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Cephalometric Evaluation for Saudi Population Using the Downs and Steiner Analysis

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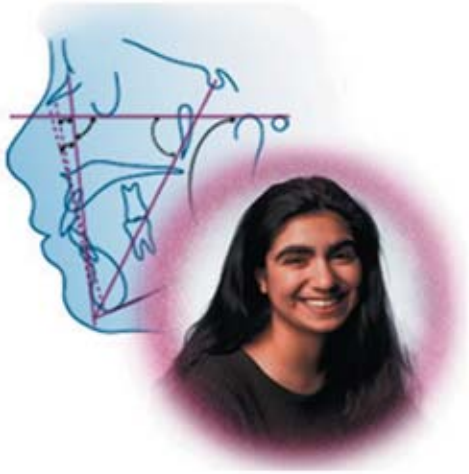

Abstract

The purpose of this study is to formulate cephalometric norms of the Saudi population; and to evaluate whether significant cephalometric differences exist between Saudi and Caucasian patients. Lateral cephalometric radiographs of 60 selected Saudis (30 males and 30 females) with esthetically pleasing and harmonious faces, Angle I molar relationship, with all permanent teeth present and no history of orthodontic treatment or facial trauma, age range between 20 and 30 years were analyzed using the Downs and Steiner analysis. The means, standard deviations, and ranges of the measurements were compared with the norms established by Downs and Steiner. Statistically, several significant differences were noticeable in the results of the present study when the cephalometric mean values for the selected Saudi population were compared with the norms suggested for a white Caucasian population by Downs and Steiner. The results of the present study are significant and showed normal Saudis have a slightly protrusive maxillae, a tendency to Class II facial pattern, and a high mandibular plane angle. These results have clinical implications in the diagnosis and treatment of adult Saudis with dentofacial deformities.

Keywords: Cephalometric analysis, Downs, Steiner, Caucasian norms, Saudi population

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Introduction

As Mills pointed out, it is generally accepted that genetics play a large part in producing the face and the dentition of individuals.[1] It was easy to recognize familial tendencies in the tilt of the nose, the shape of the jaw, and the look of the smile. It was apparent certain types of malocclusions run in families.[2] Malocclusion could be most probably produced by inherited characteristics in two ways. The first would be an inherited disproportion between the size of the teeth and the size of the jaws, which would produce crowding or spacing. The second possibility would be an inherited disproportion between size or position of the upper and lower jaws, which would cause improper occlusal relationships and the development of inter-arch variations in anterior-posterior, vertical, and transverse dimensions, which would produce Class II and/or Class III skeletal discrepancy.[3]

Populations differ in their character, size, growth, and shape. These differences are due to a complicated interaction of genetic and environmental factors.[2] Distinctions between races by geographical location, historical origins, culture, or language[4] were usually subsumed into three major racial groups: Asiatic or (Mongoloid), Black (or Negroid), and White (or Caucasian).[4, 5] The classification of three groups gave each group its own characteristics, which in general serve to distinguish them from each other. However, research studies and anthropological findings indicate not only did each racial group have its own standards[6-9] but within the same race, each subgroup had its own standards.[10-12] It is illogical to apply the standards of one racial group to another, or within the same race , or to apply the standards of one subgroup to another.[13-16]

In ancient times, beauty was described geometrically. Indeed, sculptors of that time measured the human body geometrically. Later, form was added to create so-called "normative values," which was described as beauty. And in the present time, facial harmony and esthetics have remained predominantly linked to racial preferences.

Several studies have been reported for various racial sub-groups, and information concerning cephalometric findings in the Caucasian[17], Japanese[18, 19], Chinese[20, 21], American Africans[7, 22-23], and Nigerians[24] is available; however, few studies were available on the physical characteristics of Arabs.[12, 25-26, 36-37] Although Arabs are Caucasian[5], there is hardly any published scientific research related to the population of the Arabian Peninsula (the Saudi Arabians).

According to Steiner and Downs, the norms they obtained in a predominantly Caucasian population were to be used only as guides and not as absolute values for every patient. With this concept, they emphasized there was an infinite variety of facial variations within a particular racial group. Indeed, if faces are to be viewed objectively, there must be recognition of the infinite variation of racial, familial, and individual form. Therefore, although the Saudi Arabians are Caucasians, we can only use the established data for Caucasians as a reference for comparison with the expected variations within the subgroups.

The achievement of harmonious and proportional craniofacial esthetics is one of the desired results of orthodontic treatment. Several diagnostic aids are available to help the clinician meet this goal, including cephalometric radiography.[27, 28] Interventions on the jaws and facial skeleton can alter the facial appearance.[29, 30] With the increasing number of Saudis seeking professional treatment from orthodontists, maxillofacial surgeons, or plastic and reconstructive surgeons, it has become apparent there is a need to determine what constitutes a pleasing or normal face for the Saudi population. A comprehensive and accurate diagnostic assessment of any orthodontic patient involves the comparison of the patient's cephalometric findings with the norms of his or her ethnic groups. Treatment plans and clinical

procedure should not be freely switched without consideration of the racial group involved and without thorough understanding of the differences between races and their ranges of normal.

Therefore, the present study was concerned with an ethnic group for which little cephalometric information was available, the Saudis. The purpose of this study was to formulate cephalometric norms for the Saudi and compare these data with the norms established by Downs[31] and Steiner.[32]

Materials and Methods

The sample consisting of 60 Saudi dental students (30 males and 30 females) were selected according to the following criteria:

1. Have a pleasing and harmonious face
2. Age 21 to 23 years old
3. Angle class I molar relationship
4. All permanent teeth present
5. No history of orthodontic treatment

A lateral cephalometric radiograph was taken for each of the participants in a standard position with the teeth in centric position and with lips relaxed. These were taken on a Broadbent Bolton cephalometer (Siemens, Erlanger, Germany) at the College of Dentistry of the King Saud University in Riyadh, Saudi Arabia. Study casts were made for each subject. The radiographs were then digitized using the Dentofacial Planner (Dentofacial Software Inc., Toronto, ON, Canada) in the Dental College. A total of 68 landmarks were digitized for each individual by means of an electronic cursor and then the data passed into the computer. A print out was then prepared for each tracing, which reproduced the traced points according to Downs (Figure 1) and Steiner analysis (Figure 2). The data from the 60 students were statistically analyzed to obtain the mean values, range, and standard deviation. The t-test was used to compare the sample under investigation to the Downs and Steiner means.

Results

The means, standard deviations, minimum, and maximum values for the Saudi sample, according to Downs and Steiner analysis, are shown in Tables 1 and 3. Tables 2 and 4 show a comparison of craniofacial values between the Saudi and the Caucasian samples using the Downs and Steiner analysis. The results of the t-test, when applied to the male and female values, showed there were no significant differences between sexes. Figure 3 represents the range of Downs values of the Saudi sample when superimposed on a Downs polygon.

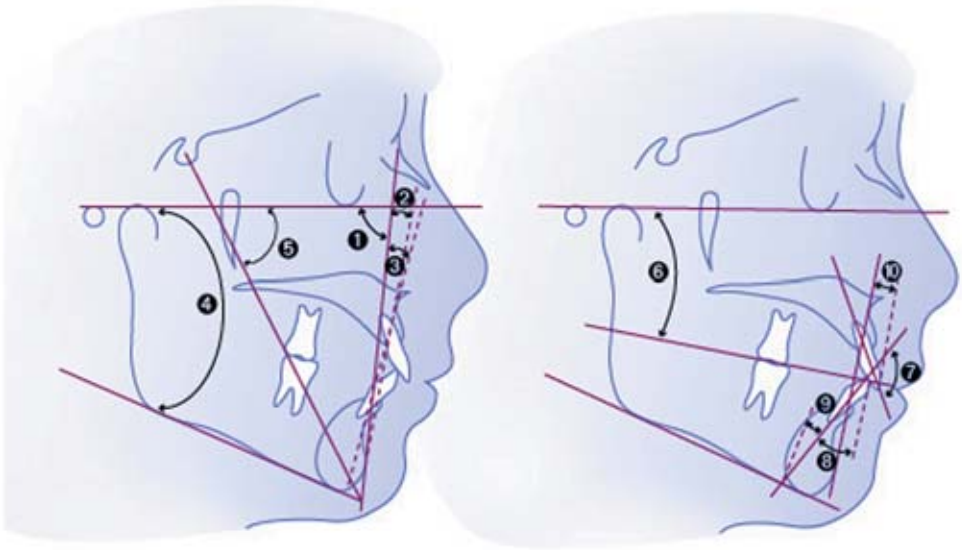

Figure 1: Downs analysis with the reference points identified. 1, Facial plane. 2, Convexity. 3, A-B plane. 4, Mandibular plane. 5, Y axis. 6, Occlusal plane. 7, Interincisal angle. 8, T to Occlusal plane. 9, T to mandibular plane. 10, ⊥ to A-P plane.

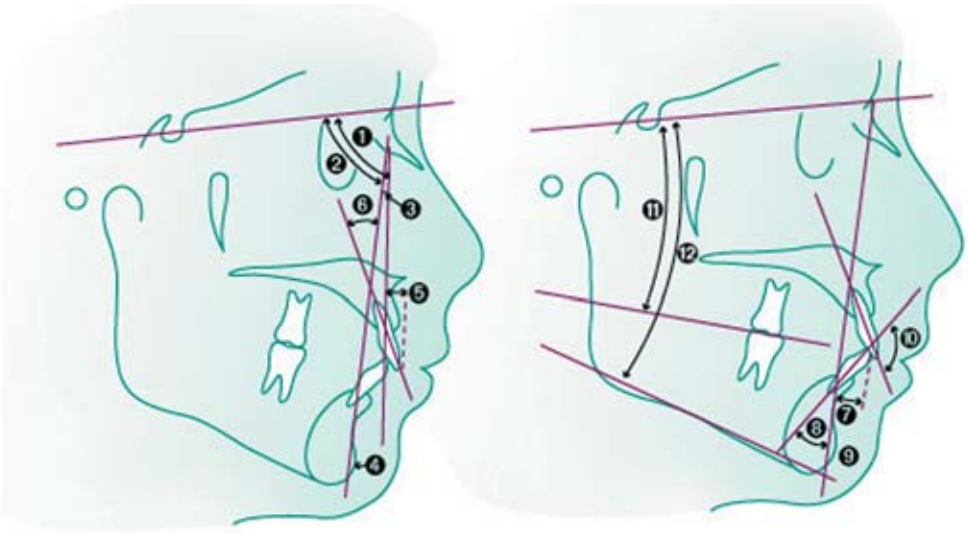

Figure 2: Steiner's analysis with the reference points identified. 1. SNA; 2. SNB; 3. ANB; 4. SND; 5. I TO NA (mm); 6. I to NA (angle); 7. I to NB (MM); 8. I to NB (angle); 9. Po to NB (MM); 10. Interincisal; 11. Occlusal to SN; 12. GoGn to SN.

Table 1. Means, standard deviations (SD), minimum and maximum of cephalometric values for the Saudi sample according to Downs analysis (N = 60).

Parameters	Minimum	Maximum	Mean	SD
Facial plane (°)	80.2	93.2	87.7	3.1
Convexity (°)	-6.3	17.1	4.1	4.7
A-B Plane (°)	10.0	3.3	-3.9	2.6
Mandibular plane(°)	14.6	34.1	24.3	4.6
Y axis (°)	55.0	69.0	61.0	3.3
Occlusal plane (°)	-4.4	16.1	7.1	4.0
Interincisal angle (°)	107.3	142.0	124.8	6.9
⊤ to occlusal plane (°)	14.5	33.5	23.5	4.9
⊤ to mandibular plane (°)	-5.9	+21.9	6.3	5.6
⊥ to A-P plane (mm)	2.3	11.4	7.1	2.1

Discussion

Cephalometric studies on non-Caucasians indicated there were measurable skeletal and dental differences when compared to Caucasians. The mean values for measurements of one racial group could not be considered normal for others. Steiner and Downs indicated their norms (means) were to be used as guides, not as absolute values for every patient. This concept emphasized in a normal range of a particular racial group, an infinite variety of facial patterns existed. If this infinite variety existed within any single racial group, what would be the possibilities of individual differences between two or more racial groups?

Numerous studies have shown differences between racial groups exist. As mentioned earlier, Saudi Arabians are considered a subgroup of Caucasians. However, in the modern biologic model, variations occur and are not perceived as unnatural. Indeed, attempts to achieve perfection for all individuals are seen as unnatural. Therefore, each different racial subgroup would best be treated according to its individual characteristics, in order to achieve an esthetically pleasing face.

Table 2. A comparison of craniofacial values between the Saudi sample and the Caucasian sample of the Downs analysis.

Downs Analysis						
Parameters	Caucasian (N = 20)		Saudi (N = 60)		t-test	
	Mean	SD	Mean	SD	t-value	Level of Sig
Facial plane (°)	87.5	3.6	87.7	3.1	0.46	NS
Convexity (°)	0	5.1	4.1	4.7	6.73	***
A-B Plane (°)	-4.6	3.7	-3.9	2.6	2.10	***
Mandibular plane(°)	21.9	3.0	24.3	4.6	4.09	***
Y axis (°)	59.4	3.8	61.0	3.3	3.64	***
Occlusal plane (°)	9.3	3.8	7.1	4.0	7.14	***
Interincisal angle (°)	135.4	5.8	124.8	6.9	-11.82	***
⊤ to occlusal plane (°)	14.5	3.4	23.5	4.9	14.35	***
⊤ to mandibular plane (°)	1.4	3.8	6.3	5.6	6.79	***
⊥ to A-P plane (mm)	1.7	3.0	7.1	2.1	19.88	***

Table 3. Means, standard deviations (SD), minimum and maximum of cephalometric values for the Saudi sample according to Steiner analysis (N = 60).

Parameters	Minimum	Maximum	Mean	SD
SNA (°)	74.9	97.1	83.6°	4.3
SNB (°)	73.4	89.7	81.0°	3.7
ANB (°)	-2.6	7.4	2.5°	2.0
⊥ to NA (°)	13.4	39.8	24.8	5.6
⊥ to NA (mm)	-.5	11.3	5.3	2.6
⊤ to NB (°)	19.3	36.6	27.8	4.3
⊤ to NB (mm)	2.3	11.3	6.1	2.1
Pog to NB (mm)	-4.0	5.2	1.1	1.6
Interincisal (°)	107.3	142.0	124.8	6.9
Occ. To SN (°)	2.9	24.0	13.3	4.3
GoGn to SN (°)	19.0	42.8	31.0	5.1

Table 4. A comparison of craniofacial values between the Saudi sample and the Caucasian sample of the Steiner analysis.

Steiner Analysis						
Parameters	Caucasian (N = 20)		Saudi (N = 60)		t-test	
	Mean	SD	Mean	SD	t-value	Level of Sig
SNA (°)	82.0°	3.9	83.6°	4.3	2.87	***
SNB (°)	80°	3.6	81.0°	3.7	2.02	***
ANB (°)	2.0°	1.8	2.5°	2.0	2.11	***
⊥ to NA (°)	22°	-	24.8°	5.6	3.90	***
⊥ to NA (mm)	4 mm	-	5.3	2.6	3.88	***
⊤ to NB (°)	25°	-	27.8°	4.3	5.10	***
⊤ to NB (mm)	4 mm	-	6.1°	2.1	7.57	***
Pog to NB (mm)	-	-	1.1°	1.6	-	-
Interincisal (°)	127°	-	124.8°	6.9	-2.44	***
Occ. To SN (°)	14°	-	13.3°	4.3	-1.31	NS
GoGn to SN (°)	31.7°	-	31.0°	5.1	-1.32	NS

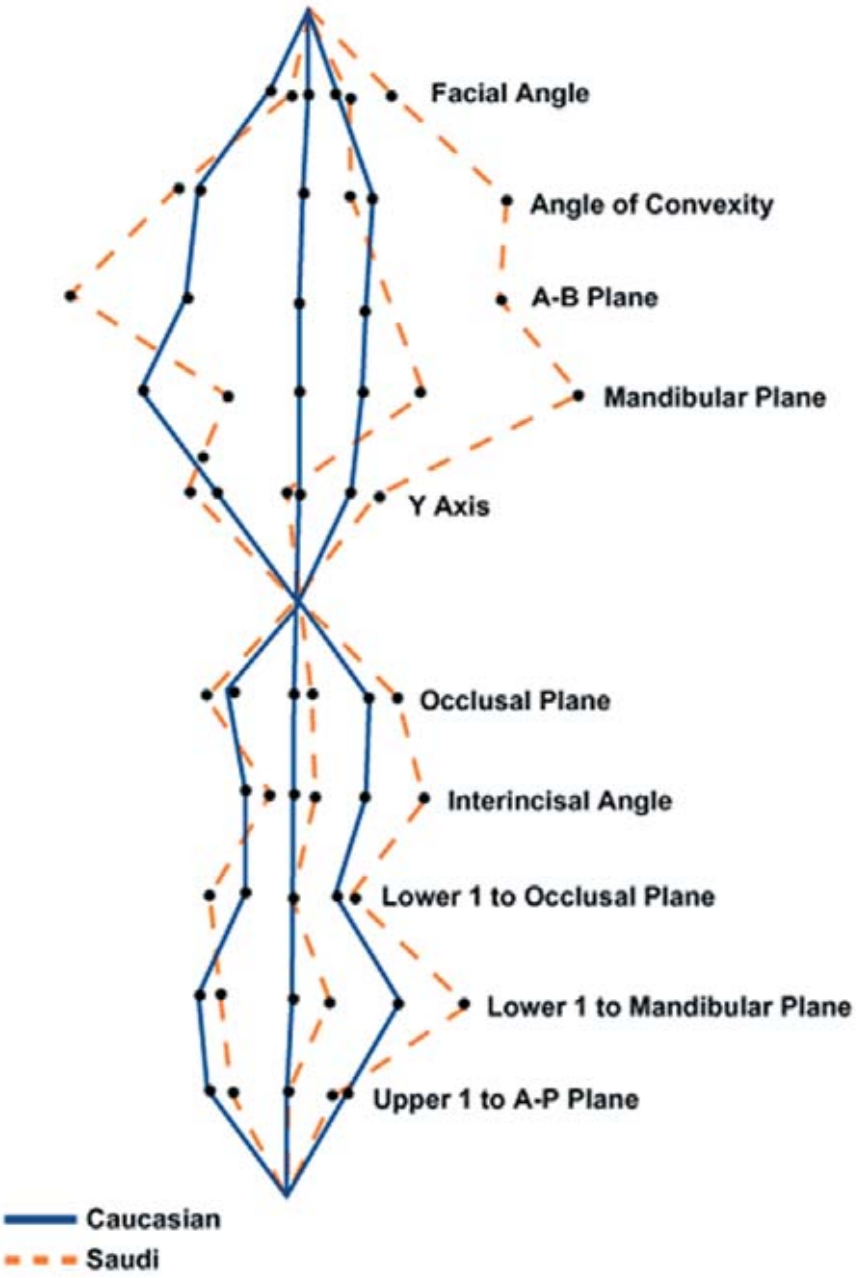

Figure 3: Caucasian and Saudi polygon.

Several statistically significant differences were noticeable in the results of the present study when the cephalometric mean values for the selected Saudi population were compared to the norms suggested for Caucasian population by Downs[31] and Steiner.[32]

The Downs Analysis

Skeletal: The mean value of the facial angle in the present study was nearly the same as that presented by Downs for a Caucasian group and was not statistically different. These findings were in agreement with Garcia[33] and in contrast to the findings of Goldsman.[34] The adult Saudi and Caucasian both had a normal lower jaw in relation to the upper face. The mean values for the angle of convexity, A-B plane angle, mandibular plane angle, and Y axis were slightly more than those of the Caucasian sample with significant differences. Saudis had more prominence of the

maxillary denture base relative to the mandible, tendency to Class II facial pattern, and a higher mandibular plane angle than those of the Caucasian sample.

The present study agrees with previous observations made by Garcia[33] and Baum[35] that what was considered normal for Caucasians was not normal for Saudi Arabians. Because there were significant differences between the Caucasian samples of Downs and Steiner on one hand and Saudi Arabians on the other hand, it is evident, in order to diagnose and treat the Saudi patient properly, cephalometric norms for this racial subgroup must be established.

Dental: The second major comparison category was dental variables. Significant differences were found for the cant of the occlusal plane angle which indicates Class II facial pattern. The interincisal angle, which indicated the over-all angulation of the axial inclination of the upper and lower incisors was smaller in the Saudi sample than that of Downs, reference norm.

The mean value of the lower central incisor to the occlusal plane revealed the Saudi sample had more inclined and forward teeth, the same finding occurred when the lower central incisor was related to the mandibular plane. A significant difference was found for the mean of upper teeth to the A-P plane, which indicates protrusion of the maxillary incisors than those of Caucasian sample.

We agree with this observation made by Garcia[33] and Baum[35] that the norm for one subgroup should not be necessarily applied to all in the racial or ethnic group.

The Steiner Analysis

Skeletal: The mean values of the SNA, SNB, and ANB angles in the present study were slightly more than those presented by Steiner for the Caucasian group, indicating maxillary and mandibular protrusion. These findings were in agreement with Jones[36], Shalhoub[25], Sarhan and Nashashibi[37], and Nashashibi et al.[12] No significant differences were found for the GoGn to SN.

Dental: The maxillary and mandibular central incisors in the Saudi sample were more procumbent than that of the Caucasian sample. The inter-incisal angle was smaller in the Saudi than that of Steiner's norms indicating a bimaxillary protrusion. No significant differences were found for the occlusal to SN.

The results of this study demonstrate a mildly more dental protrusive pattern in Saudis than white Americans. The result of the present study is in agreement with what Barakati[26] reported and in partial agreement with the result obtained by Nashashibi et al.[12] in the Saudi population.

Clinical Implications

The results of this study have clinical implications in the diagnosis and treatment planning of adult Saudi patients. Skeletally, adult Saudi demonstrated more bimaxillary protrusion with a tendency to Class II facial pattern and high mandibular plane angle. Therefore, in the diagnosis and treatment planning of a Saudi it seems more maxillary skeletal protrusion is acceptable than in a Caucasian within the limitation of our study sample.

Dentally, Saudi patients may be treated slightly more bimaxillary protrusive than in Caucasian patients. Further investigation is needed to confirm this result on the Saudi population using a larger sample size, which can be a true representative sample across the entire Saudi population.

Conclusion

In view of the findings of the current study it is evident, even in the Saudi ethnic groups with so-called well-balanced faces, there are some fundamental variations in the craniofacial structure of Saudi Arabs when compared with Downs and Steiner norms. These should be established to serve in the diagnosis and treatment of the Saudi patients. The result of the present study also supports the view that a single standard of facial esthetics should not be applied to all racial and ethnic groups.

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