Original Article

Assessment of incisor positions in Yemeni population with different skeletal patterns

ABSTRACT

Objectives: This study aimed to determine the position of the incisors and its effects on the profile, identify any possible gender differences, and compare the maxillary and mandibular anterior teeth positions between participants of short, average, and long faces.

Materials and Methods: This study comprised cephalometric radiographs of 82 participants (male: 42, female: 40) with a mean age of 21.9 ± 2.8 years. The participants were divided into three groups: short face group: Frankfort mandibular plane angle (FMA) <25°, average face group: FMA ≥25°–<30°, and long face group: FMA ≥30° . Seven linear and eight angular measurements were measured and compared between the three groups.

Results: No gender differences were found. The short face participants tend to have more proclined lower incisors, more protruded chin, more mandibular incisor display, and more retrusive upper lip position than the average and long face groups.

Conclusions: The short face participants tend to have more proclined lower incisor, more protruded chin, a more mandibular incisor display, and more retrusive upper lip position than the average face and long face groups.

Keywords: Incisor positions, profile, skeletal patterns, Yemenis

INTRODUCTION

The importance of maintaining cephalometric standards relevant to specific age and ethnic groups is well known; as one set of standards cannot be used in the diagnosis and treatment of all populations, numerous studies were conducted to determine morphological variables of the craniofacial structures of different ethnic groups.[1,2]

It is possible to evaluate the orientation of the incisor position in relation to cranial structures by their location, using linear and angular parameters to determine their inclination. The position of the upper and lower incisors with respect to their supporting bone is an essential factor for orthodontic treatment planning, evaluation of treatment progress, and determination of the outcome of treatment.[3]

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The position of the anterior maxillary and mandibular teeth is well known to affect the fullness of the lips and contribute to the facial profile attractiveness.[4] Therefore, it is necessary to evaluate the incisor position and inclinations before, during, and after orthodontic treatment for both function and aesthetics.

Downs,[5,6] Steiner,[7-9] Tweed,[10,11] and Ricketts[12-14] developed cephalometric analyses that gained widespread acceptance in clinical practice and orthodontic research so that many cephalometric goals for posttreatment positions of the incisors have been advocated.[15]

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The current study was designed to determine the position of the incisors and its effects on the profile, identify any possible gender differences, and compare maxillary and mandibular anterior teeth positions between the short, average, and long faces.

MATERIALS AND METHODS

The current study had been approved by the Research Ethics Committee, College of Dentistry, Taibah University. The material of this study comprised cephalometric radiographs of 82 participants (male: 42, female: 40) with a mean age of 21.9 ± 2.8 years recruited from university students at Ibb University and from the author private dental clinic in Ibb city, Yemen. The sampling technique used is accidental sampling. The inclusion criteria were Yemeni citizen with Yemeni ancestry, Class I molar and canine relationships, and absence of crowding; all cephalometric radiographs were of good quality, and no any restorations involved in the incisal edges of the upper and lower central incisors. Participants with previous orthodontic treatment, prosthodontic treatments, and craniofacial deformities or trauma were excluded from this study.

The participants were divided into three different groups based on the Frankfort mandibular plane angle (FMA).

- Group 1 – Short face group:<25°
- Group 2 – Average face group: ≥25°–<30°
- Group 3 – Long face group: ≥30°.

Cephalometric analysis

On the lateral cephalograms, seven linear and eight angular measurements from Steiner,[7-9] Tweed,[11] and Ricketts[12-14] analyses were adopted [Figures 1-4]. All cephalograms were traced and measured by hand on 0.003-mm matte acetate paper (Yunipa, Kimoto, Tokyo, Japan). All tracings and measurements were carried out by the same researcher.

Methodological error

Thirty cephalograms were randomly selected and measured twice with the interval of 1 month to assess the method's error, and the results were compared using a paired *t*-test. No significant differences have been found.

Statistical methods

The mean and standard deviations for the total sample and comparisons between male and female participants were done using Student's *t*-test. Comparison between the short, average, and long face groups was done using one-way analysis of variance followed by Bonferroni analysis. All statistical analyses were done using SPSS software (version 20, SPSS, IBM Corporation., USA, New York). Our level of significance was set at $P < 0.05$.

RESULTS

The mean and standard deviations of the linear and angular measurements for the total sample and comparison between male and female groups are shown in Table 1. No statistically significant differences between sexes were found.

Table 2 exhibits a comparison of linear and angular measurements between the short, average, and long face groups. Frankfort mandibular incisor angle showed significant gradual decrease among the groups in which the short face group had the highest incisor inclination in relation to Frankfort plane (63.2° ± 8.4°) followed by the average (61.8° ± 5.3°) and long face groups (58.1° ± 6.2°). Comparison between groups showed that the short face group had more significant incisor inclination in relation to Frankfort plane than the long face group ($P < 0.05$). On the other hand, the short face group demonstrated significant larger incisor-mandibular plane angle (IMPA) than those of the average ($P < 0.05$) and long face groups ($P < 0.01$), indicating that the short face participants tend to have more proclined and protruded lower incisor than those of the average and long face groups.

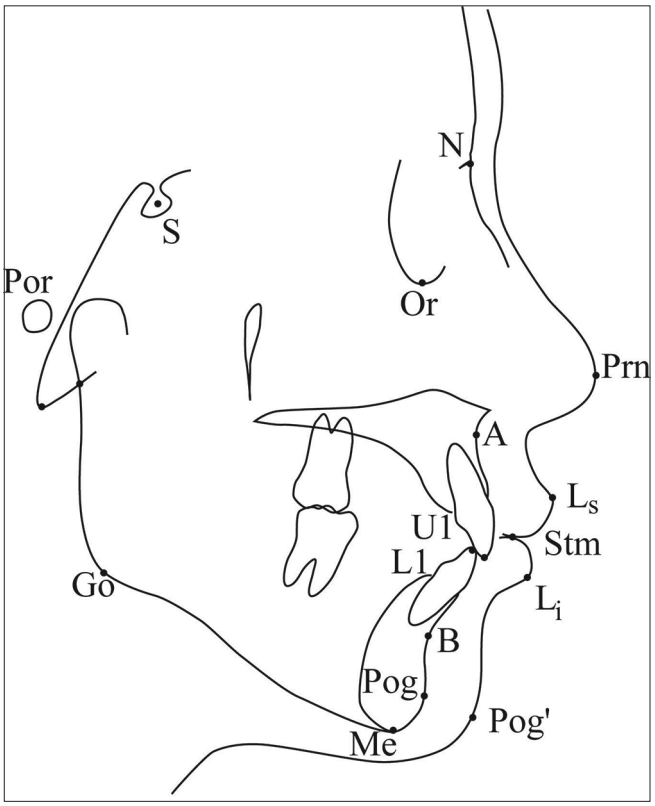

Figure 1: Landmarks. Sella (S), porion (Por), nasion (Na), orbitale (Or), gonion (Go), menton (Me), pogonion (Pog), supramentale (B), lower incisor (L1), upper incisor (U1), subspinale (A), stomion (Stm), labrale inferius (Li), labrale superius (Ls), pronasale (Prn), soft-tissue pogonion (Pog')

The bony pogonion (pog) toNB line was significantly more protruded in the short face group than the average and long face groups ($P < 0.01$), indicating a more protruded chin in the short face group compared with the other two groups. The vertical position of the upper incisor related to the occlusal plane (Mx-1) was located above the occlusal plane in all groups (0.6, 1.6, and 0.9 mm, in short, average, and long face groups, respectively). The only significant difference was found between the short and average face groups ($P < 0.05$). Furthermore, the vertical position of a mandibular incisor in relation to the occlusal plane (Md-1) was found to be located above the occlusal plane in all groups (3.1, 1.8, and 2.1 mm, in short, average, and long face groups, respectively). The short face group showed more significant mandibular incisor extrusion than the average face group ($P < 0.001$) and the long face group ($P < 0.01$).

As for lips' positions, the upper lip was located at −5.6, −3.2, and −3.8 mm before the esthetic line in the short, average, and long face groups, respectively. The short face group was found to have more retrusive upper lip position than the average face group ($P < 0.01$) and the long face group ($P < 0.05$).

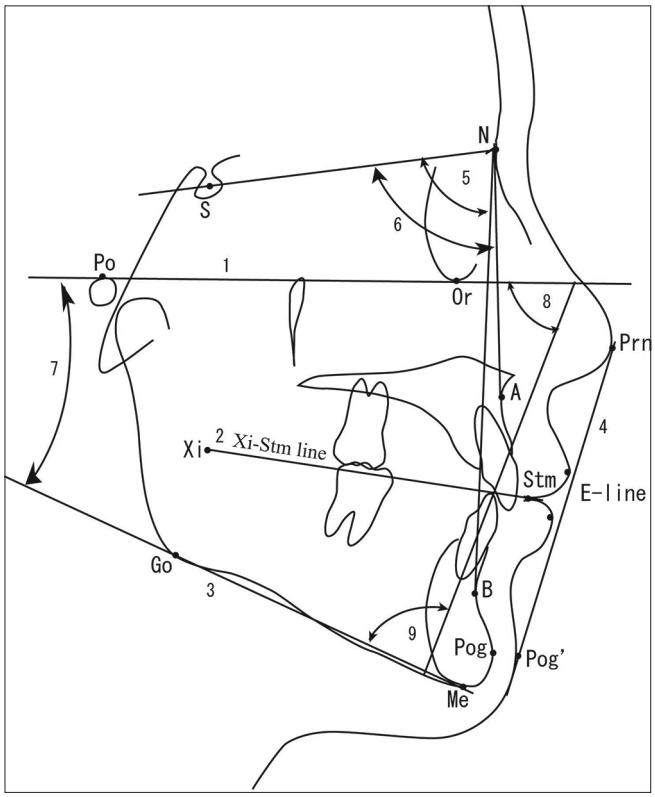

Figure 2: Reference planes and angular measurements. (1) Frankfort plane: line extended from porion to orbitale. (2) Xi-stomion plane: a line extended from Xi point to stomion point. (3) Mandibular plane: a line extended from menton (Me) to gonion (Go). (4) Esthetic Line (E-line): line extended from the tip of the nose (Prn) to the soft-tissue pogonion (pog'). (5) SNA Angle. (6) SNB Angle. (7) Frankfort mandibular plane angle. (8) Frankfort mandibular incisor angle. (9) Incisor-mandibular plane angle

Lower lip position was located at −2.6, −0.8, and −0.9 mm in short, average, and long face groups, respectively. The short face group showed significantly lower lip retrusion compared to the average face group ($P < 0.05$).

DISCUSSION

Regarding the vertical reference plane, Kambara *et al*.[16] reported that such clinical problems might arise when the standard plane is changed or altered by orthodontic treatment. Following the recommendation of Kambara *et al*.,[16] we used the line connecting Xi point and stomion as a standard plane.[16-18] It was reported that Xi point changes little after completion of growth, and the stomion point seems to be a stable standard point.[15,19]

In the present study, no significant differences between male and female groups were detected in all of the measurements. This is consistent with that reported by Al-Jasser[20] but disagrees with the findings of Miyajima *et al*.[21] who reported significant gender variation among other ethnic groups.

This study revealed that the short face group had a significantly larger IMPA than those of the average ($P < 0.05$) and long face groups ($P < 0.01$), indicating that the short face participants tend to have more proclined and protruded lower incisor than those of the average and long face groups.

Table 1: Average age and angular measurements for the total sample and for males and females

Variable/unit	Mean±SD			*P*
	Total sample (*n*=82)	Male (*n*=42)	Female (*n*=40)	
Age (years)	21.90±2.83	21.98±2.89	21.55±3.21	0.53
SNA/°	80.73±3.06	80.86±3.42	80.60±2.68	0.71
SNB/°	77.67±2.95	77.85±3.21	77.49±2.69	0.59
ANB/°	3.06±1.74	3.01±1.78	3.11±1.72	0.80
FMIA/°	61.08±7.01	61.40±7.35	60.74±6.72	0.67
FMA/°	26.43±5.37	25.79±6.31	27.11±4.14	0.27
IMPA/°	93.00±6.18	93.49±6.86	92.49±5.42	0.47
Ui-NA (mm)	6.18±2.24	6.54±1.93	6.35±2.47	0.70
Ui-NA°	22.58±6.26	25.02±5.85	25.84±6.72	0.56
LI-NB (mm)	6.45±2.20	6.54±1.93	6.35±2.47	0.32
LI-NB°	25.42±6.27	0.90±1.40	1.15±1.37	0.42
Pogonion-NB (mm)	1.77±2.07	1.99±2.12	1.54±2.01	0.22
Mx-1 (mm)	1.02±1.38	6.20±2.36	6.15±2.13	0.91
Md-1 (mm)	2.33±1.28	22.73±6.16	22.43±6.44	0.82
UL-E-line (mm)	−4.21±2.96	−4.50±3.06	−3.91±2.86	0.39
LL-E-line (mm)	−1.41±2.79	−1.29±2.89	−1.54±2.72	0.68
Li-NB/Pogonion-NB	3.60±1.00	3.20±0.91	4.10±1.20	0.58

SD: Standard deviation

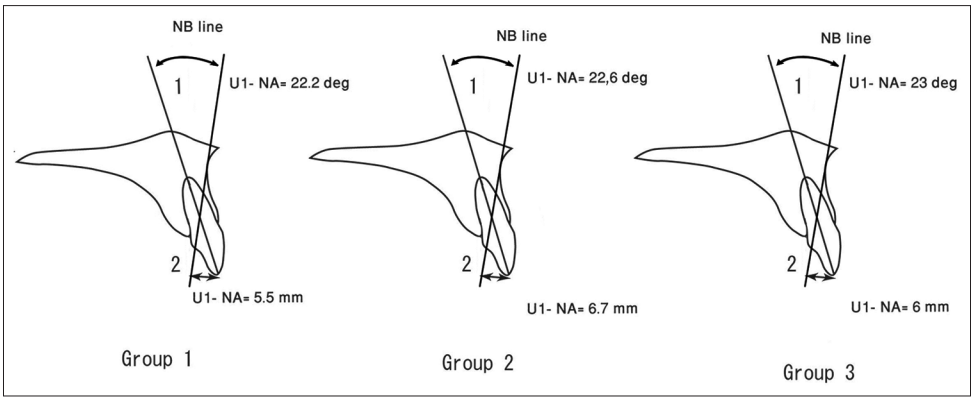

Figure 3: Average values of the maxillary incisor inclination and protrusion for the three groups. (1) U1/NA (deg): the angle formed between the long axis of the upper central incisor and the NA line. (2) U1-NA (mm): the linear perpendicular distance from the most anterior point of the crown of the maxillary incisor to line the NA line

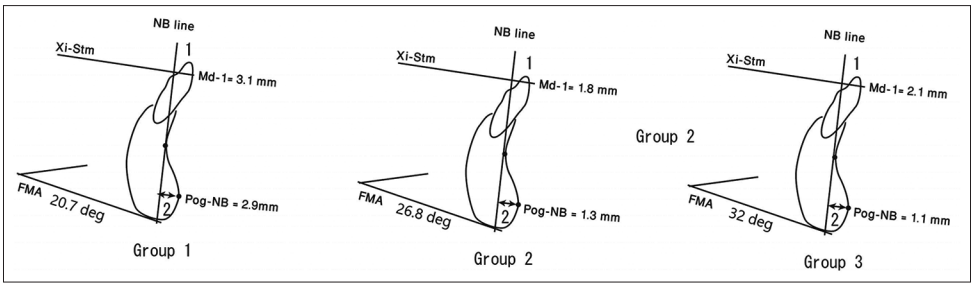

Figure 4: Average values of Frankfort mandibular plane angle, chin prominence (Pog-NB), and the mandibular incisor to the occlusal plane (Md-1) for the three groups. (1) L1/NB (deg): The angle formed between the long axis of the lower central incisor and NB line. (2) L1-NB (mm): the linear perpendicular distance from the most anterior point of the crown of the mandibular incisor NB line

Table 2: Comparison of linear and angular measurements between short, average, and long face groups

Variable/unit	Mean±SD			$P^{\dagger}$	Bonferroni
	Group 1 (n=28)	Group 2 (n=27)	Group 3 (n=27)		
SNA/°	81.0±3.5	80.3±3.3	80.8±2.2	0.69	
SNB/°	78.1±3.4	77.5±3.3	77.5±2.0	0.68	
ANB/°	3.0±2.1	2.9±1.6	3.4±1.4	0.56	
FMA/°	20.7±3.7	26.8±1.2	32.0±2.6	0.0001	(2>1)***, (3>1)***, (3>2)***
FMIA/°	63.2±8.4	61.8±5.3	58.1±6.2	0.02	(1>3)*
IMPA/°	96.1±6.5	91.7±5.5	91.1±5.3	0.003	(1>2)*, (1>3)**
Ui-NA (mm)	5.8±2.2	6.7±2.5	6.0±2.0	0.29	
Ui-NA°	22.2±6.4	22.6±6.8	23.0±5.7	0.90	
LI-NB (mm)	5.7±2.2	6.9±2.4	6.7±1.8	0.10	
LI-NB°	24.3±6.9	25.7±5.9	26.3±6.1	0.49	
Pogonion-NB (mm)	2.9±2.2	1.3±1.8	1.1±1.6	0.0007	(1>2)**, (1>3)**
Mx-1 (mm)	0.6±1.4	1.6±1.6	0.9±0.9	0.02	(2>1)*
Md-1 (mm)	3.1±1.2	1.8±1.3	2.1±1.0	0.0004	(1>2)***, (1>3)**
UL-E-line (mm)	−5.6±2.6	−3.2±3.5	−3.8±2.1	0.01	(1>2)**, (1>3)*
LL-E-line (mm)	−2.6±2.9	−0.8±2.7	−0.9±2.5	0.03	(1>2)*
Holdaway ratio	1.9±1.0	5.3±1.3	6.0±1.1	0.07	

†Refers to one-way ANOVA test, *P<0.05, **P<0.01, ***P<0.001. n: Number of participants, Group 1: Short face, Group 2: Average face, Group 3: Long face, SD: Standard deviation, ANOVA: Analysis of variance

Chin position

The distance from pog to NB line was significantly larger in the short face group than the average and long face groups. This indicates that the mandibular symphysis and the bony chin become more retrusive as FMA increases. The more protrusive chin in the short face group and more retrusive chin in the long face group are a reflection of the clockwise or counterclockwise rotation of the mandible in

the two divergent groups. Our present finding is basically in agreement with that reported by Xiao *et al*.[22] who reported that the low-angle group tended to have a more protrusive chin than the normal group, while a high-angle group showed a more retrusive chin. This finding also supports the findings reported by Kambara *et al*.[19] who conducted a study on a Japanese sample and concluded that a positive distance from pog to NB line is essential for a good profile. They also highlighted that when this distance is >4 mm, the participants appear to have Class III relationship and will not have a well-balanced profile. In addition, our current finding is in agreement with Haskell[23] who measured the amount of protruding chin area in participants with open and normal or deep bites as a percentage of total mandibular alveolar and basal area. He found that open bite patients had a smaller chin surface, related to their total alveolar mandibular and basal area, and concluded that the base of the symphysis might be narrowed in open bite patients.

Maxillary teeth position

Based on the findings of this study, the anterior maxillary teeth position (Mx-1) was found to be located above the occlusal plane in all groups. The vertical height of the maxillary incisors in the average face group was significantly higher than the short face group. Previous studies on participants with vertical skeletal dysplasia showed inconsistent results.[24]

Opdebeeck *et al*.[24] selected samples according to overbite and reported that the vertical height of the maxillary incisors in open bite participants was significantly greater than the control group. Kambara *et al*.[16] investigated the vertical incisal position in Japanese participants and found that the maxillary anterior teeth were located below the occlusal plane in all groups. They concluded that the position of the maxillary anterior teeth significantly affects not only the upper lip position but also the lower lip and that the vertical position of the anterior maxillary teeth provides an adequate overbite and overjet to the anterior mandibular teeth, resulting in a favorable interincisal angle. The present study supports the finding of Kambara *et al*.[16] since the vertical position of maxillary anterior teeth in Yemenis was located in an appropriate vertical position so that their location would positively affect the position of the upper and lower lips.

Mandibular teeth position

The vertical position in relation to the occlusal plane (Md-1) was found to be located above the occlusal plane by 3.1 mm in the short face group compared to the average and long face groups of 1.8 and 2.1 mm, respectively. This indicates that the vertical position of the mandibular anterior tooth decreases when FMA increases.

Kambara *et al*.[16] reported that the mandibular anterior teeth are inclined toward the labial as they move downward, the profile is deteriorated as the teeth move away from the line of Xi-stomion, and improve as they approach this line. This is actually what was observed in our present study in which the mean values of the mandibular incisor' inclinations in the short face group (L1-NB: 24.3°) were generally but not significantly are less inclined to the labial than the average (L1-NB: 25.7°) and long face (L1-NB: 26.3°) groups. Therefore, this change in the inclination of the mandibular anterior teeth – as presented in the short face group – will have an effect on its vertical height compared to the other two groups. This slight decrease in the protrusion and inclination of the mandibular central incisor will result in a slight effect on its vertical height.

Lips' positions

The present study revealed that the short face group displayed more retrusive upper and lower lips than the average and long face groups, indicating that both the upper and lower lips become in a more protrusive position as FMA increases. This is inconsistent with the study of Xiao *et al*.[22] who reported that the low-angle group had a more protrusive lower lip to the esthetic line than the high-angle group.

In spite of the limitation of this study of using small sample size and only Class I malocclusion, some obvious variations between groups included in this study are possibly helpful during the diagnosis and treatment planning. However, further research using a larger sample size with different types of malocclusions is recommended.

CONCLUSIONS

The short face participants tend to have more proclined lower incisor, more protruded chin, a more mandibular incisor display, and more retrusive upper lip position than the average face and long face groups.

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Conflicts of interest

There are no conflicts of interest.

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