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Evaluation of facial soft tissue thickness in symmetric and asymmetric subjects with the use of cone-beam computed tomography

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Introduction: The aims of this study were to evaluate facial bilateral soft tissue thickness in symmetric and asymmetric subjects and to investigate whether soft tissue compensates for skeletal asymmetry. **Methods:** Cone-beam computed tomography (CBCT) scans of 97 subjects were divided into a symmetry group (GSm) and an asymmetry group (GASm). Seven bilateral points were established. Each point involved 3 variables: hard tissue distance (Hard-D), soft tissue distance (Soft-D), and soft tissue thickness (Soft-Th). Measurements were taken from software-generated multiplanar reconstructions. A paired *t* test was used to assess intragroup differences and an independent *t* test for intergroup analysis. Pearson coefficient tested correlations between variables. **Results:** In GASm, significant differences were found in all Hard-D and Soft-D measurements, with higher values observed on the deviated side ($P < 0.01$). As for Soft-Th evaluation, results of only 1 reference point presented statistical significance. Intergroup comparison detected significant differences in all Hard-D and Soft-D variables ($P < 0.01$), but no significant differences in Soft-Th. **Conclusions:** Asymmetric subjects presented differences in hard and soft tissue distances between deviated and nondeviated sides, although without affecting soft tissue thickness. It can be concluded that soft tissue does not compensate or disguise an underlying skeletal asymmetry. (Am J Orthod Dentofacial Orthop 2019;155:216-23)

Facial esthetics is a traditional and current topic of discussion in several fields of research, because it has direct and expressive impact on a person's quality of life. Facial disharmony can lead to social and psychologic disorders, often including difficulties in relationships and ability to integrate into society. Facial esthetics can be achieved only with harmony between the various components of the craniofacial complex.[1,2] The search for this balance not only is a challenge for the clinician or the orthodontist, but also figures as an esthetic requirement for all people. Symmetric faces are perceived as more attractive, serving as a considerable indicator of higher genetic quality.[3] Several scholars of facial anatomy developed methods to render this issue in a less subjective view, conducting studies in attempts to establish standard values from samples of individuals considered to be attractive by society in general.[4-6] Disharmonies came to be better diagnosed and studied owing to those analyses.

The evaluation of facial asymmetry is an important aspect to correct orthodontic diagnosis and is sometimes overlooked by the clinician. Subjects with ever-growing esthetic demands and advancing technologies drive the orthodontist into committing to a broader diagnosis, seeking to offer treatment with the best clinical results.

Facial asymmetry may be related to hard tissue, soft tissue, or both.[7] There are still few studies that elaborate on the role that each of the tissues play in the derangement. Skeletal analysis of facial asymmetries found on cephalometric evaluations may be different from the results obtained in soft tissue analyses.[8,9] It is possible to assume that facial soft tissue thickness influences visual perception by enhancing or compensating for an underlying skeletal asymmetry, exhibiting differential expression between left and right sides of the face.

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All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.
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Submitted, December 2017; revised and accepted, March 2018.
0889-5406/$36.00

https://doi.org/10.1016/j.ajodo.2018.03.024

Symmetric and balanced faces may display skeletal asymmetries that are compensated for or disguised by the soft tissues.[8,10]

Previous methods were developed in orthodontics to evaluate soft tissue thickness, such as the use of ultrasound devices,[11,12] overlapping of photographs and radiographs, use of specific equipment such as stereo photogrammetry, 3-dimensional (3D) electromagnetic digitizers and laser scanners,[13-16] and multiplanar reconstructions from computed tomographic (CT) scans.[7,8,17,18] The evolution in 3D diagnosis based on cone-beam computed tomography (CBCT) allowed for a better comprehension of facial anatomy, reducing many limitations encountered in 2-dimensional analyses of frontal and lateral cephalometric radiographs,[18] which reinforces the reason for its being used in the present study.

It is important to point out that during diagnosis and treatment planning, orthodontists should carefully observe the relationship between hard and soft tissues, especially in asymmetric patients undergoing orthognathic surgery, so that treatment guidelines target facial appearance, not just skeletal structures. Because facial asymmetry has several causes, including asymmetric muscular habits, such as unilateral mastication,[19] facial muscles might develop differently on each side, enhancing or disguising bone asymmetry. Therefore, the aim of this study was to evaluate in 3D images the bilateral thickness of facial soft tissue in symmetric and asymmetric subjects and to investigate whether it compensates for skeletal asymmetry.

MATERIAL AND METHODS

The sample initially comprised 1446 CBCT scans taken as records of subjects beginning orthodontic treatment at the Orthodontic Clinics of the Postgraduate Course in Dentistry of the Universidade Federal do Rio de Janeiro (UFRJ) in Brazil, because scanning provides an entire 3D view of the craniofacial anatomy and contributes to better diagnosis and treatment planning. According to the established inclusion and exclusion criteria (see below), 97 CBCT scans were selected for this study, which was approved by the Ethics Committee on Research of Clementino Fraga Filho University Hospital, UFRJ, Brazil.

Sample size was calculated based on the 2.94 mm average SD value regarding soft tissue thickness at point Go1 on the nondeviated side, obtained from a pilot study with 20 CBCT scans of asymmetric individuals. After using the formula proposed by Pandis,[20] it was calculated that there should be at least 33 patients in each group, so that a 2-mm difference[8,18] in soft tissue could be detected with 80% test power ($\alpha = 0.05$).

A CBCT device (KODAK 9500 Cone Beam 3D System; Carestream Health, Rochester, NY) was used for scanning with standard regulation of 90 kV, 10 mA, field of view 18.4 × 20.6 cm, 0.3 mm voxel size, and 24-second scan. The CBCT scans were made with each subject sitting in a vertical position, with the Frankfort horizontal plane parallel to the ground and the midsagittal plane perpendicular to it; teeth were in maximum intercuspation, the tongue was positioned against the palate and subjects were instructed not to swallow.

CBCT scans were exported in DICOM files and evaluated with the use of Dolphin Imaging software (version 11.7 Premium; Dolphin Imaging and Management Solutions, Chatsworth, Calif). To standardize all CBCT scans, head position was oriented in virtual space by the same operator (L.S.) according to the transverse, coronal, and sagittal reference planes.[21]

The following inclusion criteria were used for sample selection: permanent dentition with first permanent molars in occlusion; lack of previous treatment that might have interfered with the normal course of maxillary or mandibular growth and development; normal vertical facial pattern (Frankfort-mandibular plane angle [FMA] 20°-30°); and artifact-free CBCT scans in DICOM files. FMA was assessed in lateral cephalometric views generated from the CBCT scan. Subjects with syndromes, history of facial soft tissue derangement, or surgery on the craniofacial complex were excluded. Individuals were divided into 2 groups according to the deviation of the menton point (Me) from the vertical reference line (VRL), which in turn was perpendicular to the horizontal reference line (lateral orbitale right to left) and intersecting crista galli, according to Masuoka et al.[8] The sample was split into a symmetry group (GSm; n = 50) and an asymmetry group (GASm; n = 47). GSm comprised all individuals with deviation of Me $\leq$2.0 mm from the VRL, and GASm comprised individuals with deviation of Me $\geq$3.5 mm.[12,17] This preliminary evaluation was carried out on frontal cephalometric images generated from CBCT scans by means of Dolphin Imaging software. The sagittal skeletal pattern was classified according to the ANB angle on lateral cephalometric images also generated from the scans by the 3D software into skeletal Class I, Class II or Class III malocclusions (ANB 0-4°, ANB >4°, or ANB <0°, respectively).[6,22] Anatomic structures of interest were identified and measured separately, on both sides of the face, in a standard protocol and by the same operator, on all CBCT scans. The initial reference point used for mandibular soft tissue evaluation was the gonion

Table I. Description of points used in this study

Point	Description
Go1	Point located on the axial plane, corresponding to gonion point.
Go2	Point located on the same axial slice as Go1, positioned 15 mm anteriorly. For its placement, the vertical ruler provided by the software was used as shown on the axial slice.
Go3	Point located on the same axial slice as Go1 and Go2, positioned 15 mm anteriorly to point Go2. For its placement, the vertical ruler provided by the software was used, as shown on the axial slice.
Go4	Point located on an axial slice 15 mm above the axial slice of Go1. For its placement, the vertical ruler provided by the software was used as shown on the coronal slice.
Go5	Point located on the same axial slice as Go4, positioned 15 mm anteriorly. For its placement, the vertical ruler provided by the software was used as shown on the axial slice.
Go6	Point located on an axial slice 15 mm above the axial slice of Go4. For its placement, the vertical ruler provided by the software was used as shown on the coronal slice.
Go7	Point located on the same axial slice as Go6, positioned 15 mm anteriorly. For its placement, the vertical ruler provided by the software was used as shown on the axial slice.

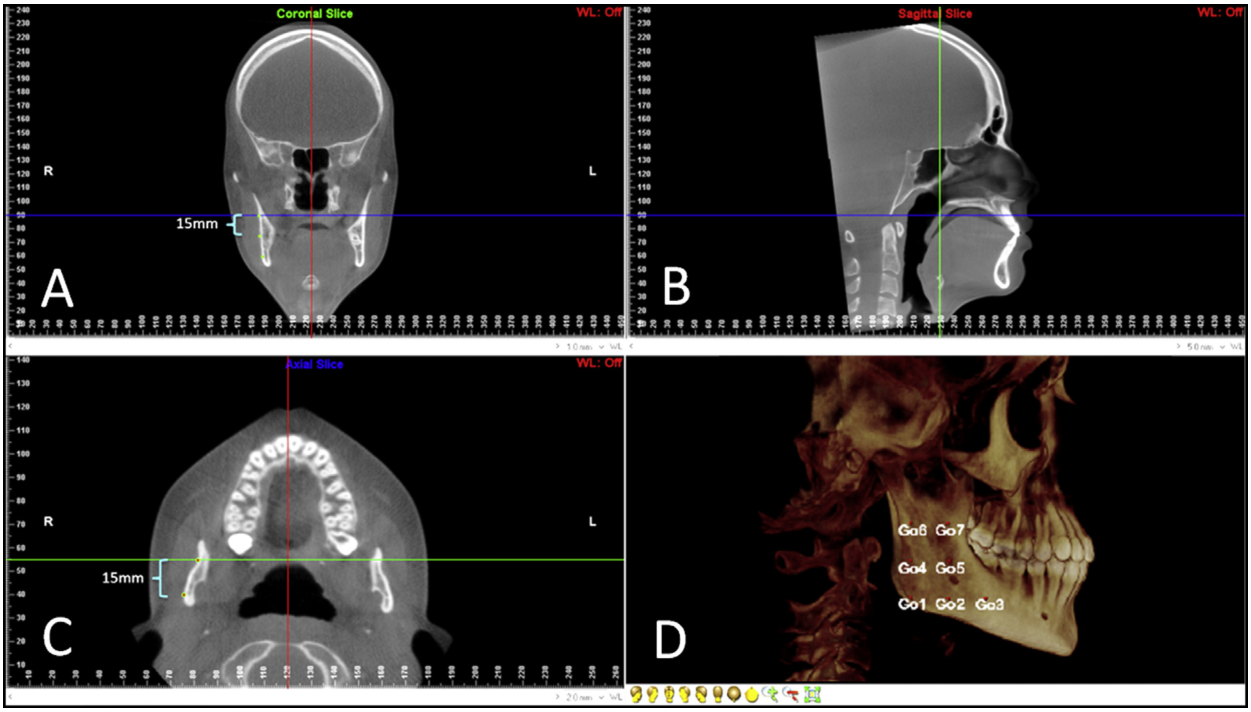

Fig 1. Multiplanar reconstruction images generated with the use of Dolphin Imaging software as they appear on the screen, illustrating the 3-dimensional position of points used in this study. **A,** Coronal slice with points Go2, Go5, and Go7; **B,** sagittal slice; **C,** axial slice with points Go6 and Go7; **D,** lateral view of 3D reconstruction illustrating the position of reference points used to measure hard tissue and soft tissue asymmetry and soft tissue thickness on the right side.

point (Go), the midpoint on the mandibular angle between the ramus and the body.[23] In GASm, the side of Me deviation was referred to as the deviated side, and the opposite side was the nondeviated side. In GSm subjects, the terms right and left side of the face were used.[22,24]

Point go was initially marked on the 3D image and later adjusted on the multiplanar reconstructions; the precise landmark was determined only after being positioned on the 3 slices and then identified as point Go1. The rendered virtual image was used only for initial spatial location, because renderings are projected images and do not depict the real surfaces. Six additional points were derived from Go1 (Table 1; Fig 1), to cover a larger area of the masseter muscle.

All measurements regarding hard and soft tissue distances, as well as facial soft tissue thickness, were taken on transverse slices of multiplanar reconstructions

Table II. Description of variables used in this study

Variable	*Description*
Hard tissue distance (Hard-D)	Horizontal distance between the midsagittal plane and the outer contour of the cortical bone.
Soft tissue distance (Soft-D)	Horizontal distance between the midsagittal plane and the outermost surface of soft tissue.
Soft tissue thickness (Soft-Th)	Horizontal distance between the outer contour of the cortical bone and the outermost surface of soft tissue.

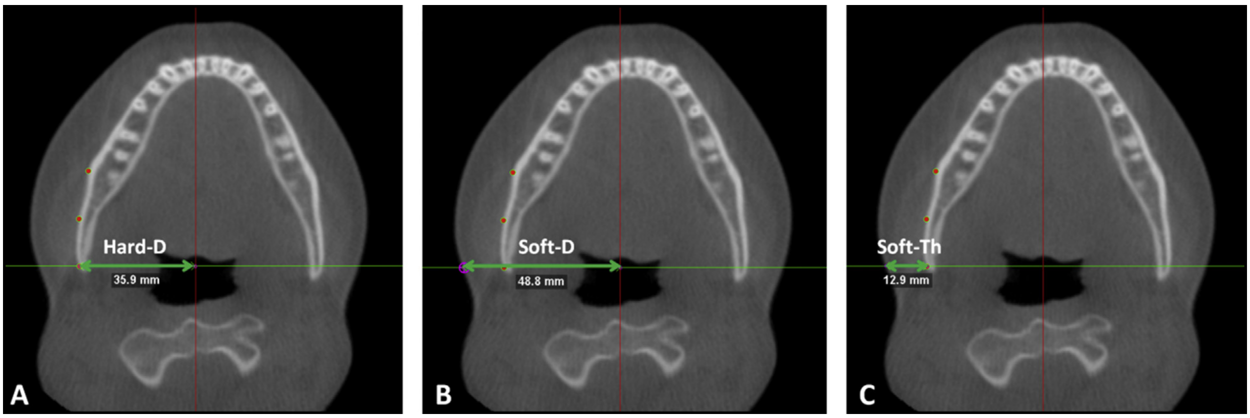

Fig 2. Axial slice illustrating the method used for measuring hard tissue and soft tissue asymmetry. **A,** Hard tissue distance (Hard-D); **B,** soft tissue distance (Soft-D); **C,** soft tissue thickness (Soft-Th). Measurements were taken from point Go1 and are indicated by the arrows on the green line.

with the use of the Digitize/Measurement tool from the previously determined points. Three measurements were taken at each of the points considered in this study (Table II; Fig 2).

Statistical analysis

All measurements were repeated for 30% of the CBCT scans after an interval of 2 weeks. Operator calibration was tested by means of intraclass coefficient correlation (ICC).

Descriptive analysis was carried out for all studied variables. Data normality was assessed by means of the Kolmogorov-Smirnov test. Because the sample displayed normal distribution, a paired t test was used to verify intragroup differences between sides of groups GSm and GASm ($P < 0.05$). The independent t test evaluated absolute differences between sides of both studied groups ($P < 0.05$).

Pearson correlation coefficient was used to test absolute differences between soft tissue thickness related to age, ANB angle, and Me deviation in GASm individuals ($P < 0.05$).

Statistical analysis was carried out with the use of SPSS software, version 22.0 (Chicago, Ill). A 5% level of significance was adopted.

RESULTS

ICC analyses demonstrated excellent rates of reproducibility, with values >0.9 for all studied variables.

This study was conducted from the analysis of 97 CBCT scans and the sample's demographic characteristics are presented in Table III. Of the 47 asymmetric subjects, 33 displayed Me deviation to the left side (70.2%), and 14 to the right side (29.8%).

Descriptive data analyses and intra- and intergroup comparisons between symmetric and asymmetric individuals are presented in Table IV.

Intragroup comparisons in the asymmetry group showed statistically significant differences in all measurements of hard and soft tissue distance ($P < 0.01$), whereas the soft tissue thickness variable displayed statistical difference only at point Go3. In symmetric individuals, intragroup comparisons detected statistical differences only in soft tissue thickness at points Go2, Go3, and Go4.

In intergroup comparisons, a statistically significant difference was observed in hard and soft tissue distances at all reference points used in the study ($P < 0.01$). However, for the soft tissue thickness variable, only point Go5 presented statistical significance.

According to the results, no correlation was found between soft tissue thickness and parameters such as

Table III. Demographic characteristics of the sample

Characteristic	*Total*	*GASm*	*GSm*
Patients (n)	97	47	50
Male (n)	45	22	23
Female (n)	52	25	27
Age (y), mean ± SD	16.21 ± 4.32	17.06 ± 5.04	15.42 ± 3.38
Age (y), range	11-28	11-28	11-25
FMA (°), mean ± SD	25.96 ± 3.05	25.91 ± 3.14	26.02 ± 3.00
FMA (°), range	20-30	20-30	20-30
ANB (°), mean ± SD	2.57 ± 3.70	2.15 ± 3.62	2.97 ± 3.77
ANB (°), range	−10.3 to 10.9	−10.3 to 10.9	−3.70 to 10.1
Me deviation (mm), mean ± SD	2.89 ± 2.06	4.78 ± 1.20	1.11 ± 0.58
Me deviation (mm), range	0-9.2	3.5-9.2	0-2.0

GASm, Asymmetry group; *GSm*, symmetric group.

Table IV. Descriptive data analyses and comparisons between GASm and GSm and between both sides in each group

	GASm (n = 47)				*GSm (n = 50)*				
Variable	*Deviated side*	*Nondeviated side*	*Absolute difference*	*P value**	*Left side*	*Right side*	*Absolute difference*	*P value**	*P value†*
Hard tissue distance (Hard-D)									
Go1	45.75 ± 4.11	42.97 ± 3.86	3.45 ± 2.22	0.000	44.52 ± 3.44	44.29 ± 3.66	2.07 ± 1.51	0.538	0.001
Go2	43.92 ± 3.40	41.15 ± 3.27	3.47 ± 2.27	0.000	42.49 ± 2.46	42.34 ± 2.91	2.00 ± 1.60	0.683	0.000
Go3	40.18 ± 3.24	36.90 ± 3.59	3.63 ± 2.60	0.000	38.54 ± 2.21	38.39 ± 2.99	2.05 ± 1.67	0.692	0.001
Go4	47.13 ± 3.44	45.05 ± 2.85	3.16 ± 2.08	0.000	45.98 ± 2.64	45.88 ± 2.85	1.86 ± 1.50	0.788	0.001
Go5	44.06 ± 3.20	41.94 ± 2.81	3.08 ± 2.25	0.000	43.04 ± 2.72	43.04 ± 2.67	1.81 ± 1.49	0.986	0.001
Go6	48.87 ± 3.24	47.19 ± 2.22	2.98 ± 2.14	0.001	47.82 ± 2.61	48.07 ± 2.72	1.64 ± 1.38	0.410	0.000
Go7	44.74 ± 2.81	43.00 ± 2.41	2.74 ± 1.84	0.000	43.67 ± 2.51	43.79 ± 2.39	1.69 ± 1.30	0.680	0.002
Soft tissue distance (Soft-D)									
Go1	57.27 ± 4.85	54.68 ± 4.65	3.38 ± 2.28	0.000	56.22 ± 3.82	56.34 ± 3.90	2.05 ± 1.53	0.739	0.001
Go2	58.36 ± 4.04	55.68 ± 3.62	3.22 ± 1.91	0.000	56.83 ± 4.01	57.42 ± 3.78	2.02 ± 1.37	0.200	0.001
Go3	56.31 ± 3.69	53.58 ± 3.45	3.14 ± 2.02	0.000	55.09 ± 3.67	55.57 ± 4.06	2.07 ± 1.50	0.184	0.004
Go4	62.70 ± 4.48	60.39 ± 4.01	2.99 ± 2.09	0.000	61.55 ± 3.67	61.93 ± 3.56	1.70 ± 1.23	0.203	0.000
Go5	62.78 ± 4.04	60.34 ± 3.63	2.97 ± 1.95	0.000	61.88 ± 3.63	61.99 ± 3.69	1.60 ± 1.25	0.695	0.000
Go6	66.01 ± 3.97	64.39 ± 3.64	2.54 ± 1.69	0.000	65.11 ± 3.54	65.47 ± 3.41	1.50 ± 0.97	0.159	0.000
Go7	64.88 ± 4.01	63.15 ± 3.57	2.35 ± 1.67	0.000	64.27 ± 3.67	64.69 ± 3.72	1.42 ± 0.99	0.091	0.001
Soft tissue thickness (Soft-Th)									
Go1	11.51 ± 4.01	11.71 ± 4.17	1.25 ± 1.11	0.429	11.69 ± 3.19	12.04 ± 3.30	1.45 ± 1.05	0.171	0.384
Go2	14.44 ± 3.23	14.52 ± 3.22	1.20 ± 0.93	0.690	14.67 ± 2.79	15.08 ± 2.73	1.07 ± 0.86	0.032	0.480
Go3	16.12 ± 3.20	16.68 ± 3.05	1.33 ± 1.08	0.023	16.54 ± 2.85	17.17 ± 2.96	1.01 ± 0.94	0.001	0.126
Go4	15.56 ± 3.32	15.34 ± 3.33	1.15 ± 0.82	0.282	15.57 ± 2.68	16.05 ± 2.86	1.02 ± 0.80	0.009	0.459
Go5	18.72 ± 3.03	18.40 ± 3.08	2.97 ± 1.95	0.215	18.84 ± 2.70	18.95 ± 2.72	0.86 ± 0.70	0.497	0.005
Go6	17.13 ± 2.94	17.19 ± 2.91	1.35 ± 0.86	0.802	17.29 ± 2.53	17.39 ± 2.58	1.08 ± 0.88	0.596	0.136
Go7	20.14 ± 3.03	20.15 ± 3.12	1.37 ± 1.20	0.987	20.60 ± 2.82	20.89 ± 2.93	1.02 ± 0.75	0.109	0.091

Values are expressed in mm, mean ± SD.
*Paired *t* test between the 2 sides in each group; †Independent *t* test between the absolute differences between the sides of both groups.

age, ANB angle, or Me deviation in asymmetric subjects, as presented in Table V.

DISCUSSION

The aim of this study was to better understand the relationship between soft tissue and hard tissue on the asymmetric individual's face. Because perfectly symmetrical faces can not be found, an Me deviation of up to 2.00 mm was tolerated for GSm.[1,25,26] During literature review, it could be observed that different amounts of chin deviation were considered to be acceptable when characterizing an asymmetric subject. When conducting this research, studies of asymmetry evaluation[7,12,17,22] and asymmetry perception[8] were revised, and it was established that chin deviations ≥3.5 mm were necessary to feature in group GASm. Individuals with Me deviation >2.0 mm and <3.5 mm were excluded from the sample so that differences

Table V. Pearson correlation coefficient for age, ANB angle, and menton (Me) deviation compared with soft tissue thickness (Soft-Th) absolute differences in asymmetric subjects

	Absolute difference (Soft-Th)						
Variable	*Go1*	*Go2*	*Go3*	*Go4*	*Go5*	*Go6*	*Go7*
Age							
r	−0.037	0.176	−0.009	0.129	0.210	0.078	0.145
P	0.805	0.236	0.954	0.388	0.156	0.601	0.329
ANB							
r	−0.132	−0.177	−0.059	−0.201	−0.165	−0.124	−0.053
P	0.376	0.233	0.694	0.175	0.266	0.406	0.725
Me deviation							
r	0.104	0.150	0.163	0.188	0.024	0.193	−0.184
P	0.487	0.315	0.273	0.205	0.872	0.193	0.216

between groups could be firmly established, leaving a gap between GSm and GASm boundaries.

In this study, 70.2% of asymmetric subjects had Me deviation to the left side, in line with previous studies.[12,17,19,27] Some authors suggest that emotions are more evidently expressed on the left side of the face, and that therefore this could be a functional asymmetry related to the side of tissue displacement.[28-30]

To prevent facial height from influencing studied groups, only individuals with normal patterns of vertical growth were selected (Table III). There are muscular differences between the various vertical patterns,[31] with long-face individuals presenting more oblique inclination of muscle fiber bundles,[32-34] which would introduce a bias in the present research.

Masseter morphology can vary among individuals with different sagittal skeletal patterns.[34,35] ANB angle evaluation was necessary and highly relevant to ensure that subjects with different sagittal skeletal patterns were included in both GSm and GASm (Table III). There was a balanced distribution of 15-17 skeletal Class I, Class II, and Class III patients in each group. Previous studies have reported a correlation between masticatory muscles and facial morphology.[34,36,37] For this reason, reference landmarks proposed in this methodology were located in areas corresponding to the masseter muscle, because it may present differences between deviated and nondeviated sides,[38,39] influencing tissue thickness and facial asymmetry.

Our results showed significant differences in Hard-D and Soft-D variables between right and left sides in symmetric individuals, supporting the hypothesis that symmetry in the chin region is reflected to the posterior part of the lower facial third in these subjects. Although the differences in Hard-D and Soft-D variables were not significant, some Soft-Th variables displayed significance. A possible explanation for the statistical difference found in Soft-Th at points Go2, Go3, and Go4 in GSm would be the much lower numeric values expressed for this variable compared with Hard-D and Soft-D numbers (Table IV). This way, a smaller SD contributes to greater sensitivity in significance. However, large variability in soft tissue thickness (0.6-4.6 mm) was observed at different anatomic points by Hwang et al, when right and left sides of individuals with 1.5 mm chin deviation were compared.[26]

In asymmetric subjects, intragroup comparison confirmed the statistically significant difference between all variables of Hard-D and Soft-D, with high values especially on the deviated side. The largest absolute difference in Hard-D was observed at point Go3 (3.63 mm) (Table IV). This might be due to the fact that it is located in an area closer to the alveolar ridge and teeth, usually with developing third molars in this age group. Our results were in accordance with Lee et al's findings from evaluating asymmetric individuals with mandibular prognathism.[18] As seen in the literature, the differences between deviated and nondeviated sides increase as the points are moved downward.[7,12,14,18,40] This vertical gradient of asymmetry corroborates studies that claim the mandible is more affected by asymmetry than the maxilla.[12,19] It can be suggested that the mandible is more involved because of its mobility and for being more susceptible to external influences during its development.

The question of whether soft tissue compensates for an underlying hard tissue asymmetry was the aim of some studies[17,18,41] because of the importance of accomplishing a full diagnosis regarding facial muscles, especially in asymmetric subjects who will be submitted to orthognathic surgery. In Soft-Th evaluation of GASm, only point Go3 demonstrated a statistically significant difference. It can be assumed that point Go3 may have been positioned on the anterior boundary of the masseter muscle in some cases, which would explain why this difference was found only on this site. Results suggest that soft tissue does not compensate for skeletal asymmetry, because soft tissue thickness was similar on both sides of the face (Table IV). However, previous studies corroborate the hypothesis that soft tissue, with bilateral differences in its thickness, compensates or attenuates skeletal asymmetry.[17,18,40,41] Besides methodologic variations regarding this research, one possible explanation for our different results would be sample diversity. Asymmetric individuals with larger amounts of chin deviation, with averages of 5.9 mm, 5.4 mm, and 8.8 mm, were found in some studies in the literature.[18,40,41] Lee et al included patients with asymmetric craniosynostosis, revealing more severe cases of asymmetry compared with the individuals evaluated in our study.[42] This level of severity may have affected their results, suggesting that muscles behave differently to certain degrees of asymmetry in an attempt to disguise it.

To investigate this hypothesis, Pearson correlation coefficient was calculated to assess whether the difference in thickness would increase as Me deviation also increased (Table V). Our results did not confirm such a correlation, but this may have occurred due to a lack of variability in chin deviation values. This happened because of the high concentration of asymmetric patients with Me deviation of ~4.5 mm. The small variability in chin deviations values from our sample may be considered a limitation of the present study. Future research with a sample including larger chin deviations values and a better distribution related to its degree of severity would be recommended to advance in this area of knowledge.

Correlations between soft tissue thickness differences and age or ANB angle were not evidenced either, despite the previously addressed variations in masseter muscle morphology within the different sagittal skeletal patterns.[35]

As discussed earlier, soft tissue thickness response to facial asymmetry is still an issue that should be investigated, because of the many divergences observed and the insufficient number of manuscripts with similar methodologies, allowing for more accurate comparisons to be made. Besides understanding tissue behavior as a means of diagnosis, orthodontists and oral surgeons also need to comprehend how soft tissue will behave after the surgical correction of an asymmetry.[18,43,44] This information provides greater predictability of treatment outcomes.[34,40]

CONCLUSIONS

Based on the results of this study, the following conclusions can be drawn:

1. Symmetric subjects present hard and soft tissue symmetry in the posterior region of the mandible.
2. Asymmetric subjects show differences in hard and soft tissue distances when deviated and nondeviated sides are compared at the posterior region of the mandible, which are larger on the deviated side.
3. Soft tissue thickness did not present significant differences between sides in asymmetric individuals. It can be concluded that soft tissue thickness does not compensate or disguise the underlying skeletal asymmetry.

ACKNOWLEDGMENTS

The authors thank Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) for supporting academic and professional development, and Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ) for the financial support provided during the acquisition of the software used in this research (APQ1, number E-26/110.543/2014).

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