Original Article

Thickness of Facial Soft Tissue in Adult Patients with Class I, II and III Skeletal Patterns in Digital lateral Cephalometery

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Abstract

Introduction: Understanding the variations in the thickness of facial soft tissue is important in forensic medicine, dentistry, and plastic surgery. This study aimed to evaluate the thickness of the facial soft tissue in adolescents with different maxillary skeletal patterns and compare them between both sexes, by using digital lateral cephalometric radiographs. **Methods:** 97 patients over 18 years of age referring to a private radiology center for digital lateral cephalometric radiographs participated in this study. Standard digital lateral cephalometric radiographs of patients were categorized based on the ANB angle to three Skeletal jaw classes (I, II, and III). Then, in each of the lateral cephalometric radiographs, the Soft tissue landmarks including glabella, nasion, subnasale, labrale superius, stomion, labrale inferius, labiomental, pogonion, menton, and the vertical distance of each landmark to the bone surface were determined. Soft tissue thickness landmarks at each site were measured separately in males and females and in three different skeletal class groups. Statistical analysis of multivariate multiplicative variance was used to compare the data. **Results:** The results of the study showed that soft tissue thickness in Glabella and Labiomental points were not significantly different between men and women (P-value >0.05). Other landmarks in men were significantly higher than women(P-value<0.05). As for the relationship between soft tissue thickness and skeletal classes, subnasale, labrale superius, stomion, labrale inferius had significant association with skeletal classification (P-value<0.05). **Conclusion**: These findings point to the importance of sex and cranial morphology in soft facial tissues for accurate facial reconstruction.

Keywords: Thickness of facial soft tissue, Skeletal jaw classes, Lateral cephalogram.

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Introduction

Soft tissue information is similar to the skull in different races, gender, and ages (children and adults) (3, 5, 12). Most facial rejuvenation techniques use the average facial soft tissue thickness in anatomical landmarks. Five major methods for measuring soft tissue thickness including needle puncture, ultrasonography, x-ray, MRI, and CT have been reported in the literature, each of which has its inherent advantages and disadvantages (3, 6). According to the Angle classification, the patients were categorized into three classes of I, II, and III of the skeletal class; in the first class, the ANB angle (angle between the point-Nasion-B point) is between 0 and 4 degrees. In this class, the mesiobuccal cusp of the first molar is placed in the mesiobuccal groove of the first molar and the teeth are regularly arranged on the occlusion line. In class two the ANB angle is more than 4 degrees, and the first molar cusp is more than the buccal groove of the lower first molar and is usually close to the embrasure between the lower first molar and the lower second premolar. This mode can be caused due to the posterior position of the first molar of the mandible or due to the anterior position of the maxillary first molar. The occlusal line can be correct or not. The class II skeletal relationship is such that the maxilla is above the normal state, or the jaw is lower than the normal position, or a combination of these two states. In class III, the ANB angle is less than zero degrees. This class can be caused by the smaller size of the maxilla, the greater size of the mandible, or a combination of both. Maxillary deficiency, reduction in posterior, and vertical posterior maxilla trigger the creation of class III. If the maxilla is small in the anterior-posterior or is only in the posterior state, it directly creates a class III state. However, if the maxilla has not grown vertically, it causes the mandible to rotate upwards and forwards, and cause the class III appearance and mandiblular prognathism, which is due to a change in the position of the mandible and usually in these cases the size of the mandible is normal (4). Some studies have been done to change the hypothesis to solve the problem or need to be mentioned by evidence; in a study by Pithon et al. (5) in 2014 measured the soft-facial thickness of the face in young northeastern Brazilians according to gender and their skeletal jaw class. They investigated lateral cephalometric radiographs of 300 children aged 8 to 12 years. The results of this study showed that there is no significant difference in soft tissue thickness between skeletal classes for the majority of measured points. For class I, a statistically significant difference was found between the males and females at the point of rhinion, subnasal, and upper lip. It was concluded that there is no significant difference in soft tissue thickness between skeletal classes except between class II and III for stomion states, lower lip, and pogonion.

In a study by Thiemann et al. In 2017, the aim was to provide a precise collection of soft tissue thickness measurements in German population. In Amira software, three-dimensional models of the skull and facial skin were divided semi-automatically by measuring thresholds and surface extraction algorithms. The soft tissue depth was measured in 38 Landmarks (10 Midline and 28 bilateral Anatomical Landmarks). Thickness analysis of the soft tissue of the face was done for each landmark according to age, sex, and BMI variables. The soft tissue thickness was affected by these three variables. The thickness of the soft tissue of the face increased with increasing BMI. The difference between male and female was statistically significant for nearly all anatomical landmarks, except for nasal and orbital areas. Also in this study, it was asymmetry was reported in half of the bilateral landmarks(6).

In a study of Ruiz Perlaza in 2013, 30 patients (26 males and 4 females) aged 18 to 35 years of age participated in the assessment of the thickness of the facial soft tissue in Colombia. In this study, The CBCT images were prepared with a resolution of 0.3 mm from the patients, and in the 17 anatomical landmarks the thickness of the facial tissue was measured. There was a significant difference between the two genders in only a few landmarks, mostly in the midline, and these values were higher in males which was similar to the findings of other studies in different countries (2).

Our study aimed to evaluate the soft-facial thickness of the face in adult patients with skeletal class I, II, and III jaw patterns in digital lateral cephalometric radiographs, with minor objectives of determining the skeletal pattern of patients based on ANB angle which is categorized to three groups of Class I,II, or III and determining the location of soft tissue landmarks including glabella, nasion, subnasale, labrause superius, stomion, labrale inferius, labiomental, pogonion, menton in lateral cephalograms radiographs in both sexes. This study aimed to determine facial soft tissue thickness of adult subjects with different skeletal classes and to generate data that will be useful for maxillofacial reconstruction in plastic surgery, forensic medicine, and dentistry.

Materials and Methods

This cross-sectional study was performed on 97 patients over the age of 18 years who were referred to a private radiology center for digital radiography of cephalometry (Planmeca, Helsinki, Finland) within one year. Samples are selected in a non-objective and purpose-based manner. Descriptive data were used for appropriate tables and charts. Data analysis was performed using a two-factor analysis of variance based on the establishment of basic assumptions. Otherwise, appropriate nonparametric statistical tests were used.

Patients were divided into three classes of I, II, and III according to ANB angle. In Class I, the ANB angle is between 0 and 4 degrees. In class II, the angle of the ANB is greater than 4 degrees, and in the class III , ANB is less than zero degrees(2,9,10). The number of patients in each class was determined considering the gender. Then, in each of the lateral cephalometric radiographs, soft tissue anatomical landmarks including glabella, nasion, subnasale, labrale superius, stomion, labrale inferius, labiomental, pogonion, menton were determined using MicroDicom software, (MicroDicom, version 0.8.8.653)(Fig.1). The vertical distance of each of these landmarks to the corresponding bone surface was measured by a dental student under the supervision of a radiologist using a measurement tool in the MicroDicom software in millimeters and recorded in the checklist. Then, soft tissue thickness at each site was compared in males and females in class I, II, and III skeletal jaws and then between two sexes by statistical analysis.

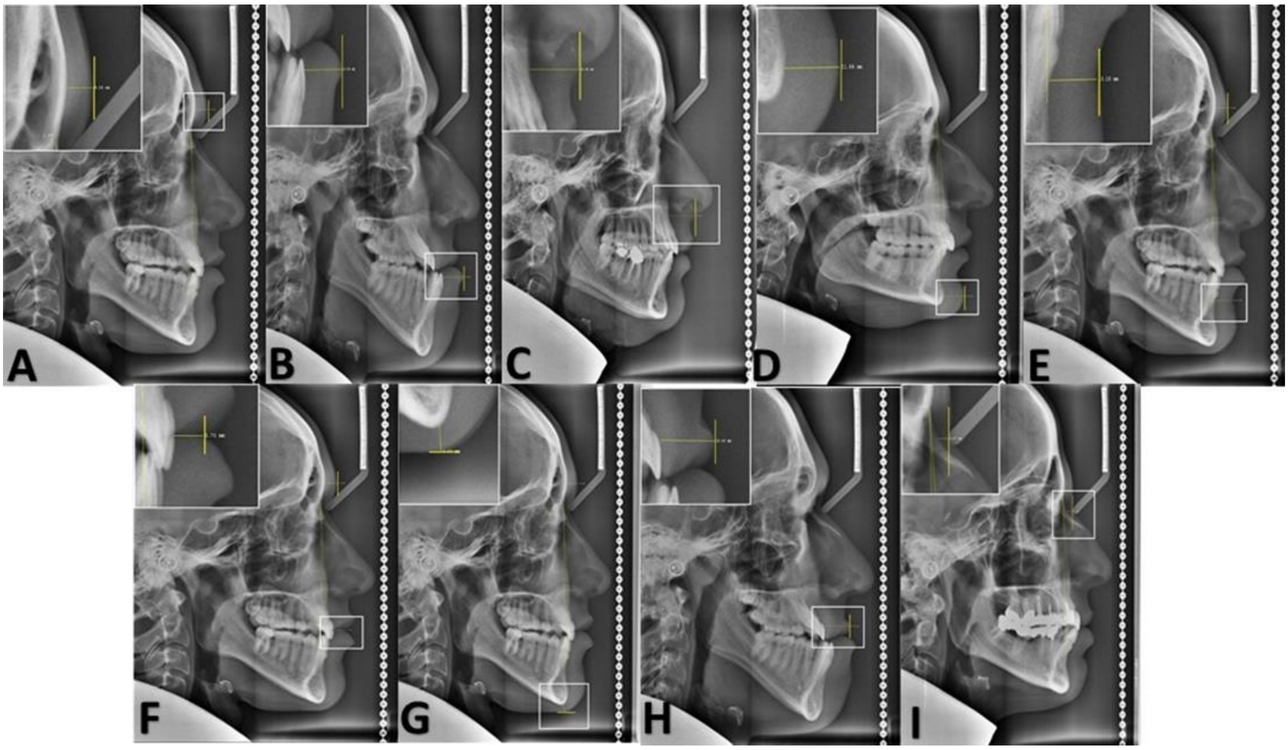

Figure 1: Soft tissue anatomical landmarks. glabella(A) , labrale inferius(B) , subnasale(C) , pogonion(D), labiomental(E), stomion(F), menton(G), labrale superius(H), nasion(I).

Results

In this study, we included 97 patients (56 women and 41 men) who were examined for soft tissue. These patients were in three skeletal classes. In Table 1, patients are categorized by skeletal class and gender. 41.2% of patients were class I, 30.9% class II, and 27.8% were class III based on ANB angle. In general, the distribution of skeletal classes in men and women did not differ significantly.

Table 1: The patients’ distribution on the basis of gender and jaw skeletal class

			Skeletal classes			
			1	2	3	Sum
gender	female	number	23	19	14	56
		percent	41.1%	33.9%	25.0%	100.0%
	male	number	17	11	13	41
		percent	41.5%	26.8%	31.7%	100.0%
sum	Number		40	30	27	97
	Percent		41.2%	30.9%	27.8%	100.0%
X^2					p=0.681 , X^2=0.769	

The variables Glabella, Nasion, SubNasale, Labrale Superius, Stomion, Labrale Inferius, LM, Pogonion, and Menton were compared between two sexes and three skeletal classes. For this purpose, the normal distribution of data was first tested using the Shapiro Wilk test, which confirmed the normality of the data distribution. Therefore, multivariate analysis of variance of two factors was used to analyze the data. It was found that there was no interaction between gender and skeletal class, so comparisons were performed only in two main factors (Fig. 2).

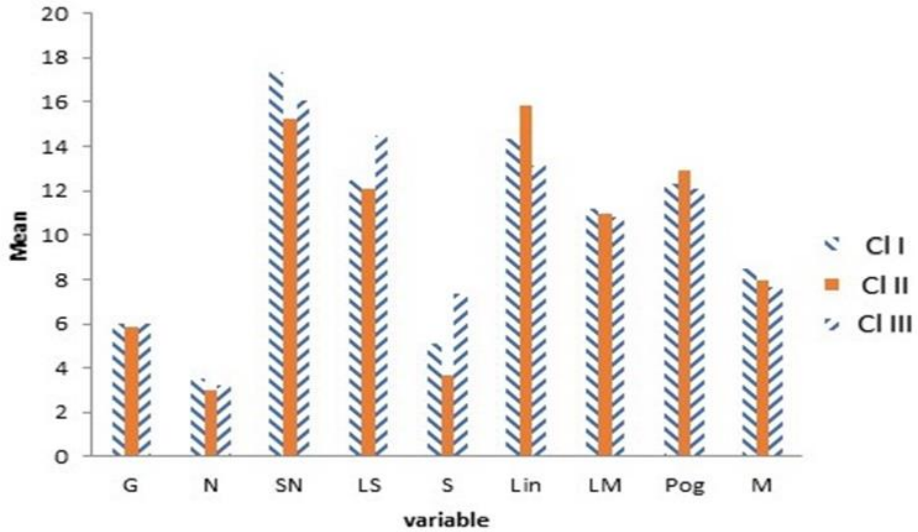

Figure 2: Skeletal class distribution and variables. glabella(G), nasion(N), subnasale(SN), labrale superius(LS), stomion(S), labrale inferius(Lin), Labiomental(LM), pogonion(Pog), menton(M).

In comparison between males and females, only Glabella (p-value=0/609) and Labiomental (P-value=0/061) variables were not significantly different (P-value>0/05). The variables of Nasion(P-value=0/024), Subnasal (P-value<0/001), Labrale Superius (P-value<0/001), Stomion (P-value<0/001), Labrale Inferius (P-value<0/001), Pogonion(P-value=0/029) and Menton (P-value<0/001) were significantly higher in males than females (P-value<0/05). (Fig. 3).

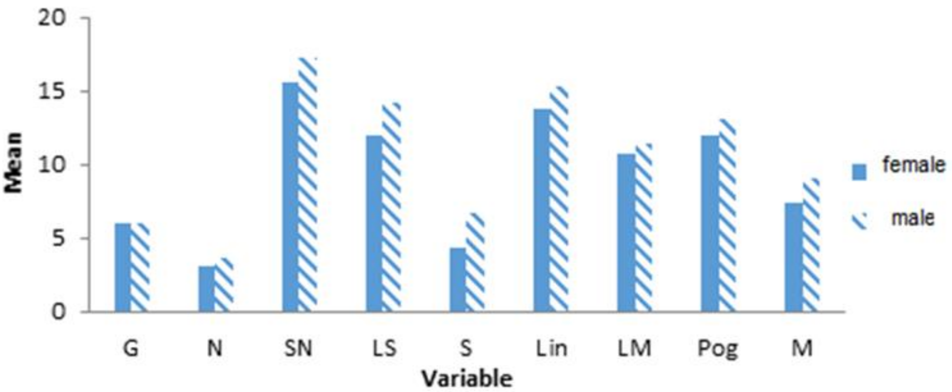

Figure 3: Gender distribution and variables. glabella(G), nasion(N), subnasale(SN), labrale superius(LS), stomion(S), labrale inferius(Lin), Labiomental(LM), pogonion(Pog), menton(M).

The Glabella, Nasion, Labiomental, Pogonion, and Menton variables were not significantly different between skeletal classes. However, three skeletal classes were significantly different in Subnasale, Labrale Superius, Stomion, and Labrale Inferius variables. As shown in Table 2, when comparing classes for meaningful variables, it was found that the average Subnasale in classes 2 and 3 is significantly less than class 1. For the Labrale Superius variable, the average for classes 1 and 2 is significantly less than class 3. For the stomion variable, the mean in class 2 was significantly lower than class 1 and class 3, and also the mean in class 1 was significantly less than class 3. For the Labrale Inferius variable, the average for Class 3 was significantly lower than for classes 1 and 2, and the average for class 1 was also significantly lower than class 2; in other words, all three classes had a significant difference together. (Table 3)

Table 2: The comparison of variable means of jaw skeletal classes

Variable	Class 1 (n=40)	Class 2 (n=30)	Class 3 (n=27)	F	P-value
Glabella	6.04±0.83	5.83±0.92	5.97±0.82	1.204	0.305
Nasion	3.51±1.22	3.00±1.33	3.22±1.24	0.764	0.469
Sub nasale	17.32±1.97	15.23±1.91	16.05±2.72	8.019	0.001
Labrale Superius	12.43±1.84	12.11±2.02	14.50±2.59	11.195	<0.001
Stomion	5.12±2.02	3.70±1.64	7.37±2.69	25.346	<0.001
Labrale Inferius	14.32±1.83	15.81±1.80	13.14±1.71	22.818	<0.001
Labiomental	11.15±1.43	10.98±1.82	10.79±1.14	0.738	0.481
Pogonion	12.27±2.12	12.92±2.40	12.11±2.37	0.661	0.519
Menton	8.46±2.39	7.92±1.44	7.63±1.58	2.461	0.091

Table 3: The comparison of jaw skeletal classes

Skeletal classes		P-value			
		Sub nasal	Labrale Superius	Stomion	Labrale Inferius
1	2	<0.001	0.691	0.004	0.001
1	3	0.036	<0.001	<0.001	0.010
2	3	0.215	<0.001	<0.001	<0.001

Discussion

Understanding the variations in facial soft tissue thickness is important in forensic medicine, dentistry, and plastic surgery. Forensic medicine uses this information as a guide for facial regeneration using superimposition techniques to detect irrelevant skeletons after skull evaluation (4-1).

Soft tissue information is also similar to the skull in different races, gender, and ages (children and adults) (3,5). Most facial rejuvenation techniques use the average facial soft tissue thickness in anatomical landmarks. Five major methods for measuring soft tissue thickness including needle puncture, ultrasonography, x-ray, MRI, and CT have been reported in articles, each of which has its inherent advantages and disadvantages (3, 6, 12).

Since these measures vary according to the articles, and also, there is no research on this issue in the Iranian population, we decided to study this issue to evaluate the facial soft tissue thickness in adults with different skeletal patterns and compared them in both sexes, using digital cephalometric radiographies, based on the ease, availability and cost, compared with other methods.

In a study done in Germany in 2017, there was a statistically significant difference between male and female sexes for almost all anatomical landmarks, except nasal and orbital areas. We also found in this study that the thickness of soft tissue in males was higher than in females (6).

In a study by Bulut et al.(1) in 2014 in Turkey, it was concluded that most of the studied landmarks had a significant difference between the two sexes, and males in all of these cases, except two landmarks related to the zygomatic arch and lateral orbit, showed higher values. In the present study, except for the soft tissue thickness at the Glabella and Labiomental points, in other landmarks, males showed higher values that were consistent with the findings of Bulut et al. study (1).

In a 2013 study in Colombia, Rui Perlaza stated that there was a significant difference between the two sexes in only few landmarks, often in the medial line, and these values were higher in males. The difference between the results of this study and the present study can be explained with the small sample size in Ruiz Perlaza's study (2).

Few studies have compared the thickness of facial soft tissue between different skeletal classes (7,8). In another study, Utsuno et al.(3) reported that soft tissue thickness differed between the three skeletal groups.. They also stated that this information could enable more accurate reconstruction than sex-specific depth alone which have similar results with this study.

In our study, statistically significant differences among the skeletal groups were observed in both males and females at the following sites: stomion, labrale superius, and labrale inferius. The thickness at the labrale superius and stomion points in each skeletal type was the greatest in Class III in both genders. On the other hand, at the labrale inferius point, for both genders, soft tissue depth was the greatest in Class II and the least in Class III, which is supported by the findings of Kamak et al. (7)

In two studies, Jeelani showed significant differences in the thickness of facial soft tissue at labrale superius, stomion, labrale inferius, and labiomental in different paired comparisons among skeletal classes (8,11) which is similar to the result of the present study.

Conclusion

The three classes had a significant difference in soft tissue thickness. These variations in soft tissue thickness between three skeletal classes tend to compensate for the discrepancies in the underlying skeletal correlation to the sagittal plane. These findings highlighted the importance of sex-related and skull morphology-related differences in the facial soft tissues for accurate facial reconstruction. Therefore, it is suggested that future studies, if possible, be done with a larger number of samples, as well as including height and weight variables, and two or more observers can be used to evaluate the soft tissue thickness in the landmarks.

Conflict of interest

There is no conflict of interest. .

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