Differences in dentofacial characteristics of Class I malocclusion between Saudi and Japanese adult females

Mona A Abbassy[1,2] and Amal Abushal[1]

ABSTRACT

Objectives: The objective was to compare dentofacial characteristics of Class I malocclusion in Saudi and Japanese adult females.

Materials and Methods: Lateral cephalograms of 50 Saudi adult female and 50 Japanese adult female (18–35-year-old) were obtained. All patients were skeletal Class I, angle Class I malocclusion, arch length discrepancy (−10–10 mm), overjet (1–5 mm), overbite (1–5 mm), absence of congenital anomalies, or significant facial asymmetries or congenitally missing tooth other than the 3rd molar and absence of temporomandibular joint problems. Patient cephalograms were traced and digitized. 16 angular measurements and 13 linear measurements of facial form were used.

Results: A comparison of the vertical dimension showed that the Saudi females had a significantly larger gonial angle, a significantly larger facial angle and longer lower face height compared to the Japanese females. Dentally, Saudi females had more protruded incisors with increased distances of the posterior teeth to the palatal plane. For the soft tissue dimension, the Saudi subjects had a significantly more prominent nose, retruded lip and a more protruded chin compared with Japanese.

Conclusions: There were significant differences in dentofacial morphology between Saudi and Japanese adult females. Both Asian countries have distinct cephalometric features, which should be considered as a reference in treating patients of varying ethnic backgrounds to optimize the final results.

Key words: Cephalometric, Class I malocclusion, comparison, ethnic differences

INTRODUCTION

Enhancing the patient's life by improving the dental, jaw function and dentofacial esthetics has always been the main goal of orthodontic treatment. Appropriate treatment is essential for a patient's well-being because the presence of dental and facial distortions may give rise to a disability that can affect both the patient's physical and mental health.[1]

The patient's motivation starts from the self-perception of their own dentofacial attractiveness leading them to seek orthodontic treatment.[2] Facial attractiveness might be related to several factors: Ethnic group, age, sex, region, and professional background. In particular, ethnic and racial differences play major roles in judging facial esthetics.[3,4] Therefore, it is essential to know the esthetic preferences of each ethnicity before orthodontic treatment is begun and consider their norms according to their ethnic group.[4]

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Cephalometric radiograph is an essential tool in orthodontics to assist researchers and orthodontists in diagnosis and treatment planning. It allows us to assess skeletal, dental, soft tissue patterns by relating the patient's malocclusion to their associated norms.[5]

Previous studies have established the cephalometric norms in different countries and ethnicities.[6-9] When comparing the dentofacial characteristics between different ethnicities, most investigators have concluded that there are significant differences between the diverse ethnic and racial groups, thus treating these different ethnicities should be based on the individual cephalometric norms for each group.[10-14]

Many cephalometric studies were conducted on the Japanese populations to obtain their cephalometric norms.[12,15-19]

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However, in these studies the Japanese sample was mainly compared to European-Americans and Caucasians.[12,15,16] On the other hand, cephalometric studies conducted on the Saudi population concentrated to obtain their cephalometric norms.[11,20-24] And compared the norms of adult Saudi population with those of European-Americans population.[21] Furthermore, the soft tissue profile of Saudi adults was compared with Caucasian-Americans.[11] However, few studies were done comparing between the Japanese and Saudi population, mainly concentrating on Class III malocclusion in both ethnicities.[25]

Nevertheless, the lack of any comparative studies between Saudi and Japanese populations with Class I malocclusion made this study a field of interest especially to compare the skeletal, dental and soft tissues differences particularly that both countries are Asian countries. The purpose of this study was to compare the differences of the dentofacial characteristics in Class I malocclusion in Saudi and Japanese adult females.

MATERIALS AND METHODS

Samples

The current study comprised two series of lateral cephalometric radiographs obtained from Jeddah, Saudi Arabia (Saudi sample), and Tokyo, Japan (Japanese sample).

- The Saudi sample consisted of 50 adult females (mean age 23.88 ± 4.72), obtained from the Department of Orthodontics, King Abdulaziz University, Jeddah, Saudi Arabia
- The Japanese sample consisted of 50 adult females (mean age 24.14 ± 4.46), obtained from the Department of Orthodontics, Tokyo Medical and Dental University, Japan.

All Saudi and Japanese patients satisfied the following criteria: (1) Female patient, (2) adult patient (18–35-year-old), (3) skeletal Class I (ANB angle between 2° and 5°), (4) angle Class I malocclusion, (5) arch length discrepancy (−10–10 mm), (6) overjet (1–5 mm), (7) overbite (1–5 mm), (8) no congenital anomalies, significant facial asymmetries or congenitally missing teeth other than the third molar, (9) no significant temporomandibular joint problems.

Cephalometric Analysis

All lateral cephalometric radiographs were taken with the teeth in maximal intercuspation, in a cephalostat oriented at the Frankfort horizontal plane. All lateral cephalograms were traced by the same investigator and then reviewed by a second investigator to assure intraexaminer and interexaminer reliability.

The selected landmarks and reference planes were digitized and converted to an X-Y coordinate system using Adobe Photoshop CS5 version 12 software (Adobe Systems, San Jose, Calif). All linear measurements were expressed as a ratio to the length of the anterior cranial base.[26] 10 angular and two linear measurements[27] were constructed for the skeletal hard tissue analysis [Figure 1], four angular and two linear measurements[27] were constructed for the dental hard tissue analysis [Figure 2], and two angular and nine linear measurements[12] were constructed for the soft tissue analysis [Figure 3].

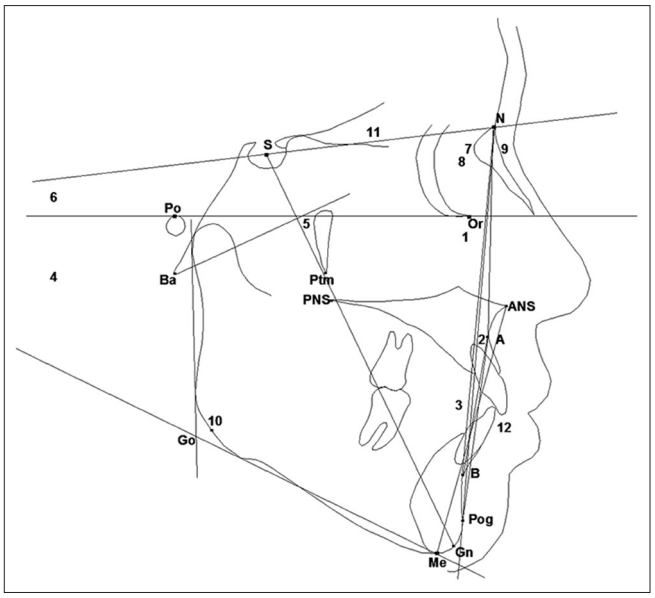

Figure 1: Skeletal hard tissue cephalometric reference points: (1) Facial angle, (2) angle of convexity, (3) A-B plane, (4) mandibular plane angle, (5) Y-axis angle, (6) FH-SN, (7) SNA angle, (8) SNB angle (9) ANB angle, (10) Gonial angle, (11) SN plane, (12) lower face height

Statistical Analysis

All statistical analyses were performed using statistic software SPSS 16.0 (SPSS Inc., Chicago, IL, USA). The mean and standard deviation (SD) were calculated for each measurement. The significance of differences in mean values of between Saudi and Japanese adult females was tested by unpaired *t*-test. One asterisk (*) indicates a 5% level of confidence ($P < 0.05$). Two asterisks (**) indicate a significant difference at the 1% level of confidence ($P < 0.01$). Three asterisks (***) indicate significant difference of 0.1% level of confidence ($P < 0.001$). A 5% level of confidence was used to represent the significant difference between the tested variables.

Method Error

The cephalometric radiographs were evaluated by two orthodontists, and all cephalograms were standardized at a magnification of 1.1%

A random selection of 20 cephalometric radiographs from each group were re-traced and re-digitized a few weeks after the initial analysis by the same investigator. The magnification factor of the radiographic image was calculated. The corrected values were used for comparing the measurements observed. The error of the method in identifying and locating the anatomical landmarks during tracing and measurements were assessed by Dahlberg's method error[25] and the coefficient of reliability,[25] calculated as follows:

$$\text{Dahlberg's method error} = \sqrt{\sum d^2 / 2n}$$

Where *d* was the difference between repeated measurements and *n* was the number of pairs of measurements. The Dahlberg error was small and acceptable; the values being <1 mm for the linear measurements and <1° for the angular measurements. The coefficient of reliability indicated that the measured variables were highly correlated, and the observed values ranged between 0.98, and 0.89.

RESULTS

The mean and SDs of cephalometric measurements for the Saudi and Japanese adult females with Class I malocclusion showed that out of the 29 variables; 20 comparisons had significant differences.

Skeletal Relationship

Skeletally Table 1 shows that, the anterior cranial base (S-N) was much larger in the Saudi females than in the Japanese ($P < 0.001$). Vertically, the Saudi showed a significantly increased Y-axis indicating a more vertical growth pattern ($P < 0.001$), and a significantly larger gonial angle ($P < 0.001$). However, the Japanese showed a smaller facial angle indicating a less prominent chin ($P < 0.001$). In particular, Japanese females had a significantly shorter lower face height than Saudi females ($P < 0.001$).

Dental Relationship

Vertically Table 2 shows that, the distance of the upper molar to palatal plane was significantly higher in Saudi females ($P < 0.001$).

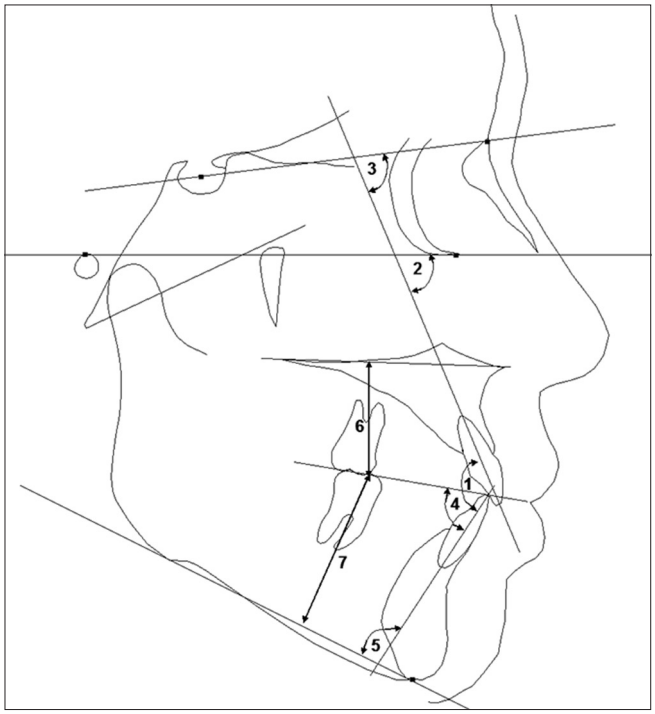

Figure 2: Dental hard tissue cephalometric reference points: (1) Interincisal angle, (2) U1 to FH, (3) U1 to SN plane, (4) L1 to occlusal plane, (5) L1 to mandibular plane, (6) UM to palatal plane, (7) LM to mandibular plane

Soft Tissue Analysis

Table 3 shows that the Saudi female subjects had a significantly less acute nasolabial angle than Japanese ($P < 0.001$) and a significantly less protruded lip positions compared with Japanese ($P < 0.001$). The thickness of the base of the upper lip in the Saudi subjects was significantly thinner than that of Japanese ($P < 0.001$). Moreover, the thickness of the soft tissue chin in the Saudi females was significantly thinner than that of Japanese ($P < 0.05$). However, the Saudi females had a significantly larger Z-angle than Japanese, and both upper and lower lip-E lines (Ricketts) were significantly higher in the Japanese than the Saudi subjects ($P < 0.001$).

DISCUSSION

Living in societies descending from various ethnic groups poses many difficulties for orthodontists treating patients in various parts of our world nowadays, because orthodontic treatment planning is critically affected by the skeletal and dental features of patients having multiple ethnic origins and having various cultures. Thus, it is of prime importance to the orthodontists nowadays to be acquainted with the various skeletal and dental features of each ethnic group to achieve the best esthetic outcome that satisfies the needs of each orthodontic patient.

This study compared the skeletal and dental properties of the Saudi females representing a country located on the Western

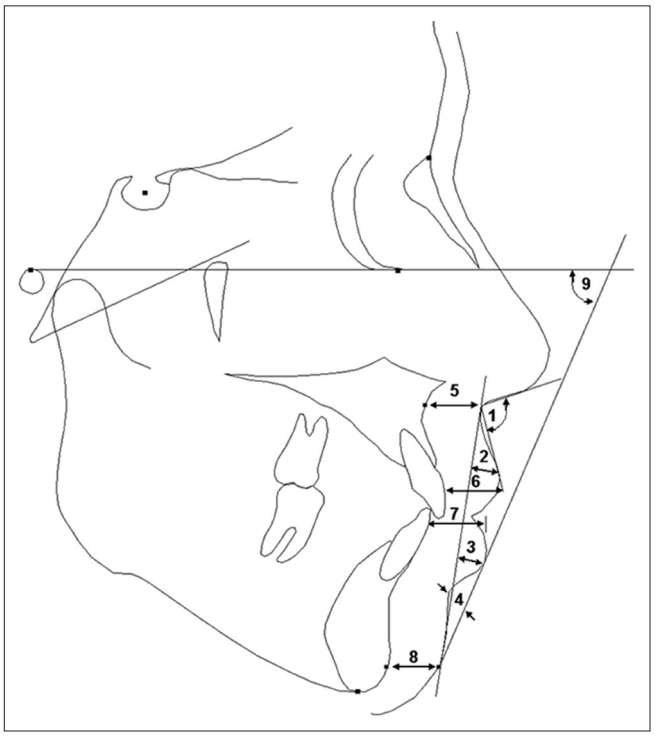

Figure 3: Soft tissue cephalometric reference points: (1) Nasolabial angle, (2) upper lip protrusion, (3) lower lip protrusion, (4) labiomental sulcus, (5) point A to subnasale, (6) incision superioris to upper lip, (7) incision inferioris to lower lip, (8) pogonion to pogonion, (9) Z angle, (10) E line to upper lip, (11) E line to lower lip

Table 1: Comparison of skeletal relatioship sample means between Saudi and Japanese adult females

	Saudi females		Japanese females		Significance
	Mean	SD	Mean	SD	
Facial angle (°)	94.50	3.37	85.52	3.25	***
Angle of convexity (°)	5.13	4.23	7.37	2.63	**
A-B plane (°)	−4.78	3.63	−4.10	3.07	NS
Mandibular plane (°)	27.23	5.35	26.89	5.21	NS
Y-axis (°)	66.68	4.04	63.64	3.5	***
FH-SN (°)	8.61	3.47	7.84	2.4	NS
SNA (°)	88.29	4.02	81.74	2.91	***
SNB (°)	85.07	3.7	78.51	3.09	***
ANB (°)	3.26	1.75	3.35	0.98	NS
Gonial angle (°)	138.29	6.02	119.72	5.55	***
S-N	79.22	3.5	69.70	2.8	***
Lower face height	77.47	6.79	57.23	4.64	***

*P<0.05; **P<0.01; ***P<0.001. NS – Not significant; SD – Standard deviation

Table 2: Comparison of dental relatioship sample means between Saudi and Japanese adult females

	Saudi females		Japanese females		Significance
	Mean	SD	Mean	SD	
Interincisal angle (°)	122.02	12.23	118.18	10.41	NS
U1 to FH (°)	116.08	8.5	115.81	8.2	NS
U1 to SN (°)	107.57	8.74	107.82	7.9	NS
L1 to mandibular plane (°)	98.58	7.52	98.52	6.31	NS
UM to palatal plane	27.17	3.27	25.50	2.24	**
LM to mandibular plane	36.21	3.57	36.36	2.84	NS

*P<0.05; **P<0.01; ***P<0.001. NS – Not significant; SD – Standard deviation

Table 3: Comparison of soft tissue relatioship sample means between Saudi and Japanese adult females

	Saudi females		Japanese females		Significance
	Mean	SD	Mean	SD	
Nasolabial angle (°)	112.26	11.9	94.26	9.3	***
Upper lip protrusion	0.06	0.02	0.10	0.02	***
Lower lip protrusion	0.06	0.02	0.10	0.03	***
Labiomental sulcus	0.06	0.02	0.06	0.017	NS
Point A to subnasal	0.18	0.0236	0.19	0.04	*
Incision superioris to upper lip	0.11	0.0235	0.16	0.03	***
incision inferioris to lower lip	0.15	0.02	0.20	0.03	***
Pogonion to pogonion'	0.14	0.03	0.18	0.037	***
Z-angle (°)	75.26	7.18	67.86	7.3	***
E-line U	-3.43	2.47	0.16	1.83	***
E-line L	0.09	3.023	2.12	2.39	***

*P<0.05; **P<0.01; ***P<0.001. NS – Not significant; SD – Standard deviation

border of Asia and Japanese females, which represent the most eastern point of the biggest continent of the world. This study was performed using a relatively larger sample size from the Saudi population than those used in previous studies. The sample was carefully selected to include Saudis, by nationality, who were characterized by being skeletal Class I and the angle Class I with malocclusion and fulfilled the selection criteria. No previous study of racial differences has compared such a sample, although several studies have evaluated patients from one ethnic group with normal or ideal occlusions.

Skeletal Relationship

The present study showed distinct racial differences between Saudi and Japanese adult females. The majority of previous studies[27-29] that compared the craniofacial morphology between Asian and Caucasians with Class I occlusion reported that Asians had a reduced anterior cranial base. No previous study compared two Asian populations as the Saudi and Japanese populations. The Saudi adult females had larger anterior cranial base than Japanese females.

Considering the vertical dimensions, the Saudi females had an increased lower face height compared to the Japanese females. This finding is in contrast with the results obtained by Alcalde *et al*.[16] and Nezu *et al*.[28] who concluded that the Japanese had longer faces but in their case they were comparing the Japanese to Caucasian sample. The mandibular position relative to the cranial base, as measured by the facial angle for the Japanese, demonstrated a more backward position of the mandible relative to the cranial base compared with the Saudi. This might be due to the short nose and less prominent chin in Japanese females. Saudi females tended to have a more vertical mandibular growth pattern than Japanese. This characteristic appears to be more significant in the Saudi population.

Dental Relationship

Considering the vertical dimension, the upper molar to the palatal plane was significantly higher is Saudi females than Japanese females. Consequently, both skeletal and dental differences might be attributed to the longer lower face height in Saudi females. The mean value in the dental vertical position may be useful to determine which teeth contribute more to the overall facial pattern. It would be helpful in treatment planning for clinicians to ascertain which teeth contribute more to the vertical disharmonies of open or deep bite.[12] However, because of the small mean and SD differences and the mean age differences between the two groups, these results should be interpreted carefully.

Soft Tissue

A comparison of the facial features revealed that the Saudi had a significantly larger nasolabial angle than Japanese indicating a less prominent nose; however the mean value was still within the normal range of values determined by Holdaway.[30] Moreover, the Japanese had significantly more protruded lip positions than Saudi agreeing with previously

reported concept of bilabial protrusion. These characteristics of soft tissues were confirmed by previous research.[12,18] However, in 1982 Nezu *et al*.[28] stated that the appearance of more protrusive lip positions were evident in Japanese patients due to their short nose and more retruded chin positions so; the lip protrusion noticed in Japanese might be only due to the position of the reference line. Ioi *et al*.[12] reported that the normal lower lip protrusion to esthetic line was 2.0 mm in Japanese and −2.0 mm in Caucasians. Although skeletally, the Saudi subjects had a significantly less retruded chin position compared with Japanese, and a significantly increased Z-angle in the Saudi compared to the Japanese. These results suggest that the thicker soft tissue chin in the Japanese females might compensate for the retruded chin position. The relationship of the upper and lower lips of Saudi females to the E-line was similar to that described by Ricketts for North Americans.[31] Conversely, the lips of Japanese subjects[16,27] were more protrusive to the E-line while those of Anatolian Turkish subjects[32] were more retrusive. These data indicate that the genetic determination is significantly higher in the soft tissue measurements than in the facial proportions. In the agreement with our findings, Mossey[33] stated that soft tissue morphology and behavior have genetic components and significant influences on the dentoalveolar morphology.

In the light of these findings, orthodontic treatment mechanics for Class I malocclusions should be considered depending on the race. Nezu *et al*.[28] stated that control of the chin, and vertical control of bite opening during orthodontic treatment was critically important not only for the Japanese patients, but also for the Saudi patients since both populations had a tendency for facial axis opening.

In conclusion, for the vertical dimension both Saudi and Japanese females had a steep mandibular plane angle. Furthermore, the Saudi females had a significantly larger lower face height together with increased distances of the upper molars to the palatal plane. Moreover, for the soft tissue dimension, the Japanese subjects had a significantly less prominent nose, protruded lip positions and a more retruded chin compared with Saudis. Therefore, our results reveal that we need to consider the profile and lip position in treatment planning for both Saudi and Japanese females. These results show that although the two countries are Asian in origin but still there are differences existing that should be taken in to account when formulating an orthodontic diagnosis and guiding in treatment plan mechanics for patients, especially in the multicultural societies we are living in nowadays. Cephalometrics is a valuable tool in orthodontics when properly used in consideration of individual variation to achieve patient's goals, desires, and expectations.

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