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Ethnic differences in the soft tissue profiles of Turkish and European–American young adults with normal occlusions and well-balanced faces

Tancan Uysal*,**, Asli Baysal*, Ahmet Yagci*, Lauren M. Sigler*** and James A. McNamara Jr.****

*Department of Orthodontics, Faculty of Dentistry, Erciyes University, Kayseri, Turkey, **Department of Orthodontics, School of Dentistry, King Saud University, Riyadh, Saudi Arabia, ***Department of Orthodontics and Pediatric Dentistry, School of Dentistry, The University of Michigan, Ann Arbor, MI, USA, ****Graber Endowed Professor, Department of Orthodontics and Pediatric Dentistry, The University of Michigan, Ann Arbor, MI, USA.

Correspondence to: Dr Tancan Uysal, Erciyes Üniversitesi, Dişhekimliği Fakültesi, Ortodonti A.D. Melikgazi, Kampüs Kayseri, 38039 Turkey. E-mail: tancanuysal@yahoo.com

SUMMARY The aim of this study was to evaluate soft tissue differences between Turkish and North American adults by comparing two sample populations with ideal occlusion and well-balanced faces. Lateral cephalometric radiographs of 117 Anatolian Turkish adults (65 female and 52 male, mean age: 23.9 ± 2.8 years) were compared with a sample of 116 adults of European–American ancestry (64 female and 52 male, mean age: 25.0 ± 6.8 years). The cephalometric analyses of Holdaway, Epker, and Legan and Burstone were performed using Dolphin Image Software 9.0. Thirty-two measurements (27 linear and 5 angular) were analysed. For statistical evaluation, independent samples *t*-tests were performed.

Distinct differences were found between the two samples in facial convexity, upper lip position and length, lower lip position, chin prominence, and chin thickness. Vertical proportional findings were similar between groups. Ethnic differences were found between Turkish and North American adults in the soft tissue profile. It is appropriate to consider these differences during routine diagnosis and treatment planning of a Turkish patient or an American patient of European ancestry.

Introduction

The evaluation of the soft tissues in patients undergoing orthodontics or corrective jaw surgery plays a crucial role in both diagnosis and treatment planning. Both hard and soft tissue norms must be considered in establishing harmonious facial aesthetics and an optimal functional occlusion (Bishara and Fernandez, 1985; Bishara *et al.*, 1998). Most widely accepted normative values, however, are based on longitudinal growth studies of untreated subjects of European (Wylie, 1947; Downs, 1948; Steiner, 1953; Tweed, 1953, 1954; Ricketts, 1960) or North American (Riolo *et al.*, 1974; Broadbent *et al.*, 1975; Prahl-Anderson *et al.*, 1979; Behrents, 1985; Bishara and Jakobsen, 1985; Buschang *et al.*, 1986) ancestry.

Legan and Burstone (1980), Holdaway (1983), and Epker *et al.* (1998) have developed a detailed soft tissue analyses that have gained wide acceptance in clinical orthodontic evaluation and orthognathic surgery planning. In that, these analyses once again were based on data derived from Caucasian samples, it has been difficult to apply the norms proposed in these analyses to other racial and ethnic groups. Thus, additional clinical studies have been conducted to evaluate possible ethnic/racial differences or determine normative values for different racial and ethnic populations (Craven, 1958; Nanda and Nanda, 1969; Humerfelt, 1970; Jacobson, 1978; Uesato *et al.*, 1978; Bacon and Mathis, 1983; Bacon *et al.*, 1983; Shalbhoub *et al.*, 1987; Cooke and Wei, 1988; Flynn *et al.*, 1989; Kapila, 1989; Park *et al.*, 1989; Lew *et al.*, 1992; Cerci *et al.*, 1993; Swlerenga *et al.*, 1994; Miyajima *et al.*, 1996; Evanko *et al.*, 1997; Hamdan and Rock, 2001; Hwang *et al.*, 2002; Scavone *et al.*, 2006).

The focus of the current study is the soft tissue profiles of Anatolian Turkish adults. Anatolia is a geographic and historical term denoting the westernmost protrusion of Asia, comprising the majority of the Republic of Turkey. Several attempts have been made to evaluate the soft tissues of the Turkish population (Göyenc *et al.*, 1992; Erbay and Canikliogl u, 2002; Erbay *et al.*, 2002; Basciftci *et al.*, 2003). For example, Erbay *et al.* (2002) investigated horizontal lip positions of Anatolian Turkish adults using several soft tissue analyses. Erbay and Canikliogl u (2002) used soft tissue analysis to evaluate the perceptions of beauty among Anatolian Turkish adults. Göyenc *et al.* (1992) examined soft tissue changes in Class I, Class II, and Class III patients with skeletal malocclusions. Basciftci *et al.* (2003) conducted a study to determine Holdaway soft tissue norms in Anatolian Turkish

adults and found insignificant differences between Turkish and Holdaway norms except for soft tissue chin thickness and basic upper lip thickness.

To our knowledge, there is no study in the literature comparing the soft tissues of Turkish and North American adults directly. Therefore, the aim of this study was to evaluate soft tissue differences between Turkish and North American populations in a sample of subjects with ideal occlusions and well-balanced faces.

Subjects and methods

In this study, a total of 233 cephalometric radiographs were traced and evaluated to compare Turkish and European–American originated untreated adults.

Turkish sample

The Turkish sample consisted of 117 subjects with ideal occlusions and well-balanced faces: 65 females with a mean age of 23.3 ± 2.5 years and 52 males with a mean age of 25.1 ± 2.6 years. Subjects were selected according to the following criteria: Turkish with Turkish grandparents, no previous orthodontic or prosthodontic treatment, well-balanced profile, Class I occlusions, and no or minimal incisor irregularity. To ensure these, inclusion criteria were followed, after a clinical examination; cephalometric radiographs were re-evaluated by two experienced investigators of Anatolian Turkish ancestry.

North American sample

Lateral cephalometric radiographs of 64 females (mean age: 21.9 ± 4.0 years) and 52 males (mean age: 28.8 ± 7.6) were used. Inclusion criteria were Caucasian, no previous orthodontic treatment, well-balanced profile, Class I ideal or near-ideal occlusion, and no or minimal incisor irregularity. The samples were selected by two investigators of European–American ancestry.

During the formation of the groups, American orthodontists selected North American white subjects with well-balanced faces. Turkish subjects were selected by Turkish orthodontists according to their perception of aesthetics. The method of subject selection created two groups that were each aesthetically pleasing according to each culture's standpoint.

Cephalometric analysis

Radiographs were traced by same operator using Dolphin Image Software 9.0 (Dolphin Imaging and Management Solutions, Chatsworth, California, USA). The accuracy of landmark placement was verified by a second investigator, and any differences were resolved by mutual agreement between the two researchers.

Landmark identification was carried out manually on digital images using a mouse-driven cursor. A total of 33 measurements (28 linear and 5 angular) were traced according to the Holdaway, Legan, and Burstone and Epker analysis. Detailed descriptions of the measurements are provided in Figures 1–3.

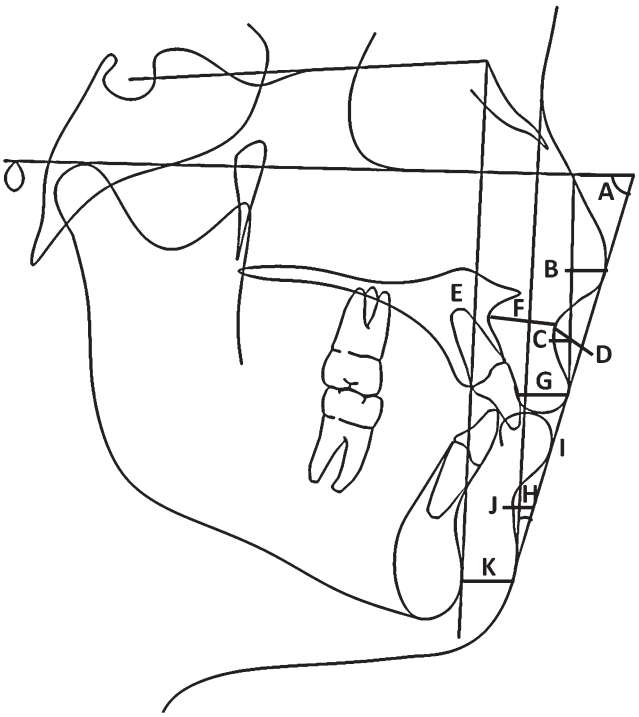

Figure 1 Holdaway soft tissue analysis measurements. A, soft tissue facial angle; B, nose prominence; C, superior sulcus depth; D, soft tissue subnasale to H line; E, skeletal profile convexity; F, upper lip thickness; G, upper lip strain; H, H angle; I, lower lip to H line; J, inferior sulcus to H; K, soft tissue chin thickness.

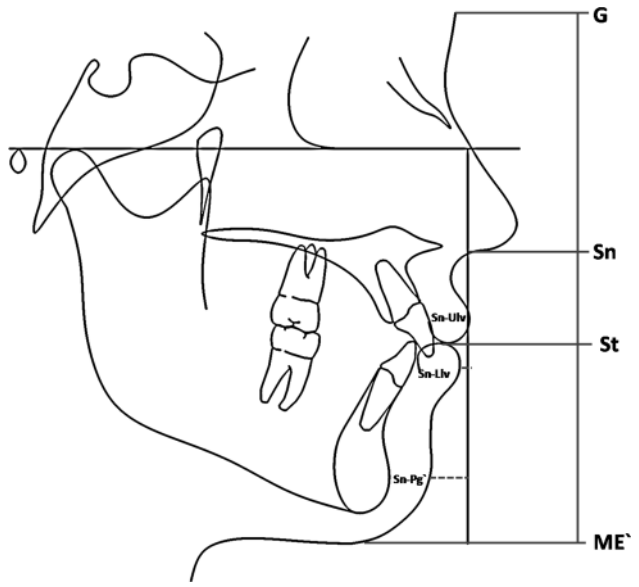

Figure 2 Epker's soft tissue relations. G, glabella; Sn, subnasale; St, stomion; ME', menton.

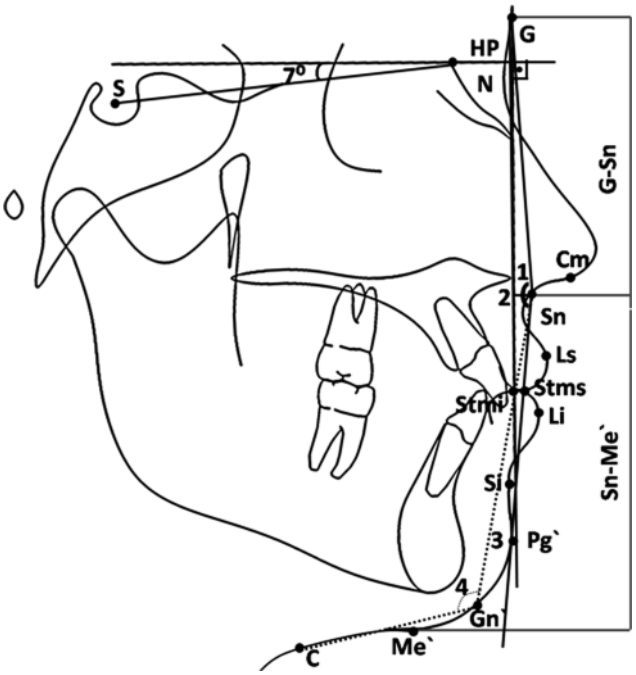

Figure 3 Legan–Burstone soft tissue analysis. Horizontal reference plane (HP), constructed by drawing a line through nasion (N) 7 degrees up from the sella–nasion line. 1, facial convexity angle (G–Sn–Pg'); 2, maxillary prognathism (G vertical–Sn); 3, mandibular prognathism (G vertical–Pg'); 4, lower face–throat angle (Sn–Gn'–C); vertical height ratio (G–Sn/Sn–Me'), lower vertical height–depth ratio (Sn–Gn'/C–Gn'), nasolabial angle (Cm–Sn–Ls), upper lip protrusion (Ls to Sn–Pg'), lower lip protrusion (Li to Sn–Pg'), mentolabial sulcus (Si to Li–Pg'), vertical lip–chin ratio (Sn–Stms/Stmi–Me'), maxillary incisor exposure (Stms–UI), interlabial gap (Stms–Stmi).

Statistical analysis

All statistical analyses were performed using the Statistical Package for Social Sciences (Windows, version 13.0; SPSS Inc., Chicago, Illinois, USA). The normality test of Shapiro–Wilks and Levene's variance homogeneity test were applied to the data. The data were found normally distributed and there was homogeneity of variance among the groups. Thus, the statistical evaluation was performed using parametric tests. Means and standard deviations were calculated for each measurement.

To determine the errors associated with radiographic measurements, 25 radiographs were retraced 3 weeks after the first measurement and all measurements were repeated. Paired sample *t*-tests were applied to the first and second data sets; differences between the first and second measurements of the 25 radiographs were insignificant. To compare Turkish and North American samples and to determine gender differences, independent samples *t*-tests were performed.

Results

Female differences

The comparison between Turkish and North American women is provided in Table 1. The mandible, lower lip, and soft tissue chin were positioned more posteriorly in Turkish women compared to North American women. Measurements regarding soft tissue convexity showed greater convexity for Turkish women. Similarly, the H angle was found to be approximately 2 degrees greater in Turkish women. Statistically significant differences between two groups were recorded for basic upper lip thickness ($P = 0.008$), soft tissue chin thickness ($P = 0.008$), nasolabial angle ($P = 0.039$), mentolabial sulcus depth ($P = 0.018$), and subnasale–lower lip to lower lip–menton ratio ($P = 0.001$) measurements.

Male differences

The comparison between Turkish and North American men is provided in Table 2. Both the maxilla and the mandible were found to be retrognathic in the Turkish sample. Soft tissue subnasale and lower lip were positioned more anteriorly relative to the H line in the Turkish sample compared to the North American sample. Similarly, the upper and lower lips were found to be more protrusive in Turkish males. The soft tissue facial angle and the H angle were larger in the Turkish sample. Upper lip length and Subnasale–stomion superioris to stomion inferioris–menton ratio were greater for American sample. Statistically significant differences between two groups were recorded for soft tissue chin thickness ($P = 0.021$), nasolabial angle ($P < 0.001$), mentolabial sulcus depth ($P = 0.004$), and subnasale–lower lip to lower lip–menton ratio ($P < 0.001$) measurements.

Discussion

This study compared the soft tissue norms of Turkish and North American adults. All study subjects had balanced facial aesthetics and ideal or near-ideal occlusions. Orthodontically treated individuals were excluded because orthodontic treatment may produce changes in the soft tissue profile.

Chin prominence and thickness

Chin prominence and soft tissue chin thickness were reduced in the Turkish sample for female and male comparisons. Basciftci *et al.* (2003) previously reported increased soft tissue chin thickness in Turkish subjects relative to Holdaway norms.

Facial convexity and jaw position

The soft tissue facial angle indicates the prominence of the lower face or the chin area (Holdaway, 1983). This measurement was approximately 2 degrees less in the Turkish sample for both genders. For Turkish women, G–Pg' and subnasale perpendicular to chin measurements showed the retrusion of the lower face. Similarly,

Table 1 Comparison between Turkish and North American females.

Analysis	Turkish females (n = 65)		North American females (n = 64)		P
	Mean	SD	Mean	SD	
Holdaway analysis					
Soft tissue facial angle	92.2	3.1	94.2	3.4	<0.001
Nose prominence	15.3	2.8	14.9	3.5	0.483
Superior sulcus depth	3.1	1.0	3.3	1.6	0.289
Soft tissue subnasale to H line	4.1	2.4	3.7	2.7	0.433
Skeletal profile convexity	1.4	2.2	1.8	2.4	0.312
Basic upper lip thickness	16.4	2.6	15.1	3.0	0.008
Upper lip thickness	12.8	1.7	12.3	3.1	0.265
Upper lip strain					
H angle	13.6	3.8	11.7	4.4	0.009
Lower lip to H line	0.7	1.4	0.3	1.2	0.070
Inferior sulcus to H line	5.3	1.4	5.0	1.4	0.262
Soft tissue chin thickness	12.1	2.0	13.5	3.5	0.008
Epker soft tissue					
Middle third height:lower third height	101.9	10.3	105.0	9.6	0.078
Upper lip length	22.3	2.7	23.5	4.4	0.070
Subnasale–stomion:stomion–menton	45.0	5.5	45.5	5.9	0.643
Subnasale–lower lip:lower lip–menton	79.7	13.1	72.5	11.0	0.001
Interlabial distance	1.2	1.1	1.1	1.1	0.647
Subnasale perpendicular to Up	1.0	1.7	1.6	2.0	0.070
Subnasale perpendicular to Lo	−1.6	2.5	0.0	2.3	0.001
Subnasale perpendicular to chin	7.42	5.07	4.1	5.59	0.001
Legan–Burstone analysis					
Facial form					
Facial convexity angle G–Sn–Pg' angle	14.2	4.9	10.6	5.2	<0.001
Maxillary prognathism G–Sn (HP), mm	5.1	3.8	5.2	5.3	0.873
Mandibular prognathism G–Pg' (HP), mm	−4.7	7.3	-1.1	7.9	0.008
Vertical height ratio G–Sn/Sn–Me' (HP)	1.0	0.1	1.1	0.1	0.179
Lower face–throat angle Sn–Gn'–C dg	105.7	7.2	106.3	7.2	0.659
Lower vertical height– Sn–Gn'/C–Gn' depth ratio	1.3	0.2	1.3	0.2	0.659
Lip position					
Nasolabial angle Cm–Sn–Ls dg	107.7	8.6	111.1	9.7	0.039
Upper lip protrusion Ls to Sn–Pg', mm	3.0	1.8	2.7	1.9	0.309
Lower lip protrusion Li to Sn–Pg', mm	2.5	2.0	1.9	1.6	0.090
Mentolabial sulcus Si to Li–Pg', mm	−5.7	1.1	−5.2	1.2	0.018
Vertical lip–chin ratio Sn–Stms/Stmi–Me'	50.3	4.9	51.6	6.3	0.168
Maxillary incisor exposure Stms–UI, mm	3.5	1.7	3.3	2.0	0.717
Interlabial gap Stms–Stmi HP, mm	1.2	1.1	1.1	1.1	0.647

mandibular retrusion maybe the reason for increased soft tissue convexity for Turkish males. Another explanation for increased soft tissue convexity may be the posterior position of soft tissue nasion or glabella points or the thinner soft tissue chin. It should be noted that no measurement was performed to evaluate the position of the forehead in the present study. Compared to the findings of Basciftci *et al.* (2003), soft tissue facial angle measurements were higher in the Turkish sample examined in the current research.

Upper lip position, contour, and length

Greater values were recorded for the H angle measurement in Turkish subjects compared to the North American sample (approximately 2 degrees for females and 3 degrees for males). This measurement shows the prominence of the upper lip in relation to the overall soft tissue profile (Holdaway, 1983). Increased thickness and protrusion of upper lip in the Turkish sample may explain this finding. According to Holdaway (1983), the ideal range for the H angle is 7–14 degrees. In the present study, the mean H angle values were within this range. Similar results were reported by Erbay *et al.* (2002) and Basciftci *et al.* (2003).

Superior sulcus depth measurement quantifies the curl or form of the upper lip (Holdaway, 1983); this measurement was not statistically significant between groups. Similar results were reported by Basciftci *et al.* (2003). From the results of the current study, it may be concluded that the Turkish men had shorter and more prominent lips as an ethnic characteristic.

Lower lip position and contour

It may be concluded that Turkish males have protrusive lower lips compared to North American males but statistically significant differences were not found between groups. Erbay *et al.* (2002) evaluated lower lip position relative to the H line in groups with normal dentitions. This measurement was −0.4 mm for males and 0.2 mm for

Table 2 Comparison between Turkish and North American males.

Analysis	Turkish males (n = 52)		North American males (n = 52)		P
	Mean	SD	Mean	SD	
Holdaway analysis					
Soft tissue facial angle	92.9	2.7	94.9	2.8	0.000
Nose prominence	15.3	3.4	16.0	3.3	0.342
Superior sulcus depth	3.7	1.4	3.2	1.8	0.114
Soft tissue subnasale to H line	5.5	2.7	3.7	3.5	0.004
Skeletal profile convexity	0.4	2.9	1.4	2.9	0.090
Basic upper lip thickness	19.0	2.7	18.0	2.6	0.072
Upper lip thickness	15.2	2.3	14.8	3.3	0.480
Upper lip strain					
H angle	14.0	3.7	10.9	4.2	<0.001
Lower lip to H line	0.5	1.8	-0.2	1.7	0.030
Inferior sulcus to H line	6.8	1.8	6.3	2.0	0.222
Soft tissue chin thickness	13.9	2.1	15.2	3.2	0.021
Epker soft tissue					
Middle third height:lower third height	99.3	9.8	96.7	7.5	0.134
Upper lip length	24.4	3.0	26.9	3.8	<0.001
Subnasale–stomion:stomion–menton	45.8	6.2	45.5	4.7	0.779
Subnasale–lower lip:lower lip–menton	80.2	13.3	68.3	9.6	<0.001
Interlabial distance	1.1	1.6	0.7	0.9	0.185
Subnasale perpendicular to Up	2.2	2.3	1.7	2.4	0.310
Subnasale perpendicular to Lo	−0.5	2.8	-0.1	2.6	0.427
Subnasale perpendicular to chin	5.8	6.2	5.0	5.6	0.473
Legan–Burstone analysis					
Facial form					
Facial convexity angle G–Sn–Pg' angle	12.1	5.8	10.4	4.9	0.106
Maxillary prognathism G–Sn (HP), mm	6.1	4.9	8.4	5.1	0.024
Mandibular prognathism G–Pg' (HP), mm	−1.4	8.5	3.5	7.8	0.003
Vertical height ratio G–Sn/Sn–Me' (HP)	1.0	0.1	1.0	0.1	0.255
Lower face–throat angle Sn–Gn'–C dg	104.9	11.8	105.5	9.7	0.765
Lower vertical height–Sn–Gn'/C–Gn' depth ratio	1.8	1.8	1.4	0.2	0.053
Lip position					
Nasolabial angle Cm–Sn–Ls dg	102.9	10.5	112.6	10.6	<0.001
Upper lip protrusion Ls to Sn–Pg', mm	4.0	1.9	2.6	2.4	0.002
Lower lip protrusion Li to Sn–Pg', mm	3.0	2.3	1.5	2.3	0.002
Mentolabial sulcus Si to Li–Pg', mm	−7.0	1.3	−6.2	1.6	0.004
Vertical lip–chin ratio Sn–Stms/Stmi–Me'	51.1	5.0	53.2	5.2	0.034
Maxillary incisor exposure Stms–UI, mm	2.3	2.1	3.0	2.3	0.127
Interlabial gap Stms–Stmi HP, mm	1.1	1.6	0.7	0.9	0.185

females. According to the findings of Basciftci *et al.* (2003), these measurements were −0.1 and 0.1 mm, respectively. In the present study, these values are 0.5 mm for males and 0.7 mm for females. The mentolabial sulcus relative to lower lip pogonion line measurement showed that mentolabial sulcus depth was increased in the Turkish sample.

Nose prominence and nasolabial angle

No statistically significant difference existed for nose prominence. The findings for nose prominence in the current investigation were distinctly different from those of Basciftci *et al.* (2003) that showed more prominent noses for Turkish individuals. The nasolabial angle was decreased in Turkish samples for both genders.

The findings from this study are important from two perspectives. Firstly, when using Caucasian soft tissue norms to analyse a Turkish patient cephalometrically, the practitioner must consider the Turkish culture's view of soft tissue facial aesthetics and try to incorporate and maintain these soft tissue features in the treatment plan. Secondly, when a Turkish practitioner is treating a Caucasian, he/she must consider the cultural bias he/she may have in soft tissue aesthetics. For example, while the practitioner may favour short, thicker, and more protrusive lips, the Caucasian adult he/she is treating may not find such a feature to be aesthetically pleasing. Ideally, any array of cephalometric norms should be ethnically specific so that patients can have aesthetic faces according to their own culture's concept of beauty.

Conclusions

According to the results of this study, there are important soft tissue differences between Turkish and European–Americans. The most important differences when comparing a Turkish patient to an American patient of European ancestry is that Turkish patients have

- More convex soft tissue facial profiles,
- More retrognathic and thinner soft tissue chins,
- More protrusive and shorter upper and lower lips (for males only),
- These differences may be taken into account when Turkish patients treated according to Caucasian norms.

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