Cephalometric norms among a sample of Yamani adults

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ABSTRACT

Background: Cephalometric norms are decisive in diagnosis and treatment planning which differ in morphological feature among different ethnic and racial group. The aim of this study was to establish the cephalometric standards for skeletal and dental relationships for Yemeni population.

Material and methods: One hundred ninety-four Yemeni university students (105 females and 89 males) aged 18–25 years, were selected from dental students in Sana’a. All participants had Class I occlusion with normal growth, facial symmetry, and no previous orthodontic, orthopedic or maxillofacial surgery treatment. A Lateral cephalometric X-ray film was taken from each selected students. Each film was traced and analyzed according to Harvold’s Cephalometric Analysis.

Results: Statistical significant differences were reported among genders in the skeletal sagittal relations; SNB, ANB, SNPG and SNBa angles, whereas, SNA angle showed no significant differences. The skeletal vertical inclination also showed statistical significant differences in ML-NL, NL-NSL, ML-NSL and Gn-tgo-Ar variables.

Yemeni males had statistically significant higher upper and lower facial height than female and no significant difference between genders in the dental relationship variable except for the I-NB line which is statistically higher in female.

Conclusion: The results of Yemeni cephalometric features showed ethnic differences in skeletal and dento alveolar relationship, sympathetic of the dento facial pattern of each population will ensure better results of treatment in ascertain optimal facial harmony.

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1. Introduction

Cephalometric norms had been used to determine the location and the severity of any existing dento facial discrepancies and subsequently to evaluate the changes that accompany orthodontic treatment. If the normal pattern and its range of variation could be described, then the abnormal one could be judged by comparison [1,2].

Normal cephalometric features had been established among different races and populations worldwide. It is essential to compare a patient’s cephalometric findings with the norms for his or her ethnic values, while considering his or her treatment goals and needs to provide a better and accurate
2. Materials and methods

This study had been carried out in Sana’a at three faculties of dentistry. A letter of ethical clearance to conduct the study was obtained from the Dean Faculty of Dentistry, Sana’a University to the Al-Salam and Science and Technology University. In addition, a letter of consent was obtained from all participants after explaining the nature and purpose of the research.

Primary screening was done for all dental students in the three universities 1585 students’ age 18 to 25 years old. First the aims of the study were explained in the lecture rooms prior to the clinical examination. Students who fulfill the inclusion criteria; normal occlusion with balanced facial profile, full permanent dentition (except for the third molars), Class I molar, incisor and canine relationship, normal overjet and overbite, normal transversal occlusion, well aligned or crowded teeth not more than 2 mm and no previous history of orthodontic treatment were registered. Later on, the selected students were called for X-ray taken according a schedule made with the X-ray center. On the day of X-ray taking, each participant had signed the consent form and worn the Lead apron for protection. The radiographic unit was Pax-3D. Each cephalometric film was placed with the profile to the right on X-ray illuminator box. The tracings were performed on standard acetate paper in a dark room using illuminator box. All radiographs were traced by the main investigator manually; Hard and soft tissue were located on the tracing paper using 0.5 sharp pencil (Figs. 1 and 2).

Cephalometric reference points (Fig. 1):

1. N - Nasion: The anterior point of the intersection between the nasal and frontal bones.
2. S - Sella: The midpoint of the sella turcica cavity.
3. Ba - Basion: The lowest point on the anterior margin of the foramen magnum, at the base of the clivus.
4. Sp - anterior nasal spine: The tip of the anterior nasal spine
5. Point A: The innermost point on the contour of the premaxilla between the anterior nasal spine and the incisor tooth (referred to as subspinale or subnasale).
6. Pm - Pterygomaxillary: The intersection of the posterior contour of the maxilla with the contour of the soft and hard palate
7. is - incision superius: The midpoint of the incisive edge of the mean maxillary central incisor.

Fig. 1 - Illustrate the hard tissue cephalometric landmarks.

8. isa - apical point of the maxillary incisor: The most apical point of the mean maxillary central incisor.
9. Point B: The innermost point on the contour of the mandible between the incisor tooth and the bony chin (referred to as supramentale).
10. Pg - Pogonion: The most anterior point on the contour of the chin.
12. ii - incision inferius: The midpoint of the incisive edge of the mean mandibular central incisor.

Fig. 2 - Illustrate the cephalometric lines and angles.
13. iia - apical point of the mandibular incisor: This is the most apical point of the mean mandibular central incisor.
14. Ar - Articulare: The point of intersection between the shadow of the zygomatic arch and the posterior border of the mandibular ramus.
15. tgo - Gonion-tangent point: The point of intersection between mandibular line and the ramus line.

Cephalometric reference line and angle (Fig. 2):

1. NSL - Nasion-sella line: It represents the cranial base. It is the main reference line which connects the point sella to the point nasion.
2. NL - Nasal line: This is the connection between the pterygomaxillare (Pm) and the anterior nasal spine (Sp). It is used as the reference line of the nasal cavity and the maxillary base.
3. ML - Mandibular line: The tangent from gnathion (Gn) to the inferior border of the angle of the mandible. It is used as a reference line for the body of the mandible.
4. NAL - Nasion-maxillary line: It is the line between nasion (N) and point A (A) and used as the reference line for the position of the maxillary incisor.
5. NBL - Nasion-mandibular line: It is the line between nasion (N) and point B (B) and used as the reference line for the position of the mandibular incisors. It is also used for measuring the chin prominence.
6. NP-g - Nasion-pogonion line: It is the line between nasion (N) and pogonion (Pg) and used to describe the sagittal position of the chin and a reference line for the position of the lower incisors.
7. Ramus line: It is the line connecting the point articulare (Ar) and the gonion-tangent point (tgo).
8. Clivus line: It is the line connecting points sella (S) and basion (Ba) and representing the posterior cranial base (saddle angle).
9. Nasion-gnathion line: It serves as the reference line for evaluating the index of the anterior facial height and connects point nasion (N) and point gnathion (Gn).
10. B-Pog line: It is the tangent of the chin prominence, connecting points B (B) and pogonion (Pg) and aids in the evaluation of the Norderval angle (B-pog-ML).
11. I: The line passing through the incisal point (is) and the apical point (iia) of the mean maxillary central incisor representing the long axis of the maxillary central incisor.
12. II: The line passing through the incisal point (iia) and the apical point (iia) of the mean mandibular central incisor representing the long axis of the mandibular central incisor.

2.1 The Skeletal and dental cephalometric measurements

Nineteen linear and angular measurements were obtained from the cephalometric tracings to evaluate the Skeletal and dental pattern:

Antero–posterior:
1. SNA: This angle evaluates the anterior–posterior position of the maxilla to the anterior cranial base.
2. SNB: This angle evaluates the anterior–posterior position of the mandible to the anterior cranial base.
3. ANB: It is the difference between the SNA and SNB. It indicates the discrepancy between the maxilla and mandible.
4. SNPG: It evaluates the anterior–posterior position of the chin to the anterior cranial base.
5. NSK: It expresses the cranial base angle.

The vertical inclination:
1. ML-NL: It expresses the degree of vertical inclination of the mandible in relation to the maxilla.
2. NL-NSL: It expresses the degree of vertical inclination of the maxilla in relation to the anterior base of the skull.
3. ML-NSL: It expresses the vertical inclination of the mandible in relation to the anterior base of the skull.
4. Gn-tgo-Ad: It expresses the vertical form of mandible in relation to the body and the ramus.

Face height:
1. N-Sp’ mm: It represents the upper facial height (UFH).
2. Sp’-Gn mm: It represents the lower facial height (LFH).
3. N-Sp’/Sp’-Gn × 100%: The facial index expresses the relationship between the upper and lower facial heights of the total anterior facial height.

The Chin prominence:
1. Pg-NB mm: It describes the size of the bony chin prominence.
2. Norderval (N angle): It expresses the prominence of the bony chin in relation to the mandibular plane, ML. It measures the inclination of the symphysis which is an indicator of mandibular rotation.

The dental variables:
1. IS - I angle (interincisal angle): Describes the position of the upper and lower incisors.
2. IA: The angular relationship of the upper central incisor to the NA line indicates the anterior–posterior relationship of the upper incisor to the maxillary base.
3. INB: The angular relationship of the lower central incisor to the NB line indicating the anterior–posterior relationship of the lower incisor to the mandibular base.
4. INA mm: It indicates the linear anterior–posterior relationship of the upper central incisor edge to the NA line.
5. INB mm: It indicates the linear anterior–posterior relationship of the lower central incisor edge to the NB line.

Statistical analysis:
The data were collected, summarized, cleaned and coded; then entered to the Statistical Package for Social Sciences (SPSS) program (version 20). For each variable, the arithmetic mean, standard deviation, minimum and maximum values, and descriptive statistic were done. An independent sample t-test was used to compare male and female. Chi square test was used F-value of less than .05 was considered as significant.
3. Results

The total number of the dental students participated in this study was 194 students (105 females and 89 males) aged 18–25 years.

Tables 1–3 showed the mean, maximum, minimum, standard deviation and P-value of cephalometric features of both gender. Tables 4–6 showed descriptive statistics for the dento facial patterns of Yemeni Adults in general.

In the sagittal relationship as seen in Table 4, statistical significant differences were found in SNB, ANB, SNPg and SNBa angles while SNA showed a non significant difference between male and female. SNB and SNPg were higher in male then female while ANB and SNBa were higher in female.

Moreover, the vertical inclination showed statistical significant differences in all variables used in the study (ML-NL, NL-NL, ML-NL and Gn-tgo-Ar) in which female had higher values then male (Table 5).

Concerning the upper and lower facial height, it is noticed that, male had higher value then female. While the facial index showed a non significant difference (Tables 7 and 8).

The chin prominence showed a significant difference in Pg-NB line in which male had higher value then female, while Nordeval angle showed a non significant difference.

Dentally, there is no significant difference between the two genders except the angle formed by the lower incisor and NB line which is statistically higher in female the male as seen in Table 6.

4. Discussion

This study had been carried for a sample of Yemeni adult population who had Class I skeletal and dental relationships and well balanced faces. The objectives were to evaluate the cephalometric features of Yemeni population and establish the norms in which orthodontists could manage diagnosis and treatment of Yemeni patients according to their norms and not depend on other ethnic norms. The data were separated according to sex to obtain more accurate, specific and useful cephalometric normative values. Male and female variable showed significant different in most of the variables used in the study.

Table 1 – Distribution of skeletal anteroposterior cephalometric measurement among gender.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male (no 89)</th>
<th></th>
<th></th>
<th></th>
<th>Female (no 105)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Max.</td>
<td>Min.</td>
<td>S.D.</td>
<td>Mean</td>
<td>Max.</td>
<td>Min.</td>
<td>S.D.</td>
</tr>
<tr>
<td>SNA°</td>
<td>80.9</td>
<td>86.5</td>
<td>72</td>
<td>2.5</td>
<td>80.819</td>
<td>86</td>
<td>75</td>
<td>2.58</td>
</tr>
<tr>
<td>SNB°</td>
<td>78.3</td>
<td>85.5</td>
<td>70.5</td>
<td>2.5</td>
<td>77.53</td>
<td>82</td>
<td>72</td>
<td>2.45</td>
</tr>
<tr>
<td>ANB°</td>
<td>2.6</td>
<td>6</td>
<td>5</td>
<td>1.17</td>
<td>3.28</td>
<td>7</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>SNPg</td>
<td>79.2</td>
<td>85</td>
<td>72</td>
<td>2.6</td>
<td>78.25</td>
<td>83</td>
<td>72.5</td>
<td>2.53</td>
</tr>
<tr>
<td>SNBa</td>
<td>130.7</td>
<td>151</td>
<td>117</td>
<td>5.9</td>
<td>132.6</td>
<td>146</td>
<td>119</td>
<td>6.1</td>
</tr>
</tbody>
</table>

* p < .05 is significant.

Table 2 – Skeletal vertical cephalometric measurements among gender.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male (no 89)</th>
<th></th>
<th></th>
<th></th>
<th>Female (no 105)</th>
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<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Max.</td>
<td>Min.</td>
<td>S.D.</td>
<td>Mean</td>
<td>Max.</td>
<td>Min.</td>
<td>S.D.</td>
</tr>
<tr>
<td>ML-NL°</td>
<td>20.1</td>
<td>35</td>
<td>9</td>
<td>5.6</td>
<td>22.4</td>
<td>32</td>
<td>9</td>
<td>5.2</td>
</tr>
<tr>
<td>NL-NL°</td>
<td>8.9</td>
<td>21</td>
<td>2</td>
<td>3.7</td>
<td>10.7</td>
<td>22</td>
<td>3</td>
<td>3.6</td>
</tr>
<tr>
<td>ML-NL°</td>
<td>29</td>
<td>41</td>
<td>20</td>
<td>5.8</td>
<td>33.1</td>
<td>43</td>
<td>21</td>
<td>4.5</td>
</tr>
<tr>
<td>Gn-tgo-Aro</td>
<td>117</td>
<td>137</td>
<td>100</td>
<td>7.8</td>
<td>121.2</td>
<td>134</td>
<td>108</td>
<td>6.3</td>
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<tr>
<td>Face height</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N-Sp mm</td>
<td>63.58</td>
<td>75.9</td>
<td>51.5</td>
<td>5.7</td>
<td>57.1</td>
<td>70.7</td>
<td>48.1</td>
<td>5.5</td>
</tr>
<tr>
<td>Sp-Gn mm</td>
<td>77.9</td>
<td>99.6</td>
<td>63</td>
<td>8.3</td>
<td>69.4</td>
<td>86.1</td>
<td>55.6</td>
<td>7.3</td>
</tr>
<tr>
<td>Lower facial height%</td>
<td>55.1%</td>
<td>56.8</td>
<td>55.0</td>
<td>59.3</td>
<td>54.8%</td>
<td>54.9</td>
<td>53.6</td>
<td>57.0</td>
</tr>
<tr>
<td>N-Sp/Sp-Gn &gt; 100</td>
<td>81.92</td>
<td>92</td>
<td>68</td>
<td>6.55</td>
<td>82.62</td>
<td>103</td>
<td>69</td>
<td>7.12</td>
</tr>
</tbody>
</table>

* p < .05 is significant.

Table 3 – Chin prominence measurements among gender.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male (no 89)</th>
<th></th>
<th></th>
<th></th>
<th>Female (no 105)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Max.</td>
<td>Min.</td>
<td>S.D.</td>
<td>Mean</td>
<td>Max.</td>
<td>Min.</td>
<td>S.D.</td>
</tr>
<tr>
<td>Pg-NB mm</td>
<td>2.4</td>
<td>5.77</td>
<td>0</td>
<td>1.2</td>
<td>1.7</td>
<td>5.7</td>
<td>0</td>
<td>1.2</td>
</tr>
<tr>
<td>Angle°</td>
<td>63</td>
<td>77</td>
<td>55</td>
<td>4.9</td>
<td>61.7</td>
<td>74</td>
<td>53</td>
<td>5</td>
</tr>
</tbody>
</table>

* p < .05 is significant.

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The study sample was selected from three universities which in turn involve subjects from all cities of Yemen. A relatively large sample consisted of 105 Female and 89 male were involved in the study (18–25 years old).

4.1. Skeletal relationships

4.1.1. Anteroposterior

In the current study all the skeletal variables showed significant differences between genders except for SNA reading where the female had higher value which inconsistence to the measurement of SNA value in Saudi population [11] and Lebanese [20] Norms. In contrast, Emirates [15], Sudanese [21] and German [22] showed higher values. The SNA Variable was in line with the finding obtained by Hamdan [19] among Jordan population which is higher than that found among Saudi [11] and Lebanese [20] and lower than that of Emirates [15] and Sudanese [21].

The SNPg showed a similar result to that of Egyptian [2] and different than other counties [11,21,22]. The SNA, SNB and SNPg showed higher value in male than female while ANB and SNBα were lower in male. However, in other countries the opposite is true in some of these variables [13,16,21]. This indicates that the Yemeni adults had different skeletal values compared to other results obtained among various populations.

4.1.2. Vertical inclination

In the present study, Male had lower values than female in the angles ML-NL, NL-NSL and ML-NSL which in agreement with the results obtained among Sudanese students [21]. In contrast the studies among the Emirates and Kuwait population revealed higher values among male [15,16].

4.1.3. Face height

In the current study, Yemeni male had higher statistical significance and lower facial height (N-Sp’ and Sp’-Gn) than female which in accordance with the results obtained by Abu-Tayyem et al. [15] Ibrahim [21] and Naranjilla [22] in Emirates, Sudan and Filipinas respectively. However, the opposite was recorded in Egypt and German [22,23].

The upper facial height (N-Sp’) in this study was in line to the finding among populations in Emirates [15] whereas it a little high than the results obtained in the Egyptian and Sudanese studies [2,21]. Moreover, The lower facial height (Sp’-Gn) in this study was much less than that obtained in Emirates [15]. However, it little more than the finding among the Sudanese [21].
4.1.4. Chin prominence
The present study showed no significant difference among Yemeni genders in relation to Nordeval angle which in line with Sudanese results but little higher than German results [21,22], whereas a highly significant difference were observed in relation to Pg-NB. Concerning genders the Pg-NB showed higher values in Yemeni male and female than Egyptian [2], Sudanese [21], and Filipinos [22]. However it found to be less than what reported among German population [22].

4.1.5. Dental variables
In this study, females tended to have greater bimaxillary proclination of the incisors than males, which is revealed by the less value of the interincisal angle although it is not statistically significant. The same finding was reported in previous studies; Saudia [11] Kuwait [16], and Sudan [21]. However, the opposite was found by Bishara [2] and Abu-Tayyem [15] in Egypt and Emirates [15]. In general, this angle was found to be of more value among Yemeni adults than that of Emirate [15], Saudis [11], Kuwait [16], and Sudan [21] but less than the finding in German [22].

5. Conclusion

- The skeletal sagittal relations and vertical inclination were significantly different among Yemeni gender.
- Yemenis had distinct cephalometric features, for which specific norms should be used as a reference in treating orthodontic patients.
- The present results when compared with the findings among different population; Arabs, African or Europeans, the Yemeni Sample showed different measurements for the different variables which might resemble some population in few of the variables but different in other.

Conflict of interest

We declare that there is no conflict of interest in this paper

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Further Reading