Male and Female Characteristics of Facial Soft Tissue Thickness in Different Orthodontic Malocclusions Evaluated by Cephalometric Radiography

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ABCDEF 1,2 **Tatjana Perović**
G 2 **Zorica Blažej**

1 Medical Faculty, University of Niš, Niš, Serbia
2 Department for Orthodontics, Dental Clinic, Niš, Serbia

Corresponding Author: Tatjana Perović, e-mail: tatjana.tanic@gmail.com
Source of support: Departmental sources

Background: The facial profile is determined by the facial soft tissue thickness (FSTT) and dentoskeletal characteristics. The aim of this study was to compare male and female characteristics of FSTT in different orthodontic malocclusions using cephalometric radiography.

Material/Methods: One hundred and twenty lateral cephalometric radiography-derived cephalograms of adult male (n=47) and female (n=73) orthodontic patients, aged between 16–22 years were classified according to their dentoskeletal relationships as Class I (n=30), Class II Division 1 (n=30), Class II Division 2 (n=30), Class III (n=30). Burstone analysis of seven linear dimensions of FSTT was used.

Results: Men had a thicker FSTT in dentoskeletal relationships Class I, Class II Division 2, and Class III. Sex differences varied from significant (t=2.056; p<0.05) for the sub-nasal area in Class II Division 2, to highly significant (t=3.772; p<0.001) for the upper lip sulcus in Class II Division 2. Women in Class II Division 1 had significantly thicker FSTT in the lower jaw area (t=2.800; p<0.01) and for the lower lip sulcus and the chin area (t=3.961; p<0.001).

Conclusions: Men with orthodontic malocclusions were characterized by thicker facial soft tissue compared with female patients in Class I and Class II Division 2; female patients in Class II Division 1 were characterized by thicker facial soft tissue of the mentolabial sulcus and chin. Men and women with a skeletal jaw relationship in Class III showed no significant difference in their FSTT.

MeSH Keywords: Face • Malocclusion • Sex Characteristics

Full-text PDF: https://www.medscimonit.com/abstract/index/idArt/907485

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Background

The human face is the most characteristic and recognizable part of a human body. It is with the face that a range of human emotions is expressed. Humans judge attractiveness according to the appearance of the face, and social acceptance depends to a great extent on the facial appearance. An attractive face is related to our perceptions of beauty and health, combined with our feelings of social accomplishment, intelligence, and happiness [1]. The face is of essential significance for interpersonal communication and social contact, and our first memory of a person is related to the image of their face [2].

A proportionate relationship among the different structures of a face is the key to its esthetic and pleasing appearance [3]. The facial profile is determined by the facial soft tissue thickness (FSTT) and dental and skeletal characteristics [4]. Face contours are traditionally considered to be a result of the position of basic hard (dental and skeletal) tissue followed by the soft tissue. However, current trends show a shift of the paradigm from the conventional analysis of hard tissues, to include soft tissue [5]. Muscles, subcutaneous fat, soft tissue, and skin, can develop proportionately and disproportionately in relation to corresponding skeletal structures [6]. There can be variations in the thickness, length, and tone of soft tissue, which all affect the facial esthetic [7].

Improvement in facial appearance has long been recognized as the most important motive for patients to accept orthodontic treatment. The essential determinant for facial esthetics is an understanding of the relationship between the facial bones and soft tissue. It was previously thought that the configuration of the soft tissue profile was primarily related to the basic skeletal configuration. However, there have been reports to indicate that soft tissue acts independently of the basic dentoskeletal base, since soft tissue is very variable in thickness, and is considered to be the main factor in determining a patient's final facial profile [8].

To plan successful orthodontic or orthognathic surgical treatment for patients, a cephalometric analysis of hard and soft tissues should take place [9–11]. This analysis is used to a large degree for determining the diagnosis and planning of orthodontic or orthognathic surgical treatment. However, with the advancement of cephalometrics, it has been established that there are differences in FSTT in different ethnic groups, which means that one standard of facial esthetics may not be applied to other ethnic groups. Therefore, researchers have compared the cephalometric characteristics of different races with the established standard of Caucasian Americans, to establish specific cephalometric values of FSTT for different ethnic groups [8,11,12]. Furthermore, age [3,13,14], sex, ethnicity [3,15], climate [16], activity, obesity and the body mass index (BMI) [17–19] of individuals have a significant influence on this relationship, together with other conditions. Aside from jaw orthopedics, knowledge of the values of FSTT can help anthropologists to determine the facial appearance of ancient civilizations, and forensic anthropologists to identify a victim by facial reconstruction, when it is not possible to apply any other method of identification [4,20,21].

Standard values of FSTT and other rules based on anatomy are used for facial reconstruction, but FSTT values are usually used for determining the thickness of tissue that lies on predetermined landmarks of the skull [5]. Knowing the quantitative distribution of FSTT in different areas is a necessary factor for creating recognizable facial contours on an unknown skull [17,18,22,23].

Recent research from different parts of the world has shown that soft tissue thickness closely corresponds to sagittal malocclusions [9,14,24–28]. There is still controversy over the influence of sex on FSTT, and most authors believe that there are significant differences between men and women in FSTT [2,5,8,25,26,29–31]. However, other authors refute these differences [16,20,32,33].

Therefore, the aim of this study was to compare male and female characteristics of FSTT in different orthodontic malocclusions using cephalometric radiography and using categories according to the presence of different sagittal dentoskeletal patterns for both sexes, and to compare these values within the same classes of malocclusion.

Material and Methods

Ethics and study approvals

A cross-sectional, comparative, descriptive clinical study was undertaken, which was approved by the Faculty of Medicine in Niš under the general project title of Clinical and Experimental Examination of the Stomatognathic System and Modern Therapeutic Procedures, Project Number 11, from March 8, 2017, Niš, Republic of Serbia. All patients provided written informed consent to participate in the study.

Patients studied

This study included the examination and the analysis of cephalometric radiography-derived lateral cephalograms to evaluate facial soft tissue thickness (FSTT) for 120 adult Caucasian orthodontic patients (73 women and 47 men) from the mid-Balkan region, which were taken from the patient archives. Cephalometric radiography-derived lateral cephalograms were recorded during routine diagnostic procedures for patients who

were examined in the Department of Jaw Orthopedics at the Clinic of Dentistry in Niš, who were aged between 16–22 years, and who underwent orthodontic therapy for the first time. Patients were excluded from the study if they had a history of trauma, craniofacial anomalies, cleft lip and palate, and previous orthodontic, prosthetic or orthognathic surgical treatment.

Cephalometric radiographs of the head using a cephalostat (head-holding device)

All patients including in the study underwent a detailed clinical assessment and analysis of their dental and skeletal profiles, as well as soft tissue profiles on cephalometric radiography. The equipment used for the imaging analysis was the Rotograf Plus (20090 Buccinasco MI Italy) (Number and series: 00036045), and the CEI-OPX/105 X-ray tube (CEI, Bologna) in March 2000, which had a protective filter (2.5 mm aluminum-equivalent). Lateral cephalometric films were taken from a distance of 165 cm from the tube, using a cephalostat to ensure rigid head fixation.

The patients were placed in the cephalostat in such a way that the sagittal plane of the head was at a 90° angle to the path of the X-rays. The Frankfort horizontal plane (from the median line of the occipital bone and upper rim of the external auditory canal) was parallel to the ground, the teeth were in a central occlusion position, and the lips were in a relaxed position. No correction for magnification factors was required, since all the radiographs were taken with the same equipment and the same proportions. Each cephalogram was fixed on the viewing box with the profile to the right, and the acetate tracing paper was fixed by tape at the top. The soft tissue and skeletal features were traced manually in a darkened room, using a 0.5 mm lead pencil. All the image tracing was done by the main investigator.

Patient grouping using the Steiner ANB angle

The criteria for categorizing patients into the four groups in the study was the size of the ANB angle according to Steiner and the angle inclination of the upper incisors. The cephalometric ANB angle was the parameter that defined the mutual sagittal relationship between the upper and lower jaw as orthognathic, distal, or mesial (Figure 1). The points that determined the ANB angle included, point (N), the nasion, located on the suture between the frontal and nasal bones; point (A), the lowest point on the line between the anterior nasal spine and the prosthion (alveolar point); and point (B), the lowest point from the line between the infradentale and the pogonion (midline of the chin).

The first patient group consisted of 30 patients (18 women; 12 men) with an orthognathic jaw relationship (Class I) and

Figure 1. The cephalometric ANB angle and the angle of inclination of upper incisors.

the ANB angle between 2–4°. The second group consisted of 30 patients (20 women; ten men) with a distal jaw relationship, an ANB angle >4°, and the inclination angle of the upper incisor >22° (Class II, Division I, or Class II/1). The third group consisted of 30 patients (17 women; 13 men) with a distal jaw relationship, an ANB angle >4° and the inclination angle of the upper incisors inclination <22° (Class II, Division 2, or Class II/2). The fourth group consisted of 30 patients (18 women; 12 men) with a mesial jaw relationship and an ANB angle <1° (Class III).

After measuring the ANB angle to classify the malocclusion, the following landmarks were traced: the anterior nasal spine (ANS), or the anterior point on the maxillary bone; the posterior nasal spine (PNS), or the posterior limit of the palate; the palatal plane, or ANS-PNS, this plane was formed by connecting the ANS to the PNS and it represented the base plane of the maxillary bone. The distance between the bone and soft tissue was measured parallel to the ANS-PNS plane. Each cephalogram was checked for its magnification and dealt with accordingly. Then, the soft tissue thickness was measured for each cephalogram at seven selected landmarks, according to the Burstone analysis (Figure 2) [6]. The following areas were used: the glabella area (G-G1), the linear distance between the G point (the most prominent point on the frontal bone) and the soft tissue, or analog point; the subnasal area (A-SN), the distance between point A (the most concave point of the
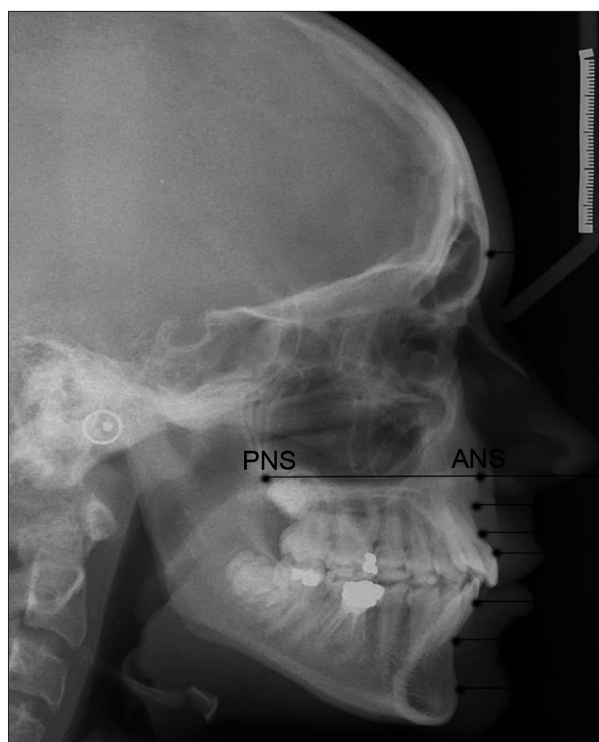
Figure 2. Soft tissue cephalometric landmarks. Seven linear distances (Burstone) from top to bottom: G-G1; A-SN; PR-SLS; J-LS; I-LI; B-SLI; PG-PG1.

anterior maxilla) and subnasale; the distance between the PR point (prosthion) and the sulcus labii superioris (PR-SLS), the most inferior anterior point on the maxillary alveolar process between the central incisors, and the upper lip; the distance between the J point (the most labial point of the upper incisor) and surface of the upper lip, labrale superius (J-LS); the distance between the I point (the most labial point of the lower incisor) and surface of the lower lip, labrale inferius (LI); the sulcus mentolabialis, the distance between the B point (the most concave point on mandibular symphysis) and labiomental sulcus. (B/SLI); the PG/PG1, the distance between the Pg point, the pogonion or the most prominent point of the chin, and soft tissue-analog point (PG/PG1)

The values of the soft tissue thickness were measured with a digital caliper (in millimeters), and seven linear distances analyzed statistically in the four groups of patients and categorized according to sex. The mean values in women and men were compared in each group of patients with malocclusion.

Statistical analysis

Statistical analysis was based on the database in which data were tabulated. Statistical parameters used included the mean value, standard deviation (SD), and amplitude of variation (min–max). The second stage of the statistical data processing consisted of verifying the scientific hypotheses with the selection of statistical test based on the type of statistical landmark, the measurement scale, and the number of samples and their size. The Student's t-test was applied to two small independent samples to compare the mean values of the soft tissue for men and women. The SPSS version 8.0 statistical package for Windows was used for processing the data.

Results

Patient clinical characteristics

The study group included 120 patients (73 women and 47 men), with varied skeletal jaw relationships, as shown in Table 1. In the first group of patients, with an orthognathic jaw relationship, there were 18 women and 12 men. In the second group, with a distal jaw relationship and protrusion of upper incisors, there were 20 women and ten men. In the third group, with a distal jaw relationship and retrusion of upper incisors, there were 17 women and 13 men. In the fourth group of patients, with a mesial jaw relationship, there were 18 women and 12 men (Table 1).

Mean values of seven horizontal dimensions, according to Burstone, in four groups of patients, categorized according to sex

The mean values of facial soft tissue thickness (FSTT) (with standard variation, minimum, and maximum values), presented

Table 1. Distribution of patients according to sex in the total population of patients with different dental and skeletal relationships.

Skeletal class	Female		Male		Total	
I	18	(60.0%)	12	(40.0%)	30	(100.0%)
II/1	20	(66.7%)	10	(33.3%)	30	(100.0%)
II/2	17	(54.8%)	13	(45.2%)	30	(100.0%)
III	18	(60.0%)	12	(40.0%)	30	(100.0%)
Total	**73**	**(60.3%)**	**47**	**(39.7%)**	**120**	**(100.0%)**

Data are given as frequencies (%).

Table 2. Mean facial soft tissue thickness (FSTT) profiles in male individuals.

Linear distance FSTT	Skeletal class			
	I	II/1	II/2	III
G-G1	7.21±1.34	5.90±1.43	6.36±1.32	6.79±0.72
	(5.0–9.0)	(4.0–9.0)	(4.0–9.0)	(6.0–8.5)
A-SN	18.75±3.03	17.30±2.84	18.04±2.30	15.79±3.45
	(11.5–22.0)	(13.5–22.0)	(13.5–22.5)	(8.0–21.5)
PR-SLS	14.96±3.24	12.75±1.90	16.00±2.05	12.75±2.50
	(12.0–20.0)	(9.0–16.0)	(12.5–20.0)	(6.0–15.5)
J-LS	14.96±3.24	12.65±1.84	17.32±3.02	13.92±2.41
	(10.0–20.0)	(10.0–16.0)	(10.5–22.0)	(9.0–19.0)
I-LI	16.67±2.45	15.60±1.41	17.79±2.69	14.58±1.62
	(12.5–21.0)	(13.5–18.0)	(12.0–23.0)	(11.5–16.0)
B-SLI	12.71±1.50	10.90±1.22	12.11±1.53	13.17±1.53
	(10.5–16.0)	(9.0–13.0)	(9.5–15.0)	(11.0–16.0)
PG-PG1	12.38±1.09	10.40±2.17	13.75±2.50	13.25±4.21
	(11.0–14.0)	(7.5–13.5)	(10.0–20.0)	(7.5–22.0)

Data are given as mean ±SD (min–max).

Table 3. Mean facial soft tissue thickness (FSTT) in female individuals.

Linear distance FSTT	Skeletal class			
	I	II/1	II/2	III
G-G1	6.47±1.04	7.05±1.42	6.29±0.64	6.34±1.11
	(4.5–8.5)	(5.0–10.0)	(5.0–7.5)	(4.5–8.0)
A-SN	16.83±1.59	16.48±2.45	16.47±1.94	16.17±2.39
	(12.0–19.0)	(12.0–21.0)	(13.5–21.0)	(12.0–20.0)
PR-SLS	12.67±1.76	12.35±2.10	13.44±1.73	12.92±1.86
	(7.0–15.0)	(7.5–16.0)	(11.5–17.5)	(8.5–15.5)
J-LS	12.97±1.69	12.00±1.94	14.56±2.09	13.11±1.82
	(8.5–15.5)	(8.0–17.0)	(11.0–19.0)	(10.5–17.0)
I-LI	15.31±1.39	15.33±1.77	15.41±1.54	13.39±2.08
	(12.0–18.0)	(12.0–19.0)	(12.0–17.5)	(8.5–16.5)
B-SLI	11.78±1.52	12.63±1.74	12.06±1.21	11.86±1.90
	(10.0–15.5)	(10.0–15.0)	(10.0–14.0)	(8.5–16.5)
PG-PG1	12.61±2.13	13.83±2.26	12.12±1.32	12.28±1.52
	(9.0–18.5)	(8.5–19.0)	(9.5–14.0)	(10.0–15.0)

Data are given as mean ±SD (min–max).

Table 4. Sex differences in mean facial soft tissue thickness (FSTT) in patients with a skeletal relationship of class I.

Linear distance FSTT	Male	Female	t-test	p
G-G1	7.21±1.34	6.47±1.04	1.696	p>0.05
A-SN	**18.75±3.03**	**16.83±1.59**	**2.266**	**p<0.05**
PR-SLS	**14.96±3.24**	**12.67±1.76**	**3.089**	**p<0.01**
J-LS	**14.96±3.24**	**12.97±1.69**	**2.199**	**p<0.05**
I-LI	16.67±2.45	15.31±1.39	1.940	p>0.05
B-SLI	12.71±1.50	11.78±1.52	1.654	p>0.05
PG-PG1	12.38±1.09	12.61±2.13	0.354	p>0.05

Data are given as mean ±SD (min–max).

Table 5. Sex differences in mean facial soft tissue thickness (FSTT) in patients with a skeletal relationship of class II/1.

Linear distance FSTT	Male	Female	t-test	p
G-G1	**5.90±1.43**	**7.05±1.42**	**2.084**	**p<0.05**
A-SN	17.30±2.84	16.48±2.45	0.825	p>0.05
PR-SLS	12.75±1.90	12.35±2.10	0.507	p>0.05
J-LS	12.65±1.84	12.00±1.94	0.879	p>0.05
I-LI	15.60±1.41	15.33±1.77	0.427	p>0.05
B-SLI	**10.90±1.22**	**12.63±1.74**	**2.800**	**p<0.01**
PG-PG1	**10.40±2.17**	**13.83±2.26**	**3.961**	**p<0.001**

Data are given as mean ±SD (min–max).

in seven horizontal dimensions in the area of the glabella, the floor of the nose, the upper lip sulcus, the upper and lower lip, the mentolabial sulcus, and the pogonion in male individuals with a skeletal relationship in Class I, II/1, II/2 and Class III are shown in Table 2.

The mean values of FSTT in seven horizontal dimensions in the area of the glabella, the floor of the nose, upper lip sulcus, upper and lower lip, mentolabial sulcus and pogonion in female individuals with a skeletal relationship in Class I, II/1, II/2 and Class III are shown in Table 3.

The mean values of all the parameters from the overall sample, for patients of both sexes, had a low coefficient of variation values, which indicated homogeneous and representative sets. The coefficient of variation was somewhat greater (31.8%) only for male patients in Class III for the thickness PG-PG1, and this indicated a slightly greater variability in this parameter.

The following results were obtained by comparing the values of the parameters in male and female patients: in the group of patients with an orthognathic jaw relationship, male patients had a significantly greater FSTT in the area of the floor of the nose (A-SN), sulcus labrale superius (PR-SLS) and labrale superius (J-LS) when compared with female patients, which

was determined by a t-test, for the parameter A-SN (t=2.266; p<0.05); for the parameter PR-SLS, (t=3.089; p<0.01; and for the parameter J-LS (t=2.199; p<0.05). The values of the parameters are presented in Table 4.

In the group of patients with a skeletal jaw relationship in Class II/1, female patients had a significantly increased FSTT when compared with male patients in the area of the glabella (G-G1), mentolabial sulcus (B-SLI), and the pogonion (PG-PG1) (Table 5), which was determined by the t-test, for the parameter G-G1 (t=2.084; p<0.05); for the parameter B-SLI (t=2.800; p<0.01) for the parameter PG-PG1 (t=3.961; p<0.001).

In the group of patients with a skeletal jaw relationship in Class II/2, male patients had significantly increased FSTT of the subnasal area, sulcus labrale superius, labrale superius and inferius, and pogonion (Table 6), which was determined by the t-test, for the parameter A-SN (t=2.056; p<0.05) for PR-SLS (t=3.772; p<0.001), for J-LS (t=3.004; p<0.01) for I-LI (t=3.078; p<0.01), and for the parameter PG-PG1 (t=2.331; p<0.05).

In the group of patients with a skeletal jaw relationship in Class III, there was no statistically significant difference in FSTT between male and female patients (Table 7).

Table 6. Sex differences in mean facial soft tissue thickness (FSTT) in patients with a skeletal relationship of class II/2.

Linear distance FSTT	Male	Female	t-test	p
G-G1	6.36±1.32	6.29±0.64	0.174	p>0.05
A-SN	**18.04±2.30**	**16.47±1.94**	**2.056**	**p<0.05**
PR-SLS	**16.00±2.05**	**13.44±1.73**	**3.772**	**p<0.001**
J-LS	**17.32±3.02**	**14.56±2.09**	**3.004**	**p<0.01**
I-LI	**17.79±2.69**	**15.41±1.54**	**3.078**	**p<0.01**
B-SLI	12.11±1.53	12.06±1.21	0.098	p>0.05
PG-PG1	**13.75±2.50**	**12.12±1.32**	**2.331**	**p<0.05**

Data are given as mean ±SD (min–max).

Table 7. Sex differences in mean facial soft tissue thickness (FSTT) in patients with a skeletal relationship of class III.

Linear distance FSTT	Male	Female	t-test	p
G-G1	6.79±0.72	6.34±1.11	1.245	p>0.05
A-SN	15.79±3.45	16.17±2.39	0.352	p>0.05
PR-SLS	12.75±2.50	12.92±1.86	0.209	p>0.05
J-LS	13.92±2.41	13.11±1.82	1.043	p>0.05
I-LI	14.58±1.62	13.39±2.08	1.678	p>0.05
B-SLI	13.17±1.53	11.86±1.90	1.987	p>0.05
PG-PG1	13.25±4.21	12.28±1.52	0.767	p>0.05

Data are given as mean ±SD (min–max).

Discussion

The findings of this cross-sectional, comparative, descriptive clinical study showed that men with orthodontic malocclusions were characterized by increased facial soft tissue thickness (FSTT) compared with women, in Class I and Class II Division 2 (ClassII/2), but that women in Class II Division 1 (Class II/1) were characterized by increased FSTT of the mentolabial sulcus and chin. Men and women with a skeletal jaw relationship in Class III showed no significant difference in their FSTT.

Because it may never be possible to describe and predict all the variations of the male and female human face and the relationship between the bone and soft tissue, the measurement of FSTT has multiple diagnostic, clinical, anthropological, and forensic applications, including craniofacial reconstruction, facial plastic surgery, reconstructive and orthognathic maxillofacial surgery, and evaluation of benign and malignant facial tumors [18]. Because soft tissues do not form a layer of equal thickness which simply shapes the configuration of basic dental and skeletal structures, the variability of FSTT can reflect the facial profile and should be a factor in diagnosis and the planning of orthodontic treatment [10,12].

Recent studies have shown that not all areas of the soft tissue profile directly follow skeletal structures and, in some areas the contours of the facial tissue deviate from basic skeletal structures [7,18,34]. In everyday orthodontic practice, there are standard cephalometric measurements and analysis done on the basis of cephalometric radiography of facial profiles to determine relationships between contours of a facial skeleton, as well as FSTT measurements [4].

Lateral cephalometric radiography, which generates a lateral cephalogram, shows dental, skeletal, and soft tissue profiles, and is used to determine dental and skeletal relationships, with the aim of planning orthodontic treatment [33]. More contemporary methods for determining FSTT have recently been developed [14,23], including computed tomography (CT) scanning [35], cone beam CT (CBCT) [17,19], ultrasonography [4], and magnetic resonance imaging (MRI) [18,22]. Needle puncture measurements of FSTT have been reserved for cadaveric studies [21]. In the present study, standard profile lateral cephalometric radiography was chosen as the method of measurement of FSTT, for several reasons, but mainly because it provides the opportunity to objectively measure important structures and relationships, and most previously published studies have used this method [30]. Also, lateral cephalometric radiography is used in routine clinical practice

and is a standard diagnostic procedure in orthodontic therapy, and is associated with minimal exposure to X-radiation.

The main findings of the current study have shown that male patients with a skeletal jaw relationship in Class I had significantly thicker soft tissues in the subnasal area, sulcus labrale superius, and labrale superius, compared with female patients. Other linear distances were greater in males, but this difference was not statistically significant (Table 4). These findings have been supported by previously published studies on the differences in FSTT and orthognathic jaw relationships between male and female patients, but the present study has shown differences in the degree of statistical significance of these differences. Tedeschi-Oliveira et al. established significant sex differences for FSTT in ten out of 32 parameters examined, but this study was performed on cadavers, and used the needle puncture method [36]. Hwang et al. used facial CT scanning to develop a database for craniofacial reconstruction in Korean adults and showed that most of the markers measured higher values in men compared with women, with the landmarks associated with the lip areas showing the greatest difference, of almost 2.00 mm [29]. A previously published study on the FSTT that included Japanese children and young adults showed similar results, and the linear distances of the subnasal, labrale superius, and labrale inferius showed statistically significant sex differences in patients between 16–18 years-of-age, which was the oldest age group in the study [37]. Review of the findings from different studies that included different ethnic groups, from different parts of the world indicates that FSTT of the lip area is greater in men than in women, regardless of the race.

Kamalpreet et al. established the differences between men and women in FSTT in patients from northeast India using CT scanning and MRI [18]. Aggarwal and Singla reported on the presence of significant differences between men and women, and men had increased values for FSTT for the labrale superius, labrale inferius, pogonion and menton, compared with women, and recommended that this difference should be taken into consideration when planning orthodontic therapy [30]. Hamid and Abuaffan [4], Ramesh et al. [5], Chen et al. [22], Atashi et al. [38], and Masoumeet et al. [17] have all shown differences in FSTT between men and women, but have given the explanation as being due to the influence of body mass index (BMI). Karnaket et al. [27], and Maurya et al. [39] found significant differences between men and women in the area of the labrale superius and pogonion. Panenkova [2], Subramanian et al. [10], Celikoglu et al. [28], and Al-Mashhadany et al., in patients with a Class I sagittal relationship [31], showed significant differences between men and women for the FSTT of the labrale superius, labrale inferius and pogonion, and came to similar conclusions as the present study. However, in contrast to the findings of the present study, Drgacova et al. [20],

Figure 3. A female patient with a thinner upper lip and thicker soft tissues of the lower lip, mentolabial sulcus and chin, which have a compensatory effect on the appearance of the profile with a distal jaw relationship and protrusion of the upper incisors.

Stephan et al. [32], and Briers et al. [33] reported that differences did exist between men and women for the FSTT but that these differences were given undue credence to the difference in FSTT rarely went beyond 2mm, which was of no significance in everyday clinical practice.

In the present study, in the group of patients with a skeletal jaw relationship in Class II/1, women had a significant increase in FSTT when compared with men in the area of the glabella, mentolabial sulcus, and pogonions (Table 5). In contrast to these findings, AlBarakati reported significant differences in the thickness of the labrale superius and inferius, which were greater in males in an examination of FSTT in residents of Saudi Arabia with the same dental and skeletal relationship [8]. The findings of Maurya et al. [39], of patients in northern India with dental and skeletal relationship in Class II/1, showed a significantly increased FSTT in the area of the upper lip sulcus, upper and lower lip, and in the lower lip sulcus for men, and in the area of the pogonion for women. Similar results have been published by Hamid et al. for patients in Sudan, and by Ramesh et al., for patients in India [4,5].

In the present study, the finding of a significantly thicker soft tissue covering reference points on a retroposition lower jaw was established for women, and may be explained by the natural compensatory mechanism, by which soft tissue thickness tends to compensate for the underdevelopment of the lower jaw (Figure 3). Most of the previously mentioned studies agree with this hypothesis, even though the findings in men were more pronounced than in women [4,5,8,12,39].

In the present study, the finding in the group of patients with a skeletal jaw relationship in Class II/2 showed that men had a significantly increased FSTT of the subnasal area, sulcus labrale superius, labrale superius and labrale inferius, and area of the chin compared women (Table 6). According to previously published research by Tanic et al., who compared FSTT using the same method as in the current study, they established that the thickest soft tissues in the area of the sulcus of the upper lip, upper and lower lip, showed significant differences between men and women [25]. In a further study by same authors, published a year later, they established significant differences in the area of the sulcus labrale superius and labrale inferius, with patients in Class II/2 having much greater values of FSTT compared with patients in Class II/1 [26]. With this distribution of soft tissue thickness, the retrusion of the upper and lower incisors and posterior position of dentoalveolar jaw segments was camouflaged, which is the basic morphological feature of this dental and skeletal relationship [26]. This compensatory mechanism was more pronounced in men, which is similar to the results of the present study [26].

In this study, the findings were that only in the group of patients with a skeletal jaw relationship in Class III, there was no statistically significant difference between men and women in FSTT (Table 7). Jabbar et al. determined the existence of reduced thickness of soft tissue in the chin area in patients in Class III in comparison with other classes, without significant sex differences [9], which is similar to the results of this study. Other studies have also emphasized reduced FSTT in the chin area, and an increase in FSTT in the area of the upper lip and upper lip sulcus as compensation for the existing skeletal disharmony in Class III [25,27].

The FSTT is greater in men, although its statistical significance varies in different studies. In the present study, the only exception was in patients with a dental and skeletal relationship in Class II/1, where the FSTT was greater in women. The results indicated that the FSTT in all groups was greater in men compared with women, possibly because of the effect of testosterone in facilitating the synthesis of collagen that provides men with thicker skin. However, estrogen hormone in women facilitates the synthesis of hyaluronic acid, resulting in a decrease in the synthesis of collagen, which makes women's skin thinner [31].

Of the variety of factors mentioned that influence the variability of FSTT, it is certain that sex plays a significant role. In some aspects of clinical practice, these differences may be important, including for esthetic and corrective surgery, and jaw orthopedics. However, in other aspects of clinical practice, these differences may be less important, for example, in forensic anthropology. Therefore it is important to continue to study the relationships between the facial dentoskeleton and the soft tissues, to identify the key factors that affect daily clinical practice.

Conclusions

In this study to compare male and female characteristics of facial soft tissue thickness (FSTT) in 120 patients with different orthodontic malocclusions, using cephalometric radiography, men with orthodontic malocclusions were characterized by thicker facial soft tissue compared with female patients in Class I and Class II/2, and female patients in Class II/1 were characterized by thicker facial soft tissue of the mentolabial sulcus and chin. There were no significant differences between men and women in FSTT in patients with Class III malocclusion.

Conflict of interest

None.

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