Original Article

Cephalometric Norms for Saudi Adults Living in the Western Region of Saudi Arabia

Ali H. Hassan[a]

Abstract: European-American norms are still used in the orthodontic treatment of Saudi patients, despite the different ethnic backgrounds of Saudis. The aims of this study were to evaluate the cephalometric features of a Saudi population and to establish cephalometric norms for Saudis living in the western region of Saudi Arabia. Seventy lateral cephalometric radiographs of Saudis (32 females and 38 males; aged 18–28 years) with acceptable profiles and Class I dental relationships were traced and analyzed. The mean value, standard deviation, and range of 16 angular and linear variables were calculated. The resulting norms for Saudis were compared with European-American norms using an independent *t*-test. Male and female groups were also compared using the *t*-test. Saudis tend to have an increased ANB angle because of retrognathic mandibles and bimaxillary protrusion as compared with European-Americans. Males tend to have more prognathic mandibles than females as indicated by the statistically significant increase in facial angle ($P < .05$) and SNB angle ($P < .05$). Although the anterior lower face height was similar in males and females, males tend to have a steeper mandibular plane angle when related to the anterior cranial base than females ($P < .05$). Saudis have distinct cephalometric features, which should be used as a reference in treating Saudi orthodontic patients. (*Angle Orthod* 2006;76:109–113.)

Key Words: Saudi Norms; Cephalometric; Norms

INTRODUCTION

Orthodontic treatment is best when the facial and cephalometric characteristics of the ethnic background of patients are considered. The orthodontic literature contains many studies involving cephalometric and profile standards of European-American, African-American, Japanese, and Chinese populations[1–17] but little for Arabs and Saudis in specific.[18–24]

Bishara et al[19] established cephalometric standards for Egyptian adolescent boys and girls and compared them with a matched Iowa adolescent sample. There was a great similarity in the overall facial morphology between the Egyptian and Iowan populations. Hamdan and Rock[21] evaluated the cephalometric features of a Jordanian population as compared with the Eastman standards and found different skeletal and dental cephalometric features for the Jordanians. Shalhoub et al[22] evaluated lateral cephalometric radiographs of 48 adult Saudis with normal facial proportions, compared them with a North American sample, and established a set of cephalometric norms for Saudi adults living in Riyadh. Sarhan and Nashashibi[23] compared cephalometric radiographs of Saudi boys (10–14 years old) with a similar British sample. They found slightly more prognathic Saudi faces, more protruded incisors and lower gonial and saddle angles as compared with the British sample. Al-Jasser[24] described the craniofacial characteristics of 87 Saudi students with acceptable profiles and occlusions and compared them with Steiner's European-American standards. It was also concluded that Saudis have different craniofacial features when compared with Steiner norms.

Unfortunately, all the previously mentioned studies were performed in the central region of Saudi Arabia and do not represent the multiracial background of the Saudis. In addition, no single study has been performed in the other regions of Saudi Arabia. The western region of Saudi Arabia, also known as Hijaz, is unique in its ethnic diversity that is mainly because of the Hajj, where Muslims from all over the world come to attend this yearly Islamic pilgrimage in Makkah. Saudis who live in this region are of mixed ethnic origin

[a] Assistant Professor, Department of Preventive Dental Sciences, Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia.

Corresponding author: Ali H. Hassan, BDS, PhD, Department of Preventive Dental Sciences, Faculty of Dentistry, King Abdulaziz University, PO Box 122423, Jeddah 21332, Saudi Arabia (e-mail: alireserach@gawab.com).

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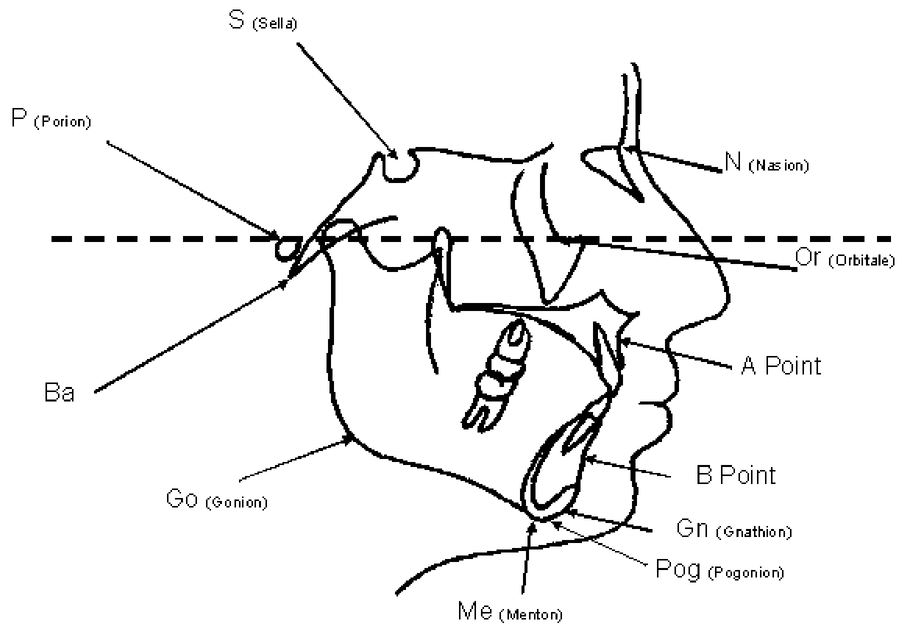

FIGURE 1. The different cephalometric landmarks used.

TABLE 1. Different Linear and Angular Measurements Used

N-PG-FH	Intersection between N-PG and Frankfort horizontal (FH) plane
SN-FH	Angle between SN plane and FH plane
SNA	Maxillary apical base relationship to anterior cranial base
SNB	Mandibular apical base relationship to anterior cranial base
ANB	Apical base relationship
NA-APg	Angle of convexity
FMA	Inclination of mandibular plane to FH
MP-SN	Inclination of mandibular plane angle to anterior cranial base
OC-PL-SN	Inclination of occlusal plane to anterior cranial base
y-axis	Angle made between SN and NGn line
L-FC-HT	Lower face height (anterior nasal spine-Menton)
N-S-BA	Cranial base angle
U1-SN	Inclination of maxillary incisors to anterior cranial base
U1-NA (angle)	Inclination of maxillary incisors to NA
U1-NA (mm)	Protrusion of maxillary incisors to NA
U1-L1	Inclination of maxillary incisors to mandibular incisors
L1-MP	Inclination of mandibular incisors to mandibular plane
L1-NB	Inclination of mandibular incisors to NB
L1-NB (mm)	Protrusion of maxillary incisors to NB

and descendants of Arabs, Indians, Turks, Indonesians, Africans and others. Most of them settled in the western region and eventually became Saudis.

Vorhies and Adams[25] simplified the reading of Downs' cephalometric norms, when they developed a polygon or wiggle, in which cephalometric readings were expressed graphically. A wiggle, as described by Vorhies and Adams,[25] is a graph in which all average norms are plotted on a central vertical line. The maximum and the minimum readings of each norm are plotted on either side of the central line in a manner that all the Class II readings are placed on the left side and the Class III readings are placed on the right side of the central line.[25]

The objectives of this study were to evaluate the cephalometric features of a Saudi population living in the western area of Saudi Arabia, to establish Saudi norms in this area, and to present them diagrammatically in the form of a polygon for easier use.

MATERIALS AND METHODS

A total of 70 lateral cephalometric radiographs of Saudi adults (32 females and 38 males; aged 18–28

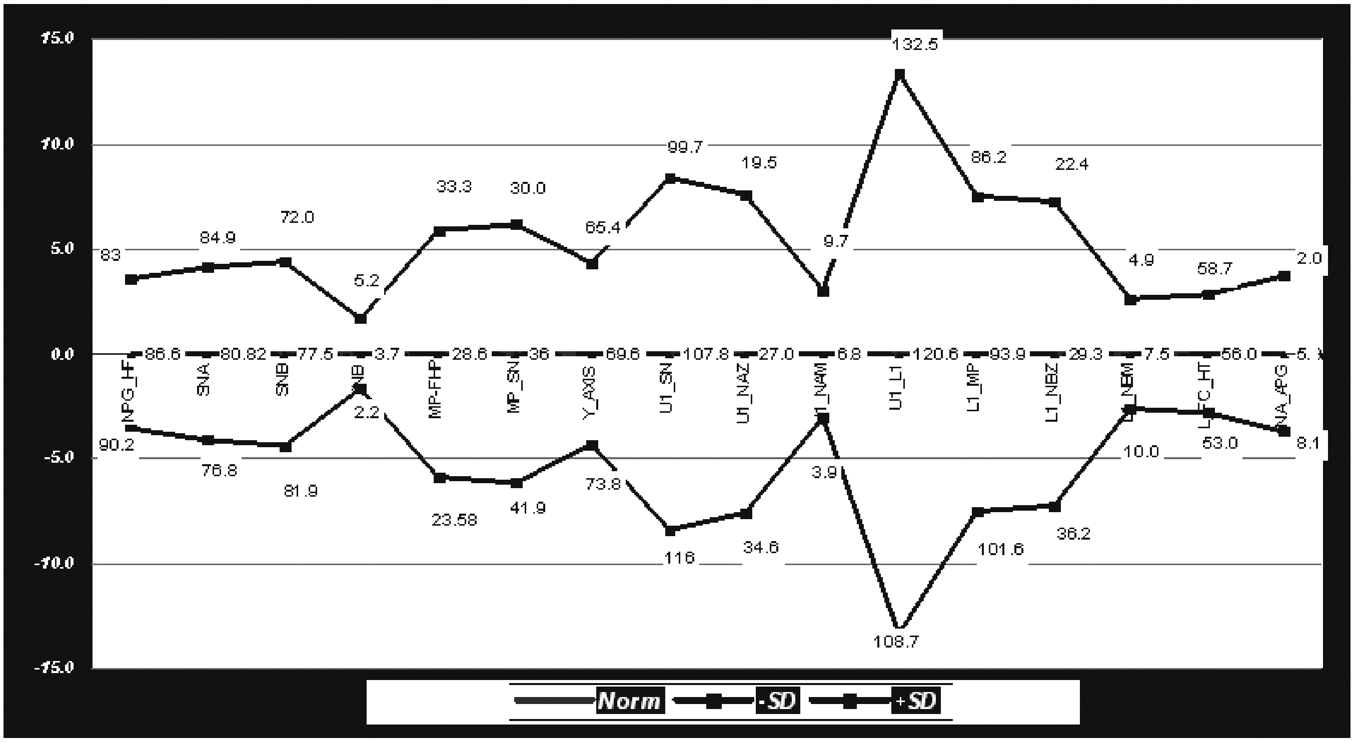

FIGURE 2. Wiggle for Saudi Norms.

years) with balanced and acceptable facial profiles, minimum overbite and overjet, Class I skeletal and dental relationships, and no previous orthodontic treatment were traced and analyzed manually by a single examiner. All selected subjects were Arab Saudis (by nationality) living in the western region of Saudi Arabia. A total of 16 angular and linear measurements were calculated (Figure 1; Table 1). The mean value, standard deviation, and range for each variable were calculated. Measurements were compared with European-American norms, and the differences were analyzed and highlighted. European-American norms were derived from Downs,[1,2] Hasund,[26] and Riedel[3] analyses. Independent sample *t*-tests were performed to compare Saudis and European-Americans and to compare male and female groups.[27] To assess tracing errors, a second tracing was prepared for each of 10 tracings. The mean error in linear measurements was 0.45 mm and in angular measurements was 0.93°.

A set of cephalometric values for male and female Saudis was established. The resulting data (means and standard deviations) were represented diagrammatically in the form of a polygon (wiggle), using the program Microsoft Excel (Microsoft, Redmond, Wash) (Figure 2). The standard deviations were used instead of the maximum and minimum readings in the polygon, unlike the classic wiggle of Vorhies and Adams.[25]

RESULTS

Compared with European-Americans, Saudis were found to have an increased facial convexity (ANB, 3.65 ± 1.65), a more convex profile (NA-APg $= 4 \pm 3.5$), and a steeper mandibular plane (FMA, 28.0 ± 5.8). In addition, the upper and lower incisors were significantly more proclined and more protruded. The y-axis angle was significantly steeper ($P < .001$) and the anterior lower face height insignificantly shorter in Saudis than in European-Americans (Table 2).

Males were found to have more prognathic mandibles than female as indicated by the statistically significant increase in SNB ($P < .05$). Although the anterior lower face height was similar in males and females, males tended to have a steeper mandibular plane angle than females when related to the anterior cranial base ($P < .05$) (Table 3).

DISCUSSION

The racial, facial, and skeletal characteristics of the patient play a critical role in orthodontic treatment planning. The objectives of this study were to evaluate the cephalometric features of a Saudi population and to establish norms for the Saudis living in the western region of Saudi Arabia. This study was performed using a relatively larger sample size from the Saudi population than those used in previous studies. In addi-

TABLE 2. Saudi-adult Standards as Compared with European-American Standards Using *t*-test

Variables	Saudis (Adults) (n = 70) Mean	SD	European-American(s) (Adults) (n = 48–93) Mean	SD	*t*	*P*
N-PG-FH	86.6	3.64	87.8	3.57	0.98	>.05
SNA	80.8	4.06	82.01	3.89	0.85	>.05
SNB	77.5	4.48	79.97	3.69	1.69	>.05
ANB	3.7	1.522	2.04	1.81	2.59	<.05
NA-APg	5.01	3.05	1.62	4.78	2.8	<.01
Mandibular plane/FH	28.5	4.79	22.4	5.6	3.57	<.001
MP-SN	35.9	5.96	31.7	5.19	2.12	<.05
y-axis	69.6	4.2	59.4	3.82	7.16	<.001
U1-SN	107.8	8.07	103.97	5.75	1.46	>.05
U1-NAZ	27.3	7.5	22	6	2.13	<.05
U1-NA (mm)	6.8	2.9	6	1.9	1.02	>.05
U1-L1	120.6	11.89	130.9	9.24	2.64	<.01
L1-MP	93.9	7.7	93.09	6.78	0.32	>.05
L1-NB	29.34	6.89	25	6	1.87	>.05
L1-NB (mm)	7.52	2.63	5	1.7	2.08	<.05
L-FC-HT (%)	56.03	2.7	57	Not specified		

TABLE 3. Comparison of the Measurements Between Saudi Males and Females Using *t*-test

Variable	Male Mean	SD	Female Mean	SD	*P*
N-PG-HF	87.2	4.4	83.5	3.7	<.05*
SNA	80.9	4.9	79.6	3.9	>.05
SNB	77.2	5	75.5	3.5	<.05*
ANB	3.7	3	4.1	2.9	>.05
NA-APg	6.9	6.5	8.9	11.1	>.05
FMA	25.8	5.7	27.8	5.3	>.05
MP-SN	35.4	6.2	33.2	5.5	<.05*
OC-PL-SN	13.3	9.3	20.5	6.5	>.05
y-axis	70.2	6.2	70.3	6.4	>.05
U1-SN	107.9	8.8	103.9	8.8	>.05
U1-NA (angle)	23.5	8.1	23.1	8.4	>.05
U1-NA (mm)	7.1	3.4	6.6	3.4	>.05
U1-L1	120.3	11.3	117.4	12.5	>.05
L1-MP	97.5	9.6	96.6	9.3	>.05
L1-NBZ	29.5	7.3	30.7	7.3	>.05
L1-NB (mm)	7.2	2.9	7.5	3	>.05
L-FC-HT	55.8	3.3	54.8	2.8	>.05

tion, the sample was selected carefully to include Saudis, by nationality, who had Class I skeletal and dental relationships and pleasant faces. By definition, the Saudi population, especially in the western area, is a multiracial mixed population that consists of people who have lived in Saudi Arabia for a long period of time and eventually obtained nationality. Because we believe that Saudis living in this area represent the new Saudi race, which has been established because of interbreeding among the different communities, selection was open to include all Saudi Arabs living in the western province of Saudi Arabia.

Results are consistent with previous studies in Riyadh, Central Province, in that Saudis tend to have bimaxillary protrusion. Important findings are the increased ANB angle and mandibular plane angle in Saudis as compared with European-Americans with Class I skeletal relationship, which adds more value for using these measurements in evaluating skeletal relationships in Saudis (Table 2).

The polygon is considered a versatile tool for practical clinical use, which simplifies the reading and its presentation to the patients. In addition, presenting the norms of such a mixed race of Saudis is advantageous in the sense that it counts for the expected variability by including norms within one standard deviation.

CONCLUSION

Saudis have distinct cephalometric features, for which specific norms should be used as a reference in treating orthodontic patients. In addition, presenting Saudi norms on a polygon is a faster and practical method of analyzing cephalometrics.

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