The variation of facial soft tissue thickness in Iraqi adult subjects with different skeletal classes (A comparative cephalometric study)

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ABSTRACT

Background: The variation of facial soft tissue thickness is an important factor in facial reconstruction and superimposition methods in forensic dentistry as well as for orthodontist and plastic surgeons because they provide the basis for quantification and repeatability. The purpose of this study was to compare facial soft tissue thickness of Iraqi patients with different types of skeletal relations.

Materials and method: Lateral cephalometric study was conducted on 60 adult Iraqi patients with normal vertical dimensions (diagnosed clinically and radiographically as SN-Mandibular Plane angle 28°-36°), aged 18-30 years, classified according to skeletal sagittal relationship using ANB angle into three groups (each group consist of 10 male and 10 female subjects): Class I group (ANB2-4°), Class II group (ANB>4°) and Class III group (ANB<2°). Cephalometric analysis of soft tissue thickness was achieved by 10linearmeasurements using AutoCAD program 2007.

Results and Conclusions: This study showed that the facial soft tissue thickness measurements were significantly higher in male than in female in almost all measured midline landmarks, in comparing the three skeletal relation groups, Class III group show the highest readings when compared to Class I and Class II, Class II show the lowest results among the three groups (except for the labiomental fold area and pogonion area), while Class I group lies between the other two groups for all the measured values.

Key words: Facial soft tissue thickness, cephalometric study. (J Bagh Coll Dentistry 2012; 24(Sp. Issue 2):143-149).

INTRODUCTION

Facial soft tissue thickness is not only of importance for plastic surgeons and orthodontists in order to plan the treatment procedure, but also for biologists to determine the facial appearance of ancient populations and forensic anthropologists for reliable identification of a victim [1, 2]. In the forensic field, facial reconstruction is a technique widely used in order to determine the facial appearance of a victim from skeletal remains [3].

Though the bony structure of the skull gives some information about facial appearance, this is not enough when used alone. Facial harmony and balance is determined by both the skeleton and the soft tissue [4]; however, most of the visual impact of the face is provided by the structure of the overlying soft tissues and their relative proportions [5]. Discriminative information is not provided about any single anatomic component of the face (fat or muscle) nor do these soft tissue depths give precise estimations of any individual's soft tissue thickness [6], despite this, soft tissue depth measurements play a significant role in both facial approximation and craniofacial superimposition methods because they provide a basis for quantification and thus, repeatability [4].

An evaluation of the soft tissue structures (nose, lips, and chin), besides the proportional relationship between the facial structures completes the hard tissue description [7].

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Knowledge of soft tissue depths pertaining to the growth and development period is important for dentistry and forensic anthropology [8]. It is also well established that in order to determine suitable tissue thicknesses, sex, age and ethnicity of the individual should be known; during facial reconstruction, plastic material should be placed on the skull depending on the facial soft tissue thickness at certain regions. Eye-sockets, forehead and the nasal septum, which are different for each individual, are precisely determined, and the face is finalized according to the age and the sex [9, 10].

Welcker [11] was the first to publish soft tissue depth tables for any application, and then in, Kollmann and Buchly [12] in 1898 were the first to conduct facial approximations using soft tissue depths, without knowing the facial appearance of the individual [4]. Later, Suzuki [13] compared Japanese adults with European adults and reported the racial differences with respect to sex. After that, various authors have studied facial tissue thickness in Caucasian adults [14], European [15], European-American [16], Japanese [17], and African-American [18]; in another study, Williamson et al. [10] emphasized the effects of aging on facial soft tissue thickness.

Dumont [5] studied soft tissue thickness in white children based only on types of dental occlusion, and Utsuno et al. [19], studied the facial soft tissue thickness differences among the occlusion classes in a relatively small sample of Japanese females. Facial soft tissue thickness has also been studied in the Turkish population [20,21].

For Iraqi population, many studies evaluate the facial soft tissue profile [22-24], Nevertheless, none of the studies to date has evaluated facial soft tissue thickness in Iraqi population according to the occlusion types as a direct measurement from bony to soft tissue landmarks. The main purpose of the present study is to determine the differences between facial soft tissue measurements among three skeletal relation types in Iraqi adults.

MATERIALS AND METHOD

The sample

The sample was selected from a group of Iraqi patients attending the Orthodontic Department at College of Dentistry, University of Baghdad and from students of the same college. Out of 207 clinically and radiographically examined patients, only 60 fit the selection criteria, all of the selected cases have normal vertical facial height (SN-Mandibular Plane Angle value 28◦-36◦ measured by AutoCAD program) then the sample was divided into three groups with regard to the value of ANB angle, each group consist of 10 male and 10 female subjects, Class I group for subjects with ANB 2◦-4◦, Class II group for subjects with ANB angle > 4◦, and Class III group for subjects with ANB angle <2◦.

The Selection criteria

1. The subjects are Arabic Iraqi in origin.
2. Adult patient (Age range 18-30 years).
3. No previous orthodontic treatment.
4. No severe craniofacial disorder, such as cleft lip and /or palate.
5. No apparent trauma of the jaws and facial soft tissue.
6. Full set of permanent dentition excluding the third molar.

The instruments

1. Diagnostic set (mirrors, probes).
2. Kidney dish.
3. Cotton.
4. Sterilizer (Memmert, Germany).
5. Disinfectant agent (Hibitane 5%).
6. Millimeter graded vernier (Dentaurum, Order-No. 042-751-00).

The Equipments

1. PM 2002 CC Proline Planmeca X-ray machine (Finland) available in the Collage of Dentistry at Baghdad University for lateral Cephalometric radiograph.
2. Personal computer (IBM Lenovo B570e Pentium IV).
3. Flash ram.
4. AutoCAD programs version 2007.

Method

1. History: including the name, age, medical history and dental history.
2. The intraoral examination includes: Open mouth examination to examine the maxillary and mandibular teeth and Closed mouth examination to measure the amount of anterior over bite by using intraoral vernier when the subject closing in centric occlusion.
3. Cephalometric analysis: Lateral cephalometric radiographs were taken for the subjects, then by specialized computer program (AutoCAD version 2007) used on Pentium IV computer, the problem of magnification of the lateral cephalogram is corrected by multiplying the readings by the magnification factor which is obtained as a ratio between the real distance measurement for a scale and the distance measurement for the same scale from radiographic image.

Skeleto-dental Cephalometric Landmarks:

The following landmarks were identified:

1. **Point S (Sella)**: the midpoint of the hypophysial fossa [25].
2. **Point N (Nasion):** the most anterior point on the nasofrontal suture in the median plane [26].
3. **Point G (Glabella):** the most prominent point of the bony forehead in the median plane [26].
4. **Point Me (Menton):** the lowest point on the symphysial shadow of the mandible seen on a lateral cephalograms [25].
5. **Point Pog(Pogonion):** most anterior point of the bony chin in the median plane [26].
6. **Point A (Subspinale):** the deepest midline point in the curved bony outline from the base to the alveolar process of the maxilla [26].
7. **Point B (Supramentale):** most anterior part of the mandibular base, it is the most posterior point in the outer contour of the mandibular alveolar process in the median plane [26].
8. **Point Pr (Prosthion):** alveolar rim of the maxilla; the lowest most anterior point on the alveolar portion of the premaxilla in the median plane between the upper central incisors [26].
9. **Point Id (Infradentale):** alveolar rim of the mandible; the highest most anterior point on the alveolar process in the median plane between the mandibular central incisors [26].
10. **Point U1:** the most anteriorprominent point on the crown of the most anterior maxillary central incisor [27].

Soft Tissue Landmarks:

1. Point g: soft tissue glabella [27].
2. Point n: skin nasion [26].
3. Point sn: subnasale[26].

4. Point ls: labralesuperius, border of upper lip [26].
5. Point sto: Stomion, central point of the interlabial gap [26].
6. Point li: labraleinferius, border of lower lip [26].
7. Point sm: submentale, labiomental fold [26].
8. Pointpog: skin pogonion [26].
9. Point me: soft tissue menton [27].

Cephalometric planes

1. **Sella-Nasion (SN) plane:** it is the anteroposterior extent of anterior cranial base [26].
2. **Mandibular plane (MP):** formed by a line joining Gonion and Menton [28].
3. **Nasion-Point A plane (**N-A plane) [26].
4. **Nasion-Point B plane (**N-B plane) [26].

Cephalometric Angular measurements

1. **ANB angle**: Differences between SNA and SNB which represent anteroposterior position of maxilla in relation to mandible; its normal range from (2◦ -4◦) [29,30].
2. **SN-Mandibular plane angle (SN-MP angle**): to assess the vertical problem, its normal range from (28◦ -36◦) [31].

Cephalometric Linear measurements according to Kurkcuoglu*et al*. [27]: (Figure 1)

1. G-g: Linear distance from the most prominent point on the frontal bone to the soft tissue prominence on the forehead
2. N-n: Distance from point Nasion to soft tissue nasion.
3. Rh: Perpendicular distance from the intersection of nasal bone and cartilage to soft tissue.
4. A –sn: Distance between subnasale and A point.
5. Pr-ls: Distance between the most prominent point of the upper lip and Prosthion.
6. St-U1: Distance between the most prominent point of the upper incisor and stomion.
7. Id-li: Distance between the most prominent point of the lower lip and infradentale.
8. B-lm: Distance from point B to labiomental sulcus.
9. Pog-pog: The distance between bony pogonion and soft tissue pogonion.
10. Me-me: The distance between bony Menton and soft tissue menton.

Statistical Analysis

The data were subjected to computerized Statistical analysis including Statistical Package for Social Sciences (SPSS) version 2006 computer program, the statistical analysis include:

A. **Descriptive Statistics**

1. Mean value.
2. Standard deviation (SD).

B. **Inferential Statistics**

1. Analysis of variance test (ANOVA) to get general comparison among the study groups.
2. LSD test for variables that show significant differences among the study groups in ANOVA test.
3. Independent Sample t-test for gender differences.

In the statistical evaluation, the following levels of significance are used:

Non-significant	NS	$P > 0.05$
Significant	*	$0.05 \geq P > 0.01$
Highly significant	**	$0.01 \geq P > 0.001$
Very highly significant	***	$P \leq 0.001$

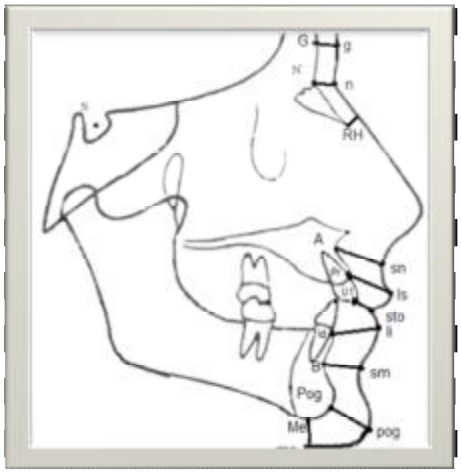

Figure 1: Cephalometric facial soft tissue thickness measurements

RESULTS

The descriptive statistics (including the mean and the standard deviation) and the gender differences of the fasial soft tissue thickness measurements for the three skeletal classes were shown in Table 1.

Table 2 show a comparism of fasial soft tissue thickness measurements among the three skeletal classes using ANOVA test, this comparism reveals a statistically insignificant difference of all the measured values among Class I ,Class II and Class III groups for the total sample and for male and female subjects except for the subnasal area in the total sample and female subjects and area of junction of upper and lower lips in the total sample and male subjects, also the male subjects show a significant difference in the area of upper lip border.

Table 3 show a comparism between each two skeletal classes for the meassurements that show a significant differences in ANOVA test

using LSD test which revealed a statistically significant difference for the whole sample between Class II and Class III groups in subnasal area and area of upper and lower lips junction, while Class I group show a non significant difference with the other two groups; for male subjects the results show a significant difference between Class I and Class III groups, Class II and Class III groups, while Class I and Class II groups show a non significant difference between them, the results also show a significant difference for male subjects in the area of upper and lower lips junction between each two compared groups; finally for female subjects, the results show a significant difference between Class II and Class III groups for the subnasal area show, while Class I group show a non signifact difference in comparim with Class II and Class III respectively.

DISCUSSION

Soft tissue depth measurements play a significant role both in facial approximation and craniofacial superimposition methods because they provide a basis for quantification and thus, repeatability [(4)].

In most of the studies, facial soft tissue depth values were reported as being greater in males than in females [(5,15,18,21,27)] , this agrees with the results of the present study as all the facial soft tissue measurements appear higher in males than in females of the same skeletal class for all the three groups, this increase is statistically significant for all measurements except for (out of ten measurements for each group) three in Class I (G-g, N-n, B-lm), five measurements in Class II (G-g, St-U1, B-lm, Pog-pog, Me-me) and two measurements in Class III (B-lm, Pog-pog).

The facial soft tissue thickness showed a different pattern when comparing the three study groups with each other, as Class III group show an increase in thickness over the other two groups, Class II group show a decrease, while Class I group lies between Class III and Class II groups, this is for the upper and middle facial midline measurements from the forehead till the border of the lower lip, at which the three groups were nearly equal in thickness, while the mandibular midline soft tissue thickness (B-lm, Pog- pog) show an increase in Class II group over Class I and Class III groups respectively, finally the mental area thickness (Me-me) show an increase in Class III group, Class I group and the lowest results in Class II group (Table 1).

The whole sample subjects showed a non-significant difference when compared the soft tissue thickness among the three skeletal classes (Table 2) except for two measurements which are the subnasal area that showed a significant incraese in Class III group over Class II group, with a non-significant increase over Class I group, the other measurement that showed a significant result is the area of junction between the upper and the lower lips which showed an increase in Class III group when compared to Class II group (Table 3) This difference could be due to retrusion of the mandible in Class II skeletal relation holding the lower lip with it and decreasing the between the upper and lower lip, in contrast to Class III relation which have a protruded mandible and an increase area of contact of upper and lower lips.

When comparing facial soft tisse thickness of the male subjects among the three skeletal classes (Table 2), the results show a non significant difference in: Glabella, Nasion, the area of junction between bone and nasal cartilage, the subnasal area, lower lip border area, labiomental fold area, pogonion and menton area; only two measurements show a statistically significant difference among the groups which are the area of upper lip border that show a significant increase in Class III group over Class I and Class II groups (Table 3), this increase in thickness in Class III group might be attributed to the relative retrusion of the maxillary bones while the soft tissue affected by the protrusion of the nose and the mandile leading to an increase in the distance between the soft tissue and bony landmarks. The other measurement that show a significant difference among the groups for male subjects is the area of junction between upper and lower lips, as Class III group show a significant increase when compared to the other two groups, Class II show a significant decrease when compared to the other two groups, while Class I group lies between Class III and Class II with a significant difference among them also (Table 3) this is also can be attributed to the position of the mandible.

For female subjects, when comparing the soft tissue thickness in the three study groups (Table 2), the results showed a non-significant difference for all the measurements except for the subnasal area which showed a significant increase in Class III group when compared to Class II group, while class I group showed a non-significant difference with the other two groups (Table 3) this is disagree with Kurkcuoglu ***et al.*** [(27)] as their results showed a significant increase in Class II and Class III groups overr Class I group in a Turkish sample.

In conclusions, the results of this study showed that the facial soft tissue thickness of Iraqi normo-divergent subjects is larger in males than in females of the same skeletal class, and class III

skeletal relation show the thickest facial soft tissue followed by class I, with the least thickness in class II skeletal relationship.

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Table 1: Descriptive statistics and gender difference of facial soft tissue thickness measurements of the three skeletal classes groups

	Variables	Descriptive statistics						Gender differences	
		Total		Male		Female			
		Mean	S.D	Mean	S.D	Mean	S.D	t-test	p-value
Class I	G-g	6.09	1.08	6.30	1.17	5.89	1.00	0.84	0.413 (NS)
	N-n	6.27	1.23	6.55	1.37	5.98	1.06	1.04	0.313 (NS)
	Rh	2.67	0.54	2.94	0.42	2.40	0.52	2.54	0.021*
	A-sn	15.49	1.75	16.63	1.28	14.36	1.40	3.78	0.001***
	Pr-ls	13.20	2.15	14.47	1.76	11.92	1.74	3.26	0.004**
	St-U1	5.27	1.97	6.25	2.24	4.29	1.00	2.54	0.021*
	ld-li	14.46	1.05	15.13	0.89	13.80	0.76	3.60	0.002**
	B-lm	11.52	1.24	11.90	1.31	11.15	1.11	1.38	0.184 (NS)
	Pog-pog	12.47	2.18	13.70	1.95	11.24	1.70	3.00	0.008**
	Me-me	8.17	1.82	9.10	1.30	7.24	1.83	2.62	0.017*
Class II	G-g	5.93	0.80	5.77	0.79	6.08	0.81	-0.86	0.402 (NS)
	N-n	5.96	1.13	6.49	1.17	5.42	0.83	2.37	0.029*
	Rh	2.63	0.53	2.89	0.52	2.37	0.42	2.47	0.024*
	A-sn	14.99	2.20	16.49	1.91	13.50	1.25	4.14	0.001***
	Pr-ls	12.52	1.88	13.86	1.46	11.18	1.14	4.60	0.000**
	St-U1	4.26	0.96	4.32	1.20	4.20	0.69	0.27	0.793 (NS)
	ld-li	14.57	1.71	15.39	1.40	13.74	1.65	2.40	0.028*
	B-lm	11.67	1.56	12.02	1.91	11.32	1.12	0.99	0.333 (NS)
	Pog-pog	12.61	1.35	13.13	1.31	12.09	1.25	1.81	0.088 (NS)
	Me-me	7.54	1.63	8.09	1.64	6.99	1.51	1.55	0.138 (NS)
Class III	G-g	6.15	0.83	6.51	0.72	5.79	0.80	2.14	0.046*
	N-n	6.34	1.26	7.07	0.78	5.61	1.25	3.14	0.006**
	Rh	2.77	0.68	3.27	0.50	2.28	0.43	4.76	0.000**
	A-sn	16.81	2.63	18.02	2.69	15.60	2.02	2.27	0.036*
	Pr-ls	14.25	2.63	16.29	1.89	12.21	1.32	5.59	0.000***
	St-U1	6.37	2.85	8.53	1.84	4.21	1.83	5.28	0.000***
	ld-li	14.58	1.97	16.09	1.19	13.08	1.31	5.37	0.000***
	B-lm	11.38	0.93	11.71	0.85	11.06	0.93	1.64	0.119 (NS)
	Pog-pog	12.37	1.73	12.90	1.27	11.84	2.02	1.41	0.176 (NS)
	Me-me	8.10	0.96	8.71	0.78	7.48	0.72	3.67	0.002**

Table 2: A comparison of facial soft tissue thickness measurements for males, females and total sample among the three skeletal classes using ANOVA test

Variables	Total		Male		Female	
	F-test	p-value	F-test	p-value	F-test	p-value
G-g	0.33	0.72 (NS)	1.74	0.195 (N(NS)	0.29	0.751 (NS)
N-n	0.58	0.565 (NS)	0.79	0.464 (NS)	0.74	0.488 (NS)
Rh	0.32	0.725 (NS)	1.85	0.177 (NS)	0.19	0.826 (NS)
A-sn	3.57	0.034*	1.71	0.201 (NS)	4.43	0.022*
Pr-ls	3.03	0.056 (NS)	5.42	0.01**	1.4	0.263 (NS)
St-U1	5.16	0.009**	13.52	0.000***	0.01	0.987 (NS)
ld-li	0.03	0.969 (NS)	1.77	0.189 (NS)	0.97	0.393 (NS)
B-lm	0.25	0.78 (NS)	0.12	0.89 (NS)	0.16	0.853 (NS)
Pog-pog	0.09	0.915 (NS)	0.71	0.502 (NS)	0.67	0.522 (NS)
Me-me	1.04	0.361 (NS)	1.59	0.223 (NS)	0.29	0.749 (NS)

Table 3: A comparison of facial soft tissue thickness measurements for males, females and total sample between each two study groups using LSD test

Gender			Total		Male		Female
Skeletal Classes	Variables		A-sn	St-U1	Pr-ls	St-U1	A-sn
	I	II	0.478 (NS)	0.13 (NS)	0.434 (NS)	0.024*	0.234 (NS)
		III	0.066 (NS)	0.099 (NS)	0.025*	0.009**	0.093 (NS)
	II	I	0.478 (NS)	0.13 (NS)	0.434 (NS)	0.024*	0.234 (NS)
		III	0.012*	0.002**	0.004**	0.000 ***	0.006**
	II	I	0.066 (NS)	0.099 (NS)	0.025*	0.009**	0.093 (NS)
	I	II	0.002**	0.004**	0.000**	0.006**	0.012*