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Photographic facial soft tissue analysis of healthy Iranian young adults: anthropometric and angular measurements

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Abstract

Background: Soft tissue profile can be widely different in various populations. Furthermore, this profile can be also continues to change throughout life. However, there are few studies that quantitatively evaluate the soft tissue profile in Iranian population. In order to determine normal reference values of facial parts in our populations, we aimed to measure standards for facial soft tissue parameters in Iranian young population.

Methods: The study samples included 155 medical students at the Firouzgar hospital in winter 2011. The soft tissue facial profiles were digitally analyzed using linear measurements and angles made with standardized photographic records, taken in a natural head position, to determine the average soft tissue facial profile for males and females.

Results: There was a statistically significant difference between males and females in 21 of our 26 measurements. The most prominent differences between the genders were observed in the measurements taken from the face region. Minimum frontal breadth and supraorbital breadth were larger in males than in females. Except for middle face height measurement, other horizontal and vertical measurements for the face were larger in males than in females, indicating wider and higher faces in men than in women. Some measurements of facial angles are discrepant between the two genders.

Conclusion: Due to the specific features of Iranian facial soft tissue values and also observable differences in facial measurements and angles between men and women, the Iranian standard values on facial measurements and angles should be given more attention, especially by plastic and cosmetic surgeons.

Keywords: Anthropometry, Measurements, Face, Analysis, Iranian.

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Introduction

The analysis of the human face is a science and an art, utilizing both aesthetic and anthropologic tools. The appearance of the face is influenced by age, sex, race, and ethnicity (1). In addition, the quantitative measurements of face can be widely changes following growth as well as after surgical procedures (2). Furthermore, facial measurements are also an integral part of the evaluation of dimorphism. Therefore, planning a surgery on the face with the aim

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of restoration of facial components or maintaining the beauty should be performed by considering each of these factors (3). On the other hand, due to the increasing scrutiny placed upon the facial appearance at the completion of maxillofacial and cosmetic surgeries, a great deal of research has been conducted to determine what factors contribute to facial esthetics naturally through growth as well as through treatment (4). Consequently, the assessment of the soft tissue profile is an important part of diagnosis and treatment plan those in need of these types of surgeries (5,6). Photogrammetry has been introduced as an alternative to direct measurements to obtain angles and distances between facial landmarks. Obtaining measurements from photographs is less intrusive to the patient and more cost-effective, it provides a permanent record of the face that can be accessed at a later time (6,7,8).

There are numerous studies which demonstrated that the soft tissue profile can be widely different in various populations. Furthermore, this profile can also be continued to change throughout life from childhood into adulthood. However, there are few studies that quantitatively evaluate the soft tissue profile in Iranian population. In order to determine normal reference values of facial parts in our populations, we aimed to measure standards for facial soft tissue parameters in Iranian young population.

Methods

This analytical cross sectional study samples included 155 medical students at the Firouzgar hospital who had an appropriate health condition and enrolled in the hospital in winter 2011. All participants were explained how to implement the project and then they all had written consent to participate in the study. A brief questionnaire for all baseline characteristics including age, gender, and race was completed and inclusion criteria were checked by an ENT resident. Dental class I occlusion (the mesiobuccal groove of the maxillary first molar sitting within the mesiobuccal groove of the mandibular first molar (9)) was performed for all subjects that the normal state considered as inclusion criterion. History of orthodontic treatment was also considered as exclusion criterion. Other exclusion criteria were history of trauma to the face and facial fractures, facial cosmetic surgery, or any significant deformity in the nose or face.

Photography devices included a camera (canon D 5 35mm) and a tripod that used to prevent vibration and considering the height of subject for setting up horizontal axis of the camera lens. To avoid red eye in the picture, the camera flash the mode set for red eye effect. The primary flash was attached to the tripod by a lateral arm, at a distance of 27 cm from the optic axis to avoid the “red-eye effect” on the records. A secondary flash was placed behind the subject to enlight the background and eliminate undesirable shadows from the contours of the facial profile. The primary and secondary flashes were synchronized to improve the image. Distance between the camera and subject fixed at 2m and the visual axis was parallel to the floor. To get the actual size of the frontal and lateral views, a one-centimeter benchmark in the middle of the irforehead and in the cheek was considered respectively. Before taking the picture if the person had to wear glasses, the glass was removed. Standardized facial photographs were obtained: with a fully opened eye, no smile, and gently closed lips, and with visible forehead and neck. For each subject, a single operator located the standard anthropometric landmarks on digital photographic images. All data were obtained from standardized digital photographic images using the standard anthropometric measuring method. After locating a total of 19 soft tissue facial landmarks on frontal view (Fig. 1) and 15 landmarks on lateral view (Fig. 2), angles (26 measurements on frontal view and 9 angles on lateral view) were measured using AutoCAD 2008 software and recorded in the checklists. Anthropometric landmarks used in this study are presented in Table 1 and Fig-

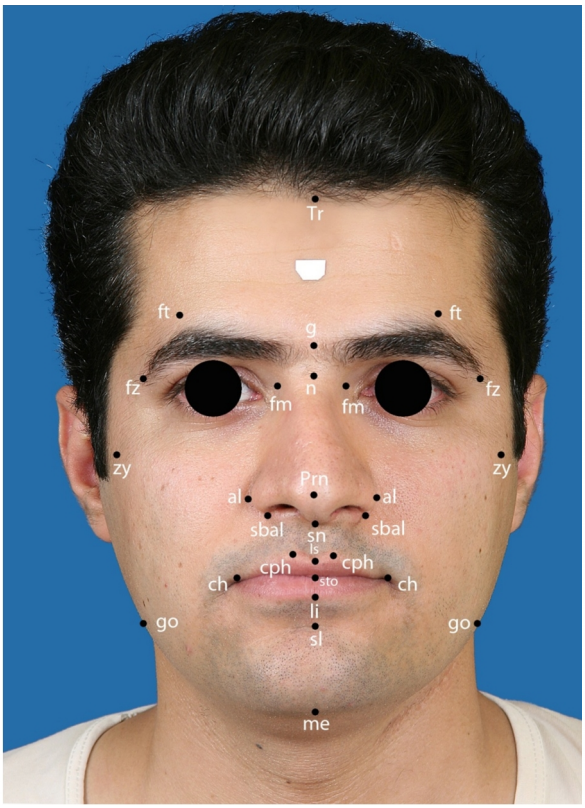

Fig. 1. Facial landmarks in frontal view (tr-trichion, g-glabella, n-nasion, mf-maxillofrontale, pr-pronasale, al-alare, sbal-subalare, sn-subnasale, cph-crista philter, ls-labialesuperius, ch-cheilion, sto-stomion, li-labialeinferius, sl-sublabiale, Me-menton, zy-zygion, go-gonion, ft-frontotemporale, fz-frontozygomaticus)

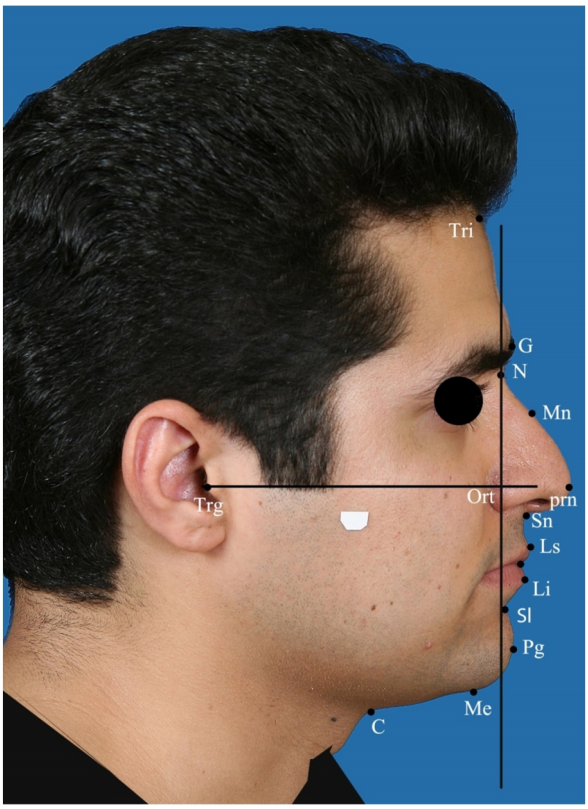

Fig. 2. Facial landmarks in lateral view (G-glabella, N- nasion, Mn- mid nasal, Prn- pronasal, Cm, Sn-subnasal, Ls-labial superior, Li-labial inferior, SL- sub labal, Pg-pogonion, Me- menton, C- cervical, Trg- tragus, Ort point- junction of true vertical and true horizontal. Reference lines)

ures 1 & 2, and 26 standard anthropometric measurements on right and left side of the face are shown in Table 2.

Results were presented as mean/SD for quantitative variables and compared using t test or Mann-Whitney U test if required. Statistical significance was determined at a p value of ≤ 0.05. All statistical analysis was performed using SPSS software (version 16.0, SPSS Inc., Chicago, Illinois).

Results

The results of the craniofacial anthropometric measurements for all 155 subjects (72 men with the mean age of 22.19/2.42 years and 83 women with the mean age of 23.38/3.24 years) were summarized by gender in Table 3. All measurements were given in millimeters. Craniofacial measurements were compared between males and females. A statistically significant difference existed between males and females in 21 of our 26 measurements. The most prominent differences between the genders were observed in the measurements taken from the face region. In this study, 19 facial landmarks were marked by the same investigator. After one month, this same investigator marked the landmarks on the 40frontal and lateral images (10 male, 10 female) that were selected randomly from the study population. Analysis was performed to obtain a G reliability coefficient. As a result, the analysis of the rate indicated good repeatability for both female and male subjects (G = 0.91).

Cranial: Four measurements were performed, two vertical (tr-n, tr-g) and two horizontal (ft-ft, fz-fz). Comparison of the measurement of cranial region showed that minimum frontal breadth and supraorbital breadth were larger in males than in females. Also, vertical measurements of

Table 1. Anthropometric landmarks used in the study

Landmarks	Region	Definition
tr-trichion	Cranial	Midpoint of the hairline
g-glabella	Cranial	The most prominent point in the median sagital plane between the supraorbital ridges
n-nasion	Face	The midpoint of the nasofrontal suture
mf-maxillofrontale	Nose	The anterior lacrimal crest of the maxilla at the frontomaxillary suture
pr-pronasale	Nose	The most protruded point of the nasal tip
al-alare	Nose	The most lateral point on the nasal ala
sbal-subalare	Nose	The point on the lower margin of the base of the nasal ala where the ala disappears into the upper lip skin
sn-subnasale	Face	The junction between the lower border of the nasal septum, the partition that divides the nostrils, and the cutaneous portion of the upper lip in the midline
cph-crista philter	Orolabial	The point on the crest of the philtrum, the vertical groove in the median portion of the upper lip, just above the vermilion border
ls-labialesuperius	Orolabial	The midpoint of the vermilion border of the upper lip
ch-cheilion	Orolabial	The outer corner of the mouth where the outer edges of the upper and lower vermilions meet
sto-stomion	Face	The midpoint of the labial fissure when the lips are closed naturally
li-labialeinferius	Orolabial	The midpoint of the vermilion border of the lower lip
sl-sublabiale	Face	The midpoint of the labiomental sulcus
Me-menton	Face	The lowest point in the midline on the lower border of the chin
zy-zygion	Face	The most lateral point on the zygomatic arch
go-gonion	Face	The most lateral point at the angle of the mandible
ft-frontotemporale	Cranial	The most medial point on the temporal crest of the frontal bone
fz-frontozygomaticus	Cranial	The most lateral point on the frontozygomatic suture

Table 2. Standard anthropometric measurements

Region	Measurement name	Plane	Landmarks
Cranial	Minimum frontal breadth	Horizontal line	frontotemporale–frontotemporale
	Supraorbital breadth	Horizontal line	frontozygomaticus-frontozygomaticus
	Forehead height I	Vertical line	trichion–glabella
	Forehead height II	Vertical line	trichion-nasion
Facial	Middle face height	Vertical line	glabella–subnasale
	Maximum facial breadth	Horizontal line	zygion-zygion
	Bigonial breadth	Horizontal line	gonion–gonion
	Physiognomic face height	Vertical line	trichion–Me(menton)
	Morphologic face height	Vertical line	nasiongnathion
	Upper face height	Vertical line	nasion–stomion
	Anterior mandibular height	Vertical line	stomion–Me(menton)
	Chin height	Vertical line	sublabiale-gnathion
	Lower face height	Vertical line	subnasale-gnathion
Nasal	Nose height	Vertical line	nasion-subnasale
	Nasal bridge length	Vertical line	nasion-pronasale
	Nose width	Horizontal line	alare-alare
	Nasal root width	Horizontal line	maxillofrontale-maxillofrontale
	Nostril floor width	Horizontal line	subalare-subnasale
Oral-labial	Philtrum width	Horizontal line	crista philtre-crista philtre
	Labial fissure width	Horizontal line	cheilion-cheilion
	Philtrum length	Vertical line	subnasale-labialesuperius
	Upper vermilion height	Vertical line	labialesuperius-stomion
	Upper lip height	Vertical line	subnasalestomion
	Lower lip height	Vertical line	stomion-sublabiale
	Cutaneous lower lip height	Vertical line	labialeinferius-sublabiale
	Lower vermilion height	Vertical line	labialeinferius-stomion

forehead height (tr - g, tr – n) were discrepant between the two genders.

Face: Seven vertical (g-sn, tr-gn, n-gn, n-sto, sto-gn, sl-gn, sn-gn) and two horizontal (zy-zy, go-go) measurements were performed. Except for middle face height measurement, other measurements (including maximum facial breadth, bigonial breadth, physiognomic face height, morphologic face height, upper face height, anterior mandibular height, chin height, lower face height) were larger in males than females. Measurements of the face showed that males had wider and higher faces.

Table 3. Standard craniofacial anthropometric measurements in Iranian population in men and women

Facial measurements	Male (mean)	SD (SEM)	Female (mean)	SD (SEM)	Total (mean)	SD (SEM)	p-value
Minimum frontal breadth	107.433	7.5873	94.564	7.1996	100.542	9.7778	< 0.001
Supra-orbital breadth	129.108	6.7111	115.102	5.6665	121.608	9.3260	< 0.001
Nasal root width	21.383	1.3058	20.054	1.7883	20.672	1.7121	< 0.001
Maximum facial breadth	138.050	9.6521	124.698	6.6860	130.900	10.5541	< 0.001
Nose width	39.771	2.6555	35.022	2.2258	37.228	3.3964	< 0.001
Nostril floor width	14.183	2.3627	12.167	1.6870	13.104	2.2597	< 0.001
Philtrum width	15.737	2.7116	12.790	2.1680	14.159	2.8403	< 0.001
Labial fissure width	53.133	4.7927	48.057	6.3020	50.415	6.1798	< 0.001
Bigonial breadth	127.229	10.9665	105.960	7.4428	115.840	14.0782	< 0.001
Forehead height I	58.933	6.1150	55.751	6.9009	57.229	6.7181	0.003
Forehead height II	68.500	5.7529	65.113	7.2194	66.686	6.7736	0.001
Nasal bridge length	40.350	6.7173	41.498	4.6480	40.965	5.7128	0.213
Philtrum length	17.567	2.5546	14.243	3.9960	15.787	3.7784	< 0.001
Upper vermilion height	6.025	1.6215	6.312	1.1496	6.179	1.3916	0.212
Lower vermilion height	9.600	2.6691	9.820	1.6889	9.718	2.1944	0.534
Cutaneous lower lip height	10.967	3.3117	8.025	2.0247	9.392	3.0667	< 0.001
Chin height	31.754	3.6766	25.302	2.4955	28.299	4.4687	< 0.001
Lower lip height	20.5667	3.02115	17.8458	2.28331	19.1097	2.97279	< 0.001
Anterior mandibular height	52.3208	4.63711	43.1482	3.62503	47.4090	6.16238	< 0.001
Midface height	76.029	5.9859	73.770	5.3207	74.819	5.7334	0.015
Morphological face height	128.350	8.9877	116.918	7.4709	122.228	9.9840	< 0.001
Physiognomical face height	196.850	12.8803	182.031	11.5016	188.915	14.2092	< 0.001
Middle face height	62.004	5.1380	62.577	4.2623	62.311	4.6826	0.455
Upper lip height	23.592	1.8256	20.555	3.9837	21.966	3.5064	< 0.001
Lower face height	75.912	5.4588	63.704	6.1785	69.375	8.4488	< 0.001
Nose height	52.437	5.0226	53.214	3.5721	52.854	4.3100	0.276

Table 4. Standard craniofacial angle measurements in Iranian population in men and women

Facial angles	Male (mean)	SD (SEM)	Female (mean)	SD (SEM)	Total (mean)	SD (SEM)	p-value
G–N –Prn, nasofrontal	132.917	6.9402	141.161	5.9041	138.860	7.2032	< 0.001
N–Prn/N–Ort, vertical nasal	32.125	4.6374	30.242	5.6559	30.767	5.4312	0.119
Prn–Sn–Ls, nasolabial	106.625	11.9011	103.581	14.5766	104.430	13.8815	0.324
Li–Sl–Pg, mentolabial	122.000	11.8211	124.258	10.0506	123.628	10.5519	0.413
Sn–Prn/N- Prn, nasal	75.500	8.7377	79.887	7.6074	78.663	8.1307	0.037
N-Mn-Prn, nasal dorsum	174.167	4.2290	178.032	2.5797	176.953	3.5576	< 0.001
G-Pg/C-Me, cervicomental	101.417	6.9590	91.952	7.2302	94.593	8.2979	< 0.001
N-Trg-Sn, med facial	27.625	1.7399	30.581	2.8718	29.756	2.9182	< 0.001
Sn-Trg-Me inf facial third	34.458	2.2838	34.903	3.2629	34.779	3.0153	0.478
G-Sn-Pg, facial convexity	167.417	3.5743	167.774	4.4332	167.674	4.1937	0.700
G-Prn-Pg, total facial	137.875	3.7103	138.145	4.1125	138.070	3.9846	0.770

Nasal: Five measurements were made for the nasal region. Although nose width and nostril floor width show statistically significant differences between males and females, nose height, nasal bridge length, and nasal root width were not different.

Orolabial: Comparing anthropometric measurements from the orolabial region, we found that all measurements were larger in males than in females, except for the upper and lower vermilion heights.

Angles: Descriptive measurements of angles are summarized in Table 4 and compared between the two genders.

Nose: There was significant difference in the angles of nasal (N-Prn-Sn), nasal dorsum, (N-Mn-Prn), and nasofrontal (G–N –Prn) between men and women, while no differences was detected in vertical nasal (N–Prn/N–Ort) angle between them.

Nasal Base and upper lip: This region was assessed by measuring Nasolabial (Prn–Sn–Ls) angle that ranged 85 to 123 degree in men and 79 to 120 degree in women. Mentolabial (Li–Sl–Pg) angle were not different between men and women. The average of cervicomental (G-Pg/C-Me) angle was 101.41/6.95 degree in men and 91.94/7.23 degree in women with a significant difference. The measurements of other

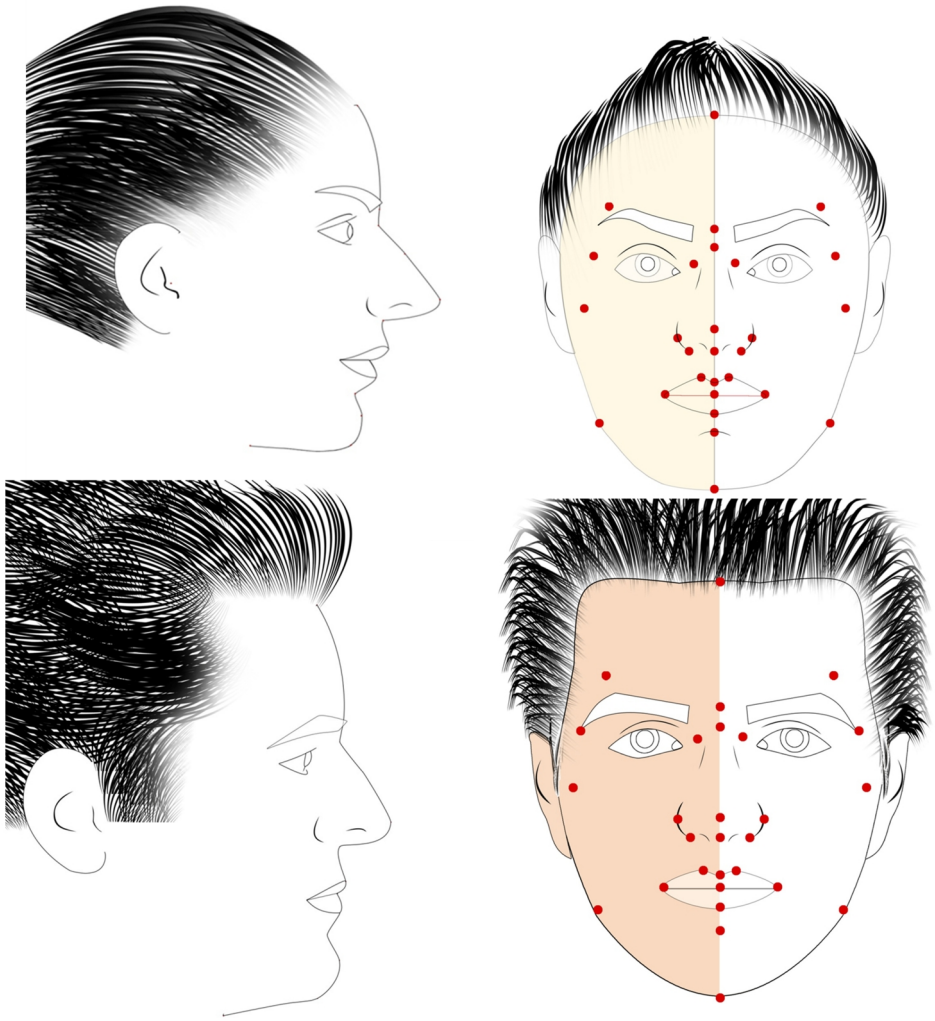

Fig.3. Schematic figures of young Iranian adults of soft facial tissue (With respect to the results of anthropometric and angular measurements)

angles were not meaningful between the two genders.

Facial convexity was assessed using facial convexity (G-Sn-Pg) angle with the mean of 167.67/4.19. Also, total facial convexity was measured by Total Facial (G – Prn – Pg) angle with the average of 138.86/7.20 degree.

Discussion

Many studies have been performed for better understanding of how growth and development could affects the skeleton, dentition, and the soft tissue profile in children and adolescence (10). It has been recently presented statistical significance in the interethnic variability of the neoclassical facial measurements with a 95 percent confidence level, allowing classification of the facial measurements into five distinct levels of variability including least variable, less variable intermediate, intermediate, more variable intermediate, and most variable (11).

Comparison of our facial measurements with the findings of other studies among different populations especially among Asians showed major similarities in different landmarks and facial angles. Similar to studies on Turkish people, in our observation, the most prominent differences between the sexes were observed in the

measurements taken from the face region (1,12). In our study, all four measurements of skull including two vertical and two horizontal were discrepant between men and women. Also, in facial measurement, except for middle face height measurement, other measurements including maximum facial breadth, bigonial breadth, physiognomic face height, morphologic face height, upper face height, anterior mandibular height, chin height, lower face height) for the face were larger in males than females. Gender differences were also present in the mentolabial and cervicomental angles. However, when this was compared to Chinese adults, most of the measured angles in our analysis were similar in the two genders, while all the linear measurements in Chinese peoples were larger in men than women, but all the angular measurements were smaller in men than women (13). Also, in some studies on both eastern and western European nations, most of the facial angles including nasofrontal, nasolabial, mentolabial, and nasal tip angle were larger in women than men (14,15). In Croatian people, almost all vertical variables were larger in the males, except the length of the nasal tip, which was larger in females (16).

With respect to the results of anthropometric and angular measurements, we decided to propound schematic figures of young Iranian adults in soft facial tissue (Fig. 3).

Conclusion

Our study revealed a highly significant sex dimorphism in the soft tissue profile, presenting that form for both size and shape differe between male and female soft tissue profiles that was similarly shown in some other populations especially neighboring countries of Iran. Due to the specific features of Iranian facial soft tissue values and also observable differences in facial measurements and angles between men and women, the Iranian standard values on facial measurements and angles should be given more attention, especially by plastic and cosmetic surgeons.

References

1. Ozdemir ST, Sigirli D, Ercan I, Cankur NS. Photographic facial soft tissue analysis of healthy Turkish young adults: anthropometric measurements. Aesthetic Plast Surg. 2009 Mar;33(2):175-84.

2. Sarver D, Ackerman M. Dynamic smile visualization and quantification: Part 1. Evolution of the concept and dynamic records for smile capture. American Journal of Orthodontics and Dentofacial Orthopedics. 2003 July;124(1):4-12.

3. Milosevic´ SA, Varga ML, Slaj M. Analysis of the soft tissue facial profile of Croatians using of linear measurements. J Craniofac Surg. 2008 Jan; 19(1):251-8.

4. Farkas LG, Katic MJ, Forrest CR, Alt KW, Bagic I, Baltadjiev G, et al. International anthropometric study of facial morphology in various ethnic groups/races. J Craniofacial Surg. 2005 Jul; 16(4):615-46.

5. Sforza C, Laino A, D'Alessio R, Grandi G, Tartaglia GM, Ferrario VF. Soft-tissue facial characteristics of attractive and normal adolescent boys and girls. Angle Orthod. 2008; 78(5):799–807.

6. Douglas TS. Image processing for craniofacial landmark identification and measurement: a review of photogrammetry and cephalometry. Comput Med Imaging Graph. 2004 Oct; 28(7):401-9.

7. Guyot L, Dubuc M, Richard O, Philip N, Dutour O. Comparison between direct clinical and digital photogrammetricmeasurements in patients with 22q11 microdeletion. Int J Oral Maxillofac Surg. 2003 Jun; 32(3):246-52.

8. Zhang X, Hans MG, Graham G, Kirchner HL, Redline S. Correlations between cephalometric and facial photographicmeasurements of craniofacial form. Am J Orthod Dentofacial Orthop. 2007 Jan; 131(1): 67-71.

9.

10. Flint WP, Haughey BH, Lund VJ, Niparko JK, Richardson MA, Robbins KT, Thomas JR. Cummings Otolaryngology - Head and Neck Surgery. 5th Edition. Philadelphia, PA: Elsevier Mosby; 2010; chap 23.

11. Hoffelder L, de Lima E, Martinelli F, Bolognese A. Soft-tissue changes during facial growth in skeletal Class II individuals. Am J Orthod Dentofacial Orthop. 2007 Apr; 131(4):490-5.

12. Fang F, Clapham PJ, Chung KC. A Systematic review of interethnic variability in facial dimensions. Plast Reconstr Surg. 2011 Feb; 127(2):874-81.

13. Malkoç S, Demir A, Uysal T, Canbuldu N. Angular photogrammetric analysis of the soft tissue facial profile of Turkish adults.Eur J Orthod. 2009 Apr; 31(2):174-9.

14. He ZJ, Jian XC, Wu XS, Gao X, Zhou SH, Zhong XH. Anthropometric measurement and analysis of the external nasal soft tissue in 119 young Han Chinese adults. J Craniofac Surg. 2009 Sep; 20(5):1347-51.

15. Anić-Milosević S, Lapter-Varga M, Slaj M. Analysis of the soft tissue facial profile by means of angular measurements.Eur J Orthod. 2008 Apr; 30(2):135-40.

16. Fernández-Riveiro P, Smyth-Chamosa E, Suárez-Quintanilla D, Suárez-Cunqueiro M. Angular photogrammetric analysis of the soft tissue facial profile. Eur J Orthod. 2003 Aug; 25(4):393-9.

17. Milosević SA, Varga ML, Slaj M. Analysis of the soft tissue facial profile of Croatians using of linear measurements.J Craniofac Surg. 2008 Jan; 19(1):251-8.