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Soft tissue cephalometric norms in Iranian normal subjects

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ABSTRACT

Soft tissue analysis has been proposed by many authors as a reliable guide in treatment planning. Thus establishing population norms is an important issue in orthodontic treatment. The aim of this study was to determine the mean values of some of the soft tissue facial traits in Iranian subjecsts as determined by Bergman. Lateral cephalograms of 120 Iranian subjects (60 males and 60 females) in five age groups (n= 24) with well balanced face and normal occlusion were used.statistical analyses were done by means of unpaired student's t-test and one way AOVA. The associations of variables with age and also with each other were assessed using Pearson's correlation coefficient. The norms valuesfor Iranian subjects differ from those of Bergman in upper and lower lip thicknesses, facial profile angle and upper lip length (in males).sexual dimorphism was determined in lower facial height, upper lip length, upper lip thickness and lower lip thickness. All of the variables were significantly correlated with age except for facial profile angle. Iranian norms differ from those of other population which are usually used. Therefore, when planning a treatment for this population their own norms should be employed.

Keywords: Soft tissue, cephalometry, Iranian, Norms

INTRODUCTION

Taking soft tissue traits into account through conducting a complete facial examination, helps orthodontists attain treatment outcomes which are optimal in terms of both hard and soft tissue harmonies. Facial attractiveness does not necessarily accompany bite correction and even sometimes occlusal treatment results in decreased facial esthetics. [1] Accordingly, to plan a treatment which is capable of improving facial esthetics while moving toward occlusal treatment, one should aims at normalizing the deviations from what is considered to be esthetically acceptable. An excellent face is differently described based on ethnicity and culture and normal values of facial traits should be established specifically for each ethnic group.

Soft tissue analysis has been proposed by many authors as a reliable guide in treatment planning. [2- 13]Bergman has also introduced several facial traits which have been said to be important in conducting a successful treatment. [1]The purposes of this study were to establish the normal values of some of these traits for Iranian male and female possessing well balanced profile and normal occlusion, and to evaluate age related changes in these values.

MATERIALS AND METHODS

The sample for this study consisted of 120 lateral cephalograms of Iranian subjects in different age groups whom were judged to have well balanced face and normal occlusion. These individuals were selected from a sample of 6150 students in the city of Isfahan in center of Iran based on having well balanced profile, competent lips, Class I occlusion, normal overjet and overbite and minimal or no crowding whom had not undergone orthodontic treatment before. The cephalograms of these subjects were retrieved from achieve of the Department of orthodontics at the Isfahan University of Medical Sciences. All cephalograms had been taken with head oriented in natural position, teeth in centric occlusion and lips in repose. The cephalograms were categorized based on thepatients' age group in five groups of 6-8, 8-10, 10-12, 12-14 and 14-17 years of age. Each group included 24 cephalograms of 12 males and 12 females. Lateral cephalograms of all subjects were hand traced by one investigator on acetate paper over view box and the tracing was further reviewed by other authors for accuracy. In this study two angular and six linear measurements were made on each radiograph. The landmarks for these measurements were identified based on Bergman's definition[1] and are depicted in Figure 1. The following measurements were made and compared between groups.

Linear variables:
Lower facial height (LFH): The distance from subnasale point (Sn) to soft tissue menton (Me′).
Upper lip length (ULL): The distance from subnasale (Sn) to stomium superious (St_s).
Upper lip thickness (ULT): Measurement from the vermilion border of upper lip (ULA) to the labial surface of upper incisors.
Lower lip length (LLL): The distance from stomium inferious (St_i) to soft tissue menton (Me′).
Lower lip thickness (LLT): Measurement from the vermilion border of lower lip (LLA) to the labial surface of lower incisors.
Nasal projection (NP): Measured horizontally from the subnasale (Sn) to the nasal tip (P′).
Angular variables:
Facial profile angle (FPA): The inner angle formed by connecting soft tissue glabella (G′), subnasale (Sn) and soft tissue pogonion (Pg′).
Naso labial angle (NLA): The angle formed by the intersection of theupper lip anterior point (ULA) and columella (Col) at subnasale (Sn).

For each of the cephalometric parameters mean and standard deviation were calculated. Independent samples Student's t-test was used to make comparison between males and females. To compare measurements between different age groups ANOVA test was used. The correlation coefficient r (Pearson) was used to describe association between measured variables and their age related changes:

$|r| > 0.8$ strong correlation
$|r| = o.4 – 0.8$ moderate correlation
$|r| < 0.4$ weak correlation

The levels of statistical significance were determined as follows:
* = $P < .05$, ** = $P < .001$, NS (not significant) = $P \geq 0.05$.

To assess reliability of measurements, 30 radiographs were randomly selected and traced again by the same examiner who did the tracing for the first time. The differences in landmark identification for linear and angular measurements were within 0.83 mm and 0.91 degrees respectively.

RESULTS

The results of this study showed that soft tissue norms for Iranian subjects are somewhat different from Bergman norms (Table 1). Upper and lower lip thicknesses were larger than Bergman norms while facial profile angle, nasal

projection and upper lip length in males were decreased compared to Bergman norms. Of the eight soft tissue variables, four showed significant differences between males and females (Table 1). These variables included lower facial height, upper lip length, upper lip thickness and lower lip thickness which all were significantly larger in males. Among different age groups four variables including lower facial height, lower lip length, lower lip thickness and nasal projection were significantly different (Table 2). Proportions of vertical variables in the lower face are shown in Table 3. As can be seen from Table 4, except for FPA, other variables were significantly associated with age. These associations were positive except for NLA which was negatively associated to age.

DISCUSSION

The Angle paradigm has formed the basis of conceptual framework and documentation since the establishment of the specialty of orthodontics until recently. [14]This paradigm placed great emphasis on the dental casts and cephalometric radiographs for diagnosis and treatment planning based on the assumption that harmonious and esthetic face automatically would follow a perfect occlusion. [14] However, laterit became obvious that hard tissue features did not reliably determine facial characteristics. [15]Therefore, a paradigm shift has occurred toward soft tissue paradigm whit diagnostic emphasis on the clinical examination of soft tissue which has revolutionized the treatment of dentofacial problems in twenty first century.

Different soft tissue analysis have been introduced by many authors. [1- 13]Arnett and Bergman[2, 3]have analyzed nineteen facial traits as facial keys to diagnosis and treatment planning in orthodontics which Bergman[1] has later developed a cephalometric soft tissue analysis based on them. [1] In our study we used Bergman analysis which has duplicated the facial traits analyzed clinically by Arnett and Bergman in a lateral cephalometric headfilm. [1]

To normalize the facial traits and ending the treatment at an attractive face, first normal ranges of these traits should be defined which are influenced by several factors among them are ethnic and cultural origin, gender difference and age. [1] Therefore we evaluated eight of facial traits suggested by Bergman in Iranian subjects with well-balanced face and normal occlusion to establish normal values. Since normal values of soft tissue traits can change as a result of growth, we defined norms for different age groups.

The data showed that the mean for facial profile angle (FPA) in our sample was 163.4± 4.8 which was not significantly different between males and females and also among different age groups. FPA was not significantly correlated with age. This angle determines the primary classification of the patient's profile and the mean value of it for a Class I profile was reported to be 168.7± 4.1. [16]The value of FPA in Iranian subjects seems to be smaller than that of whites. It can be explained by the fact that Iranian subjects predominantly have dolichocephalic head form with leptoprosopic facial type which consequently cause more prominent glabella and tendency for backward and downward rotation of the mandible which all of these lead to a more acute FPA. [17]The ticker upper lip in our sample can also contributed in more forward located subnasale point (Sn) and consequently smaller FPA. The FPA is the most important key to determine the need for anteroposterior surgical correction and it has been said that values less than 165˚ or more than 175˚ are suggestive of necessity of surgery to correct the problem. [3]Bergman has stated that FPA remains constant in normal growers since subnasale and soft tissue pogonion are progressively placed more forward as results of growth. [1]The constancy of FPA with age is in line with our findings.

The norm value for the nasolabial angle in our sample was 102± 10.32 with insignificant difference between males and females and also among age groups. The nasolabial angle showed a weak negative association with age which means that the value of nasolabial angle decreases with increasing age. Arnett et al. [18]reported the value of 106.4± 7.7 for males and 103.5± 6.8 for females as normal values for this angle which are comparable with our finding. Bergman[1]found that the value of nasolabial angle remained constant between the ages of 7 and 17 years. Orthodontic or surgical procedures which alter the anteroposterior position or inclination of upper anterior teeth can considerably affect this angle. [19- 21]Based on the value of this angle clinician can decide about desirable movements. When the angle is open and obtuse, retraction of anterior teeth by either of orthodontic or surgical procedures should be avoided. On the other hand retraction of upper anterior teeth or a surgical set back of maxilla can be successfully done when an acute angle is present. [2, 22]

The mean value for lower facial height (LFH) in our sample was 68.23± 5.55 with a significant difference between males and females. Iranian males showed larger LFH which can be explained by the general longer faces in Iranian males compared to females who have wider and shorter face. [17]LFH was positively correlated with age and this

value showed significant difference among age groups. The average increase in the LFH was 2 mm between groups of 6-8, 8-10 and 10-12 and it remained constant from the group of 10-12 to 12-14, but it revealed an average increase of about 4mm from 68.6 mm in 12-14 group to 72.7 in 14-17 group. The average value of LFH in our sample is within the normal range of 57- 74 suggested by Bergman. [1]Arnett and Bergman have stated that the evaluation of lower one- third of face is of great importance in diagnosis and treatment planning. [2]Excessive lower facial height is suggestive of vertical maxillary excess or mandibular protrusion and decreased height of lower one third is seen in subjects with vertical maxillary deficiency and deep bite cases. In the subjects with excessive facial height, it is of utmost importance to control the vertical dimension.

The normal lengths for upper lip (ULL) in our sample were 21.73± 2.61 for males and 20.45± 2.46 for females which revealed a significant difference between males and females. Despite the sexual dimorphism in ULL, the normal value for lower lip length (LLL) was comparable between males and females (45.2± 9.38 for males and 44.67± 4.08 for females). Comparing different age groups, it was determined that the groups were significantly different from each other regarding the value of LLL, while ULL did not show such a difference. Both ULL and LLL were associated with age and a stronger association was seen for LLL which can be a reflection of the cephalocaudal gradient of growth (parts which are farther away from the brain tend to grow more and later than the closer parts). [23]LLL and ULL of Iranian normal subjects in our sample was close to Bergman norms. The lengths of lips are measured in a relaxed position. A short upper lip can contribute in producing a gummy smile and long lips reduce the incisor show in rest position and also during smile. It has been said that the ULL to LLL should have a 1:2 ratio in rest position (the upper lip is about 50% of the lower lip in length). [1]Relationship between ULL and LLL in our sample revealed a similar proportion in males (48.1%) and slightly less in females (45.78%).It has been said that the upper lip and the lower lip should occupy one third and two thirds of the lower face, respectively. [7]In our sample the upper lip occupied a similar proportion of lower face in both males and females (31.38% and 30.41% respectively), which were less than one third. The lower lip occupied about two thirds of lower face in both sexes (65.28% in males and 66.44% in females).

The thickness of both upper and lower lips was determined to be more than Bergman norms. Iranian males have thicker lips than females and despite the upper lip, the lower lip was significantly different in thickness among the age groups which again can be explained based on the cephalocaudal gradient of growth. [23]Bergman has stated that an upper lip thicker than 18 mm dose not retracted as the teeth are moved back but a thin lip (thinner than 12 mm) follows incisor retraction. [1]regarding thicker lips in Iranian subjects, extraction approaches would less affect the appearance of lips and the decision between extraction or non-extraction approach would be less challenging in borderline cases.

The nasal projection in Iranian males was 13.89±2.90 and for females 13.70± 2.53 mm which these values are smaller than what provided by Bergman. [1]Racial differences and also a more forward positioned subnasale point because of thicker upper lip can justify the difference. This value showed a strong correlation with age and the difference between age groups was significant regarding nasal projection. In a mature individual a nose over 20 mm is defined as a large nose and a small nose is one less than 14 mm [3, 24].

Table 1. Comparison of Mean and SD Differences Between males and females

Variables		Total		Male (n=60)		Female (n=60)			
	Bergman Norms	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**t value**	**P value**
FPA	168.7±4.1	163.4	4.8	162.93	4.70	163.86	4.89	1.066	0.289^{Ns}
NLA	102±8	102	10.32	103.57	10.73	100.92	13.10	1.212	0.228^{Ns}
LFH	57-74	68.23	5.55	69.24	6.00	67.23	4.92	2.004	0.047*
ULL	F: 20.1±1.9 M:23.9±1.5	21.09	2.61	21.73	2.61	20.45	2.46	2.764	0.007*
ULT	12±2	15.67	1.88	16.05	2.08	15.29	1.58	2.269	0.025*
LLL	F:46.4±3.4 M:49.9±4.5	44.77	4.36	45.20	9.38	44.67	4.08	0.404	0.687^{Ns}
LLT	13±2	15.85	1.95	16.30	2.13	15.40	1.65	2.559	0.012*
NP	15.5±2.8	13.79	2.71	13.89	2.90	13.70	2.53	0.385	0.701^{Ns}

** = P < .05, ** = P < .001, *** = P < .0001, Ns = not significant*

Regarding association of measured parameters with age, it was determined that all of them were correlated with age except for FPA. The strongest association was belonged to nasal projection which is a reflection of downward and

forward movement of nose as a result of growth. [17]Among vertical parameters, LFH showed strongest association with age followed by LLL and ULL respectively. FPA showed a negative correlation with NLA and also a positive association with LLL and NP. Every increase in LFH, affect ULL and LLL which this relation is reflected in the positive associations of LFH with the other two vertical variables. LFH was negatively correlated with NLA which means with increase in LFH, NLA tends to decrease. Positive correlation of parameters which were positively associated with age needs no more explanation.

Table 2. Comparison of Mean and SD Differences Between age groups

variables	6-8 (n= 24)		8-10 (n=24)		10-12 (n=24)		12-14 (n=24)		14-17 (n=24)		
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**P value**
FPA	162.95	4.04	164.70	2.98	164.04	5.44	161.20	5.80	164.08	4.75	0.093^{Ns}
NLA	105.70	12.56	101.08	11.66	105.89	15.66	100.25	9.19	98.31	8.54	0.101^{Ns}
LFH	64.33	4.53	66.70	4.94	68.81	4.26	68.60	4.76	72.72	5.83	0.0001***
ULL	20.08	2.82	20.66	2.09	21.22	2.30	21.41	2.58	22.06	2.93	0.090^{Ns}
ULT	15.33	1.67	15.45	1.84	15.18	1.59	15.83	2.16	16.56	1.90	0.081^{Ns}
LLL	41.37	2.56	41.85	6.67	45.37	3.29	44.75	3.99	51.35	11.16	0.0001***
LLT	14.95	1.73	15.31	1.96	15.91	1.41	16.25	2.11	16.83	2.02	0.006*
NP	11.37	1.66	12.39	1.84	13.68	2.12	14.60	1.46	16.91	2.52	0.001*

** = P < .05, ** = P < .001, *** = P < .0001, Ns = not significant*

Table 3. Relationships between vertical measurements in the lower face

Proportions	Male	Female
ULL/LFH	31.38%	30.41%
LLL/LFH	65.28%	66.44%
ULL/LLL	48.1%	45.78%

Fig 1. Reference points used in the present study

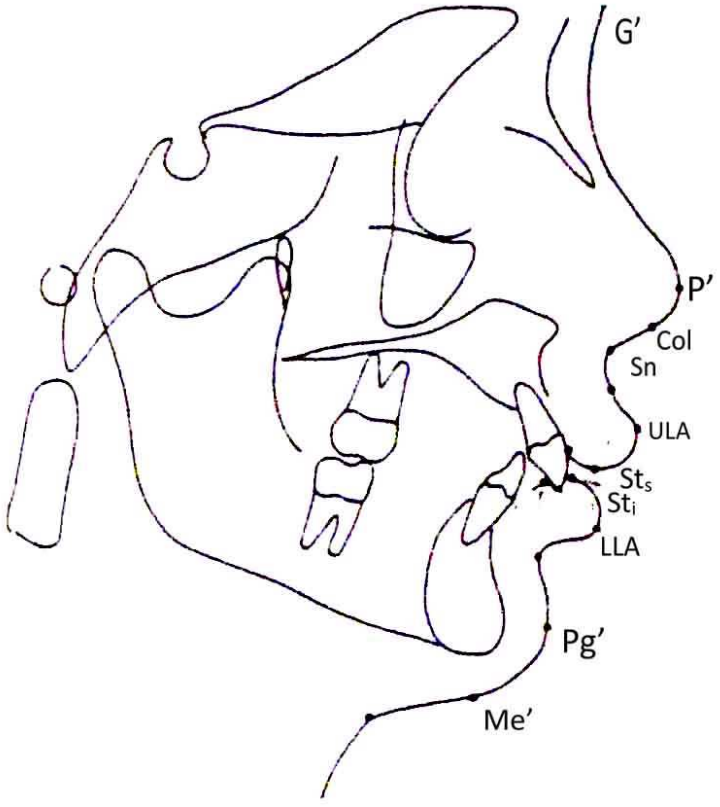

Table 4. Linear correlation between the study variables with each other and with age

variables	FPA	NLA	LFH	ULL	ULT	LLL	LLT	NP	Age
FPA	-	-0.284**	0.111 Ns	-0.128 Ns	0.085 Ns	0.220*	0.047 Ns	0.192*	-0.037 Ns
NLA	-	-	-0.227*	-0.012 Ns	-0.218*	-0.167 Ns	-0.214*	-0.293**	-0.185*
LFH	-	-	-	0.674**	0.324**	0.485*	0.467**	0.465**	0.478**
ULL	-	-	-	-	0.163 Ns	0.164 Ns	0.320**	0.250**	0.256**
ULT	-	-	-	-	-	0.337**	0.645**	0.251**	0.214*
LLL	-	-	-	-	-	-	0.347**	0.410**	0.450**
LLT	-	-	-	-	-	-	-	0.373**	0.341**
NP	-	-	-	-	-	-	-	-	0.695**

** = P < .05, ** = P < .001, *** = P < .0001 , NS = not significant*

CONCLUSION

Among the studied variables, the norm values for Iranian subjects are to some extent different from Bergman norms. In comparison of sexes significant differences are found in lower facial height, upper lip length, upper lip thickness and lower lip thickness.

Comparing age groups significant differences are found in lower facial height, lower lip length, lower lip thickness and nasal projection. All of the variables are significantly associated with age except for facial profile angle which remains constant with increasing age.

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