International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Evaluation of Facial Soft Tissue Thickness in Normal Adults with Different Vertical Discrepancies

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Abstract: ***This study aimed to evaluate and compare the soft tissue facial thickness among different vertical skeletal relations in Iraqi normal adults, and to verify the presence of gender difference. Sixty true lateral cephalometric radiographs for Iraqi adults with normal dental, sagittal and transverse skeletal relations were selected from the archive of the Orthodontic department in the College of Dentistry, University of Baghdad. Using SN-MP angle, the sample was divided into three groups each with twenty (10 males and 10 females). The soft tissue facial thickness was measured at different points using AutoCAD program. Gender difference was evaluated by independent sample t-test, while difference among the various vertical relations was determined by one-way ANOVA then Tukey HSD test. Generally, males had thicker soft tissue than females and low angle groups possessed thicker soft tissue in comparison with high and normal angle groups especially in male group.***

Keywords: Face, soft tissue thickness, cephalometrics

1. Introduction

One of the main objectives of orthodontic treatment is to achieve and conserve best possible facial beauty. To attain this, it's imperative that the orthodontist perform a thorough facial examination [1]. Faces can be classified in the vertical dimension into high, low and normal angle groups. The types of faces are influenced by the vertical growth patterns, presence of bad oral habits, development of alveolar processes, eruption of teeth and the action of the soft tissues (lips, cheek and tongue) [2].

The soft tissue covering the face including the muscles may develop in proportion or disproportion to the underlying skeletal structures [3]. Facial esthetics can be affected by the variation of these tissues with regard to their thickness, length, and tonicity [4]. Such difference between skeletal and soft tissues can cause a disassociation between the position of the underlying bony structures and the facial appearance that may alter treatment into the range of orthognathic and cosmetic surgery, so assessment of soft tissue thickness was performed in normal individuals [5]-[9], among different skeletal [10]-[17], and occlusal relations [18].

The purpose of the current study was to investigate and compare the soft tissue thickness among different vertical skeletal relations in Iraqi normal adults, and to verify the presence of any sexual dimorphism.

2. Materials and Methods

Materials

A total of 60 true lateral cephalometric radiographs belong to Iraqi adult dental students with an age ranged between 18-25 years were selected for this study.

All of the students had full complement of permanent teeth, class I sagittal and transverse skeletal and dental relations with the ANB angle (2º-4º) and Class I molar and canine classifications [19]. Subjects who had any facial asymmetry, history of any orthodontic treatment, mouth breathing or tongue thrusting, facial anomalies and maxillary sinus pathology were excluded from the study.

The samples were divided based on the vertical jaws relation using SN-mandibular plane angle [20] into three groups each with 20 subjects (10 males, 10 females).

Subjects with SN-MP angle measured 28 to 36.5º were included in group 1 (Normal angle); subjects in whom SN-MP angle measured >36.5º were included in group 2 (High angle group) and those had SN-MP angle measured <28º were included in group 3 (Low angle).

Methods

After taking student approval, clinical examination was done then standardized digital true lateral cephalometric radiographs were taken using Planmeca ProMax Dimax3 X-ray unit.

All cephalometric radiographs were analyzed using AutoCAD program (2015) and the linear measurements were divided by scale in the nasal rod to overcome the magnification.

Skeleto-dental Cephalometric Landmarks [21]-[23]

The following landmarks were identified:

[1] Point S (Sella): The midpoint of the hypophysial fossa.
[2] Point N (Nasion): The most anterior point on the nasofrontal suture in the median plane.
[3] Point G (Glabella): The most prominent point of the bony forehead in the median plane.
[4] Point Go (Gonion): A point on the curvature of the angle of the mandible located by bisecting the angle formed by the lines tangent to the posterior ramus and inferior border of the mandible.
[5] Point Me (Menton): The lowest point on the symphysial shadow of the mandible seen on a lateral cephalogram.

[6] Point Pog (Pogonion): The most anterior point of the bony chin in the median plane.
[7] Point A (Subspinale): The deepest midline point in the curved bony outline from the base to the alveolar process of the maxilla.
[8] Point B (Supramentale): It is the most posterior point in the outer contour of the mandibular alveolar process in the median plane.
[9] Point Pr (Prosthion): The 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.
[10] Point Id (Infradentale): The alveolar rim of the mandible; the highest most anterior point on the alveolar process in the median plane between the mandibular central incisors.
[11] Point U1: The most anterior prominent point on the crown of the most anterior maxillary central incisor.
[12] Point ANS (Anterior Nasal Spine): It is the tip of the bony anterior nasal spine in the median plane.
[13] Point PNS (Posterior Nasal Spine): This is a constructed radiological point, the intersection of a continuation of the anterior wall of the pterygopalatine fossa and the floor of the nose.
[14] Point Is (Incisor superius): The tip of the crown of the most anterior maxillary central incisor.
[15] Point Ii (Incisor inferius): The tip of the crown of the most anterior mandibular central incisor.
[16] Point Ap 1 (Apicale 1): Root apex of the most anterior maxillary central incisor.
[17] Point Ap 1 (Apicale 1): Root apex of the most anterior mandibular central incisor.

Soft Tissue Landmarks [21]-[23]

[1] Point g (soft tissue glabella): The most prominent point in the midsagittal plane of forehead.
[2] Point n (soft tissue nasion): The most posterior point at the root of the nose in the median sagittal plane.
[3] Point sn (subnasale): It is the point where the lower border of the nose meets the outer contour of the upper lip.
[4] Point ls (labrale superius): It is the median point in the upper margin of the upper membranous lip.
[5] Point sto (Stomion): The midpoint between stomion superius and stomion inferius.
[6] Point li (labrale inferius): It is the median point in the lower margin of the lower membranous lip.
[7] Point sm (submentale): The point of greatest concavity in the midline of the lower lip between labrale inferius and pog.
[8] Point pog (soft tissue pogonion): The most anterior prominent point on the chin in the median sagittal plane.
[9] Point me (soft tissue menton): The constructed point of intersection of a vertical co-ordinate from menton and the inferior soft tissue contour of the chin.

Cephalometric planes [21]-[23]

[1] Sella-Nasion (SN) plane: It is the anteroposterior extent of anterior cranial base.
[2] Mandibular plane (MP): Formed by a line joining Gonion and Menton.
[3] Palatal plane (PP): A line joining between anterior nasal spine and posterior nasal spine.
[4] N-A line: Formed by a line joining Nasion and point A.
[5] N-B line: Formed by a line joining Nasion and point B.
[6] N-Pog line: Formed by a line joining Nasion and point Pogonion.

Cephalometric Angular measurements [21]-[23]

[1] SNA angle: Angle formed between lines SN and NA.
[2] SNB angle: Angle formed between lines SN and NB.
[3] ANB angle: Differences between SNA and SNB.
[4] SN-MP angle: Formed between SN and mandibular planes.
[5] SN-Pog angle: Formed between lines SN and N-Pog.
[6] U1-PP angle: The angle between long axis of upper incisor and palatal plane, posteriorly.
[7] L1-MP angle: That angle formed by the long axis of the most labial mandibular incisor to the mandibular plane, posteriorly.

Cephalometric Linear measurements [16]-[18] (Figure 1)

[1] G-g: The 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 A point and subnasale.
[5] Pr-ls: Distance between Prosthion and labrale superius.
[6] Sto-U1: Distance between stomion and the most prominent point of the crown of upper incisor.
[7] Id-li: Distance between infradentale and labrale inferius.
[8] B-sm: Distance from point B to submentale.
[9] Pog-pog: The distance between bony pogonion and soft tissue pogonion.
[10] Me-me: The distance between bony Menton and soft tissue menton.

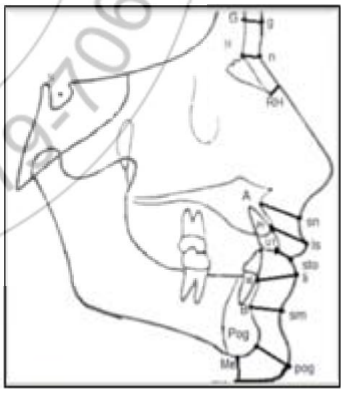

Figure 1: Some landmarks and measurements [16]

Statistical analyses

Data were statistically analyzed using Statistical Package for the Social Sciences SPSS software (version 21). Statistical analyses comprised descriptive statistics that included means, standard deviations of all variables and inferential statistics that consisted of independent sample t-test to verify the gender difference, one way ANOVA test to verify the groups' difference and Tukey honestly significant difference (HSD) test to compare between each two groups if ANOVA gives statistically significant difference.

3. Results

The descriptive statistics of the sagittal and vertical jaw relations in addition to the inclinations of the maxillary and mandibular incisors in different groups were presented in table 1. Generally, the positions of maxilla and mandible to the cranial base were retruded in high angle group and just the reverse for low angle group. The incisors were also retroclined in high angle group in comparison with low and normal angle groups.

Table 2 demonstrated the descriptive statistics and genders difference for all measurements. Generally, males had thicker soft tissue than females with variable degree of significance; mostly seen in normal and low angle groups.

Table 3 showed the groups' difference in both genders. In males, there was six variables revealed significant difference in reverse to females where there was non-significant groups' difference. Comparing each two groups in male sample was presented in table 4. Most of the difference found between the high and low angle groups.

Table 1: Descriptive statistics of skeletal and dental parameters

Variables (°)	*Genders*	*Normal*		*High*		*Low*	
		Mean	*S.D.*	*Mean*	*S.D.*	*Mean*	*S.D.*
SN-MP°	*Males*	31.30	1.49	40.60	3.06	23.40	2.63
	Females	32.20	3.05	39	2.05	23.90	2.51
ANB°	*Males*	3.40	0.84	3	0.94	2.90	0.99
	Females	3.10	0.88	3.80	0.42	2.70	0.67
SNA°	*Males*	81.80	1.93	77.10	2.69	85.30	2.58
	Females	80	2.71	79.70	1.89	83.90	2.56
SNB°	*Males*	78.10	1.85	74	2.45	82.80	2.35
	Females	77	2.31	76.20	1.75	80.90	2.47
SN-Pog°	*Males*	79.70	1.77	75	2.11	84.10	2.02
	Females	77.70	2.21	76.50	1.90	82.30	2.50
U1-PP°	*Males*	111.40	6.95	109.20	8.59	114.70	8.35
	Females	112.70	7.38	111.70	7.30	114	6.36
L1-MP°	*Males*	98	5.40	90.50	5.17	102.30	4
	Females	102.20	3.36	96	3.43	103.90	5.03

Table 2: Descriptive statistics and genders for soft tissue thickness in different groups

Groups	*Variables (mm.)*	*Descriptive statistics*				*Genders difference*	
		Males		*Females*			
		Mean	*S.D.*	*Mean*	*S.D.*	***t-test***	***p-value***
Normal angle	*G-g*	6.30	1.17	5.89	1	0.838	0.413
	N-n	6.55	1.37	5.98	1.06	1.038	0.313
	Rh	2.94	0.42	2.40	0.52	2.540	0.021
	A-sn	16.63	1.28	14.36	1.40	3.778	0.001
	Pr-ls	14.47	1.76	11.92	1.74	3.262	0.004
	St-U1	6.25	2.24	4.29	1	2.535	0.021
	Id-li	15.13	0.89	13.80	0.76	3.598	0.002
	B-sm	11.90	1.31	11.15	1.11	1.382	0.184
	Pog-pog	13.70	1.95	11.24	1.70	2.998	0.008
	Me-me	9.10	1.30	7.24	1.83	2.619	0.017
High angle	*G-g*	5.60	0.86	5.35	0.59	0.750	0.463
	N-n	6.11	0.88	4.84	1.05	2.934	0.009
	Rh	2.87	0.59	2.01	0.51	3.469	0.003
	A-sn	16.09	1.43	14.95	1.17	1.945	0.068
	Pr-ls	14.32	1.33	12.29	1.81	2.849	0.011
	St-U1	3.44	2.86	3.15	1.90	0.262	0.796
	Id-li	16	1.35	13.95	1.55	3.147	0.006
	B-sm	11.85	2	10.61	1.49	1.566	0.135
	Pog-pog	12	2.72	11.69	2.01	0.285	0.779
	Me-me	7.17	1.22	6.54	2.17	0.808	0.430
Low angle	*G-g*	6.65	0.89	6.05	0.73	1.667	0.113
	N-n	7.69	1.55	5.81	1.50	2.753	0.013
	Rh	3.19	0.82	2.41	0.70	2.305	0.033
	A-sn	17.48	0.80	15.32	1.23	4.654	0.000
	Pr-ls	17.40	1.31	13.36	0.72	8.536	0.000
	St-U1	7.75	1.77	4.49	1.30	4.684	0.000
	Id-li	17.18	1.40	13.71	1.15	6.064	0.000
	B-sm	12.13	1.51	10.23	1.08	3.240	0.005
	Pog-pog	13.96	1.58	11.07	1.87	3.722	0.002
	Me-me	9.84	2.01	7.61	1.53	2.795	0.012

P > 0.05 = Non-significant, 0.05 ≥ P > 0.01 = Significant, P ≤ 0.01 =Highly significant

Table 3: Groups' difference in each gender

Variables (mm.)	*Males*		*Females*	
	F-test	*p-value*	*F-test*	*p-value*
G-g	2.981	0.068	2.137	0.138
N-n	3.909	0.032	2.519	0.099
Rh	0.736	0.488	1.536	0.234
A-sn	3.429	0.047	1.442	0.254
Pr-ls	13.677	0.000	2.438	0.106
St-U1	8.781	0.001	2.467	0.104
Id-li	6.977	0.004	0.106	0.900
B-sm	0.088	0.916	1.376	0.270
Pog-pog	2.478	0.103	0.295	0.747
Me-me	7.903	0.002	0.862	0.434

P > 0.05 = Non-significant, 0.05 ≥ P > 0.01 = Significant, P ≤ 0.01 =Highly significant

Table 4: Tukey's HSD test after ANOVA test

Variables (mm.)	*Groups*		*Mean difference*	*p-value*
N-n	*Normal*	*High*	0.44	0.734
		Low	-1.13	0.143
	High	*Low*	-1.57	0.030
A-sn	*Normal*	*High*	0.54	0.579
		Low	-0.85	0.267
	High	*Low*	-1.39	0.039
Pr-ls	*Normal*	*High*	0.15	0.972
		Low	-2.93	0.000
	High	*Low*	-3.08	0.000
St-U1	*Normal*	*High*	2.82	0.031
		Low	-1.49	0.341
	High	*Low*	-4.31	0.001
Id-li	*Normal*	*High*	-0.87	0.274
		Low	-2.06	0.003
	High	*Low*	-1.19	0.099
Me-me	*Normal*	*High*	1.93	0.025
		Low	-0.74	0.542
	High	*Low*	-2.67	0.002

P > 0.05 = Non-significant, 0.05 ≥ P > 0.01 = Significant, P ≤ 0.01 =Highly significant

4. Discussion

This study aimed to evaluate the soft tissue thickness of the face in a sample of Iraqi adults with normal dental, sagittal and transverse jaw relations and different vertical patterns.

Generally, all the skeletal and dental measurements tend to be high in low angle groups followed by the normal angle then the high angle group, so the jaws bases tend to be retruded in high angle in comparison with the normal group. The same is true for the inclinations of the maxillary and

mandibular incisors which were retroclined in high angle subjects.

The results indicated that the soft tissue thickness in all groups is higher in males than females because of the testosterone effect in facilitating the synthesis of collagen that provide males with a thick skin, on the other hand, the estrogen hormone in females facilitates the synthesis of hyaluronic acid in addition to the decreasing in the synthesis of collagen making their skin thinner [24].

Regarding female sample, the results revealed non-significant group difference for all measurements. For males, the soft tissue thickness at glabella showed non-significant group difference being thicker in low angle group. On the other hand, significant difference was reported in nasion point especially between the high and low angle groups.

Unlike the facial soft tissue structures, the sagittal lip position is influenced by the skeletal structures, so in the presence of protrusive alveolar processes and teeth like in low angle group the lips will be thicker as shown in A-sn, Pr-Is, St-U1 and Id-li

In normal situations and after orthognathic surgery of the mandible and chin, as the vertical expansion of the skeletal tissue increases, there will be an impingement on the soft tissue thickness in a corresponding ratio of 1:1 [25],[26]. In some instances, the soft tissue over the chin is not even in thickness. The findings of the present study indicated that the soft tissue at menton point was thicker in low angle group than the normal and high angle groups. This comes in agreement with Macari and Hanna [14], moreover the thickness at point pognion was non-significantly different and this in accordance with Feres *et al.* [7] and Macari and Hanna [14] and disagreed with Celikoglu *et al.* [15] who reported a significant difference. This may be attributed to the difference in sample size and selection and different ethnic groups.

Low angle group had thicker soft tissue in most areas. Singh [27] stated that the thickness of soft tissue chin differs with each facial type. Thickness of soft tissue chin was greater in brachyfacial type than the dolicofacials where the direction of facial growth is forward just reverse to the high angle which is backward. Hambleton [28] and Hillesund *et al.* [29] found that the soft tissue chin thickness is closely related to the degree of prognathism of the chin symphysis and the more retruded chin symphysis, the less soft tissue chin thickness.

5. Conclusions

- Males had thicker soft tissue than females.
- Low angle male group possessed thicker soft tissue in comparison with high and normal angle groups.
- Females showed non-significant difference in the soft tissue thickness among different groups.

References

[1] GW. Arnett, RT. Bregman, "Facial Keys to Orthodontic Diagnosis and Treatment Planning. Part 1", Am J Orthod, 103(4), pp. 299-312, 1993.
[2] IL. Nielsen, "Vertical Malocclusions: Etiology, Development, Diagnosis and Some Aspects of Treatment", Angle Orthod, 61(4), pp. 247–260, 1991.
[3] JD. Subtelny, "A Longitudinal Study of Soft Tissue Facial Structures and Their Profile Characteristics, Defined in Relation to Underlying Skeletal Structures", Am J Orthod, 45(7), pp. 481–507, 1959.
[4] C. Burstone, "Lip Posture and Its Significance in Treatment Planning", Am J Orthod, 53(4), pp. 262–284, 1967.
[5] MMA. Al-Ta'ani, "Soft Tissue Facial Profile Analysis: A Cephalometric Study of Some Iraqi Adults with Normal Occlusion". A master thesis, Department of POP, College of Dentistry, University of Baghdad, 1996.
[6] NF. Agha, "Facial Profile Soft Tissue Analysis for Mosuli Adults, Class I Normal Occlusion". A master thesis, Department of POP, College of Dentistry, Mosul University, 1998.
[7] MFN. Feres, SF. Hitos, HIP. de Sousa, MAN Matsumoto, "Comparison of Soft Tissue Size between Different Facial Patterns", Dental Press J Orthod, 15(4), pp. 84-93, 2010.
[8] ZM. Kadhum, "Soft Tissue Cephalometric Norms for a Sample of Iraqi Adults with Class I Normal Occlusion in Natural Head Position", A master thesis, Department of Orthodontics, College of Dentistry, University of Baghdad, 2010.
[9] K-S. Cha, "Soft-Tissue Thickness of South Korean Adults with Normal Facial Profiles", Korean J Orthod, 43(4), pp. 178-185, 2013.
[10] MAS. Yousef, "Soft Tissue Facial Profile Analysis: A Comparative Study of the Dental and Skeletal Class I and Class II for Iraqi Adult Sample (A Lateral Cephalometric Study)", A master thesis, Department of POP, College of Dentistry, University of Baghdad, 2001.
[11] NH. Ghaib, I. Al-Timimy, "Soft Tissue Facial Profile Analysis", Iraqi Dent J, 33, pp. 19-113, 2003.
[12] HAH. Al-Hashimi, "A Lateral Cephalometric Evaluation of Soft Tissue Facial Profile of Skeletal Class I and Class III Adults", Must Dent J, 3(1), pp. 45-52, 2006.
[13] YA. Yassir, AS. Kadhum, SA. Al-Ajwadi, "Soft Tissue Measurements of Iraqi Individuals with Cl I and Cl III Skeletal Pattern: A Comparative Cephalometric Study", Must Dent J, 8(2), pp. 164-170, 2011.
[14] AT. Macari, AE. Hanna, "Comparisons of Soft Tissue Chin Thickness in Adult Patients with Various Mandibular Divergence Patterns", Angle Orthod, 84(4), pp. 708–714, 2014.
[15] M. Celikoglu, SK. Buyuk, A. Ekizer, AE. Sekerci, Y. Sisman, "Assessment of the Soft Tissue Thickness at the Lower Anterior Face in Adult Patients with Different Skeletal Vertical Patterns Using Cone-Beam Computed Tomography", Angle Orthod, 85(2), pp. 211–217, 2015.

[16] HMH. Al-Chalabi, "The Variation of Facial Soft Tissue Thickness in Iraqi Adult Subjects with Different Skeletal Classes (A Comparative Cephalometric Study)", J Bagh Coll Dentistry, 24(Sp. Issue 2), pp. 143-149, 2012.
[17] S. Hamid, AH. Abuaffan, "Facial Soft Tissue Thickness in A Sample of Sudanese Adults with Different Occlusions", Forensic Sci International, 266, pp. 209–214, 2016.
[18] A. Kurkcuoglu, C. Pelin, P. Ozenerb, R. Zagyapan, Z. Sahinoglu, AC. Yazıcı, "Facial Soft Tissue Thickness in Individuals with Different Occlusion Patterns in Adult Turkish Subjects", HOMO- J Comparative Human Biol, 62(4), pp. 288-297, 2011.
[19] L. Mitchell, "An Introduction to Orthodontics", Oxford University press, Oxford, 2013.
[20] R. Droel, RJ. Isaacson, "Some Relationships between the Glenoid Fossa Position and Various Skeletal Discrepancies", Am J Orthod, 61(1), pp. 64-78, 1972.
[21] T. Rakosi, "An Atlas and Manual of Cephalometric Radiography", Wolfe medical publications Ltd., London, 1982.
[22] A. Jacobson, "Radiographic Cephalometry from Basics to Videoimaging", Quintessence publishing Co., Chicago, 1995.
[23] AE. Athanasiou, "Orthodontic Cephalometry", Mosby Wolfe, London, 1995.
[24] RE. Dumont, "Mid-Facial Tissue Depths of White Children: An Aid in Facial Feature Reconstruction", J Forensic Sci, 31(4), pp. 1463-1469, 1986.
[25] S. Shaughnessy, KA. Mobarak, HE. Høgevold, L. Espeland, "Long-term Skeletal and Soft-Tissue Responses after Advancement Genioplasty", Am J Orthod Dentofac Orthop, 130(1), pp. 8–17, 2006.
[26] PS. Reddy, B. Kashyap, N. Hallur, BC. Sikkerimath, "Advancement Genioplasty-Cephalometric Analysis of Osseous and Soft Tissue Changes", J Maxillofac Oral Surg, 10(4), pp. 288–295, 2011.
[27] RN. Singh, "Changes in the Soft Tissue Chin after Orthodontic Treatment", Am J Orthod Dentofac Orthop, 98(1), pp. 41-46, 1990.
[28] RS. Hambleton, "The Soft-Tissue Covering of Skeletal Face as Related to Orthodontic Problems", Am J Orthod, 50(6), pp. 405-420, 1964
[29] E. Hillesund, D. Fjeld, BU. Zachrisson, "Reliability of Soft-Tissue Profile in Cephalometrics", Am J Orthod, 74(5), pp. 537-550, 1978.

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