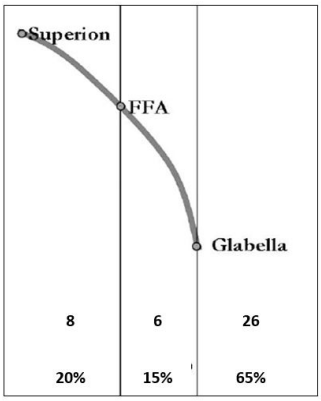

Figure 3: Frequency distribution and percentage of the maxillary central incisors position in female group.

Regarding females group, in the highest percentage of the cases, the maxillary central incisors were located anterior to glabella (65%), followed by 20% posterior to FFA and in only 15% of the cases, they lie between FFA and glabella. Chi-square test indicated non-significant gender difference.

The relationship between forehead inclination and anteroposterior position of the maxillary central incisors

The relationship between the forehead inclination and the position of the maxillary central incisors was determined in Table 3 for both genders. The relationship was strong, direct, and highly significant in males and moderate, direct, and highly significant in females.

DISCUSSION

To reach a primary and then definitive orthodontic diagnosis, orthodontists must rely on many diagnostic aids which are the frontal photographic with lip relaxed and while smiling and profile photographic with lips relaxed only. As previously mentioned, there is a correlation between the prominence and the inclination of forehead and the AP positions of the teeth and jaws, so profile photographic examination in smile with bared maxillary incisors is far important just like the frontal photograph. This is the first Iraqi study that deals with this subject.

The samples selected for the present study

Table 1: Descriptive statistics and genders difference for the measured variables.

Variables	Genders	Descriptive statistics				Gender difference (d.f.=78)	
		Mean	S.D.	Min	Max	t-test	P-value
Forehead	Males	22.05	5.965	11	33	4.451	0.000 (HS)
inclination (º)	Females	16.8	4.479	5	29		
AP Incisors	Males	19.245	14.009	-7.49	43.59	3.196	0.002 (HS)
position (mm.)	Females	9.308	13.8	-29.8	33.99		

Table 2: Frequency distribution, percentages, and gender difference regarding the position of the maxillary central incisors.

Genders		Posterior	In between	Anterior	Total
Males	N	5	10	25	40
	%	12.5	25	62.5	100
Females	N	8	6	26	40
	%	20	15	65	100

X^2=1.712, d.f.=2, P-value=0.425 (NS)

Table 3: Relationship between the forehead inclination and maxillary central incisors' position in both genders.

Relation	Males	Females
r	0.877	0.658
P-value	0.000 (HS)	0.000 (HS)

included young adult subjects to minimize the effect of any remaining skeletal growth [17,18]; as most of the facial growth is nearly completed by 16-17 years of age [19]. Those students were selected with normal dental and skeletal relationships to exclude the abnormal dental or skeletal relationships that may affect the maxillary central incisors position. AutoCAD software is used in the current study. This program is accurate, reliable, and easy to manipulate with a simple method for correction of magnification [20]. Previous studies [5,8,11] tried to resize the photos, taken from magazines and journals, to the real size and use the ruler and protractor for measuring. This could not be so accurate like measuring with AutoCAD.

The Inclination of the forehead

In the present study, the inclination of the forehead in male groups was higher significantly than females; this comes in agreement with Zou et al. study [10] on Chinese sample. The gender difference could be attributed to the greater variations in the inclinations and amount of frontal bossing in males as the frontal bones in males are thick, less rounded and slope backwards, while females had thin, smooth, more vertical frontal bone, as a results, the glabella tends to be more anterior in men [8].

Dumont et al. [21] and Al-Mashhadany et al. [22] found that the soft tissue thickness is higher in males than females because of the effect of testosterone hormone in facilitating the synthesis of collagen that provide males with a thick skin, on the other hand, the estrogen hormone in females facilitates the synthesis of hyaluronic acid in addition to the decreasing in the synthesis of collagen making their skin thinner.

Previous Iraqi studies [15,23-25] indicated that Iraqi males had large and more protrusive noses than females. Enlow et al. [26] stated that, "because of the larger, more protuberant character of the male nose, the part of the forehead contiguous with it also necessarily remodels into a more protrusive position. Therefore, the male forehead tends to be more sloping, in contrast to a more bulbous, upright female forehead. The supraorbital and glabellar parts of the male forehead tend to be quite protrusive, as compared with the much less Neanderthal-like character of the female forehead". This confirms the findings of the current study.

The mean values of the forehead inclination in Iraqi sample were near to that of Chinese but far from the American (White and African) and Indian samples. This can be attributed to difference in sample selection, number, and ethnic variation. Moreover, many studies depended on photographs from magazines and resized them to the real size and this may inherent a difference.

The anteroposterior maxillary central incisors position

The anteroposterior position of the maxillary central incisors relative to the forehead was significantly higher in males than females. This partially agreed with Singh et al. [9] and Zou et al. [10] in the mean values but not in the statistical difference. Singh et al. [9] used soft tissue nasion not FFA as a reference point.

The anteroposterior position of the maxillary central incisors is influenced by many factors like the lips and tongue forces, dentoalveolar compensation, presence of bad oral habits, skeletal relation, problems in the nasal passages, their morphology, inclination and their state in the dental arch whether crowding or spacing [13,14].

On reviewing Table 4, the Iraqi sample showed more prominent incisors than other studied samples. This difference could be due to prominent maxilla of the Iraqis or protrusive maxillary anterior teeth [15].

The position of maxillary central incisors

Reviewing Table 4 revealed that in all previous studies, the maxillary central incisors lie mostly between the glabella and FFA.

Iraqi sample differed greatly from others as in the majority of the cases, the maxillary central incisors located in front of glabella. This confirms findings of higher mean values

Table 4: Summary of the studies published regarding the forehead inclination and incisors position.

Studies		Andrews et al. [5]	Ajmera, et al. [7]	Adams et al. [8]	Zou et al. [10]	Abrol et al. [11]	Gidaly et al. [12]	Present study
Year		2008	2012	2013	2015	2018	2019	2019
Genders		Females	Females	Males	Both	Females	Females	Both
Country		USA	India	USA	China	India	USA	Iraq
Sample size		94	100	101	65	50	48	80
Forehead inclination (º)		13.7	12.963 ± 3.244	19.04 ± 4.58	M=21.01 ± 5.21	12.7 ± 3.797	26.7 ± 6.95	M=22.05 ± 5.965
					F= 13.63 ± 3.88			F= 16.8 ± 4.479
AP maxillary central incisor position (mm)		2.5 ± 1.9	2.348 ± 2.391	3.22 ± 3.17	M=1.38 ± 2.02	2.85 ± 1.877	8.58 ± 3.96	M=19.245 ± 14.009
					F= 0.66 ± 1.87			F= 9.308 ± 13.800
Maxillary incisor position	Anterior	3%	5%	1%	M=0%	12%	-	M=62.5%
					F=0%			F=65%
	In between	93%	87%	91%	M=86.2%	82%		M=25%
					F= 82.9%			F= 15%
	Posterior	4%	8%	8%	M=13.3%	6%		M=12.5%
					F=17.1%			F=20%

M=Males; F=Females

of the anteroposterior position of the maxillary central incisors and comes in accordance with Hernández-Alfaro et al. [6] and Singh et al. [9] although they used soft tissue nasion as a reference point.

The relationship between forehead inclination and anteroposterior position of the maxillary central incisors

The relationship between the forehead inclination and anteroposterior position of the maxillary central incisors was moderate to strong, direct highly significant (Table 3). This comes in agreement with the findings of other studies [4,5,7,8,10-12] hence the forehead is used as a useful landmark for assessing anteroposterior maxillary central incisors position.

Limitations of the study

This study did not address the inclination of the central incisors that may have a great effect on the anteroposterior position of the maxillary central incisors.

CONCLUSIONS

The conclusions that can be drawn from this study were:

Maxillary central incisors were significantly positioned more anteriorly relative to the forehead in males compared to females.

The maxillary central incisors were located anterior to the point glabella in most of the sample studied.

This study confirmed that forehead is a valuable landmark for assessing the facial profile as it correlated significantly with the anteroposterior position of the maxillary central incisors.

Treatment ambitions should comprise a harmonious anteroposterior relationship between the maxillary central incisors and the forehead for patients with a specified malocclusion.

Including a lateral smiling photograph is especially useful for the diagnostic purposes.

Further studies are needed to assess the anteroposterior maxillary central incisors position in relative to forehead in different age groups, malocclusion types, facial types, and ethnic groups (Kurds in North of Iraq and Negroids in Basra city).

Moreover, further study is recommended to compare the anteroposterior maxillary central incisors position relative to forehead after orthodontic treatment with different appliance prescriptions like Roth, MBT, Damon and Insignia also after orthodontic treatment accompanied by orthognathic surgeries.

CONFLICT OF INTEREST

The author had no conflict of interest to declare.

FINANCIAL DISCLOSURE

The author declared that this study has received no financial support.

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