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Pesquisa Científica

Does the volume of the naso and oropharynx differ among individuals of different skeletal and breathing patterns? A study using cbct images

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Abstract

Aim: To investigate if the volumes of the naso and oropharynx have a relationship with sex, skeletal pattern, and breathing pattern. Materials and Methods: Cone beam computed tomography images of 298 individuals (144 men and 154 women) were classified according to skeletal malocclusion (Class I, II, or III), facial type (brachycephalic, mesocephalic, or dolichocephalic), and breathing pattern (nasal or oral breathing). The volumes of the nasopharynx, oropharynx, and total volume (combination of the volumes of the naso and oropharynx) of each individual was calculated through semiautomatic segmentation with ITK-SNAP software. The images were assessed by two dentomaxillofacial radiologists independently. Multi-way analysis of variance compared the data at a significance level of 5% (α=0.05). Results: Intra- and interevaluator agreement values ranged from 0.96 to 0.98, and from 0.77 to 0.94, respectively. The volume of the nasopharynx was related to sex, with men showing greater volumes than women (p=0.0197). For the oropharynx, brachycephalic individuals had greater volumes than dolichocephalics (p=0.0423); mesocephalic individuals showed intermediate volumes and did not differ from the other types (p>0.05). Skeletal malocclusion and breathing pattern did not have an association with the nasopharynx, oropharynx, and total volume (p>0.05). Conclusions: The volumes of the nasopharynx and oropharynx differ between individuals of different sexes and facial types, respectively. Conversely, there is no relationship between the volume of these regions and the skeletal malocclusions and breathing patterns.

KEYWORDS: Stomatognathic system; Pharynx; Cone-beam computed tomography.

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Introduction

The airways are a set of conduits responsible for one of the most important functions of the human body: breathing. Among the structures that constitute the airways, the pharynx is a musculomembranous tubular organ that is part of the breathing and digestive systems. Anatomically, it is classified into three regions: nasopharynx, oropharynx, and hypopharynx[1]. Since the 19th century, the relationship between respiratory function and the craniofacial patterns has been investigated.

To the best of the authors knowledge, everything that is known so far is that the harmonious development of the craniofacial structures and the performance of orofunctional activities are directly linked to a normal nasal-respiratory function[1]. However, previous studies[1-6] that have evaluated the relationship between the craniofacial and breathing patterns and the pharynx morphometry were based on small sample sizes, pediatric patients, linear measurements of the investigated structures and/or two-dimensional radiographic images, which may limit their conclusions. So, studies on the naso and oropharynx, using modalities of exams with higher accuracy in the evaluation of the craniofacial structures, such as cone beam computed tomography (CBCT), are of interest. To the best of the authors knowledge, there are no studies on the volumetric evaluation of the naso and oropharynx regions, which investigated a possible correlation between sex, and skeletal and breathing patterns based on CBCT images.

Therefore, it is important to emphasize the clinical relevance of the pharynx, which is an important anatomic structure present in all orofacial activities and, therefore, may present a relationship with the craniofacial development. The investigators hypothesized that, as the airways are directly connected to the craniofacial complex, they could be affected by morphological variations observed in different skeletal and/or breathing patterns. Moreover, to investigate and understand this relationship there is a need for a more precise evaluation. Thus, the objective of the present study was to measure the volumes of the nasopharynx, oropharynx, and their total volume (combination of the volumes of the naso and oropharynx) of individuals of different sexes, skeletal patterns (skeletal malocclusions and facial types), and breathing patterns (nasal and oral breathing) using cone beam computed tomography (CBCT) images.

Material and methods

This study was initiated after approval by the local institutional review board (IRB) (protocol number: #3.491.476).

Study design

This retrospective and cross-sectional study was based on a convenience sample, that used CBCT scans of patients seen in a local radiology clinic from January 2014 to December 2016, prior to the present research and for clinical reasons not related to it. In the initial selection of the exams, 340 CBCT scans were obtained. CBCT images of patients 18 years old or older, obtained with an extended field of view (FOV), were included in this study. The exclusion criteria were CBCT images presenting pathological lesions, previous medical history of adenotonsillectomy, syndromic patients, and/or image artefacts hampering the evaluation of the upper airways. All patients were from southeastern Brazil.

After establishing the inclusion and exclusion criteria, the final sample of the present study was composed of 298 CBCT images of individuals of both sexes – 144 men (18 to 64 years old, mean age 32.04 ± 12.48 years) and 154 women (18 to 76 years old, mean age 30.87 ± 11.47 years) (Table 1). In addition, all images were anonymized, except for sex and age.

The CBCT images were acquired using an i-CAT® Next Generation unit (Imaging Sciences International, Hatfield, Pa) with the acquisition parameters of 120 kVp, 5 mA, 0.3 mm of voxel size, 17.3s of scanning time, and an extended field of view (FOV) of 23x17cm.

Sample classification

Each CBCT image was classified according to the individual's skeletal (skeletal malocclusion and facial type) and breathing (nasal and oral) patterns. The classification was done by two evaluators, in consensus, using the multiplanar reconstructions generated from the CBCT images in the Carestream Dental 3D Imaging software (version 3.10.9.0, Atlanta, Georgia, USA). Before the analyses, the evaluators were instructed by the study researchers, with expertise in skeletal pattern classification analyses, using images that were not part of the final sample as examples. In addition, for standardization purposes, each CBCT scan was manually reoriented, so the software's vertical reference line was positioned in the median sagittal plane, which is a plane that divides the head into two parts (right and left), passing over the nasal septum, in the coronal view; then, the horizontal reference line was positioned passing over the lowest point of the inferior margin of the orbit (Orbitale) to the midpoint on the upper edge of the external auditory meatus (Porion), in the sagittal view; and the vertical reference line, in the axial view, were positioned passing through the anterior and posterior nasal spines (Figure 1)[7].

Steiner's cephalometric standards and the Vert index were applied to establish the skeletal malocclusion (Class I, II, and III) and facial type (dolichocephalic, mesocephalic, and brachycephalic, respectively[8-10]. Skeletal malocclusion was determined

TABLE 1 · Demographic data regarding the initial selection and determination of the final study sample

Selection Criteria		AMOUNT
Initial selection of CBCT images		340 CBCT images involving the head and neck regions (extended FOV)
Exclusion Criteria (42)	*Pathological lesions*	11 CBCT images
	Adenotonsillectomy surgery	1 CBCT image
	Syndromic patients	2 CBCT images
	Image artefacts	28 CBCT images
Final sample size		298 CBCT images
Demographic profile		144 males and 154 females

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using the SNA, SNB, and ANB angles. The ANB angle was obtained by subtracting the SNB from the SNA value (ANB = SNA – SNB). ANB values 0 to 4 = skeletal Class I; ANB > 4 = skeletal Class II; and ANB < 0 = skeletal Class III (Figure 2). Facial type was determined based on the arithmetic average of the following cephalometric measurements: lower facial height (Xi-ANS / Xi-Pm), facial axis angle (N-Ba / Pt-Gn), facial depth (Po-Or / N-Pog), mandibular arch (Dc-Xi / Xi-Pm), and mandibular plane angle (Go-Me / Po-Or). Obtained values greater than 0.5 established the brachycephalic type; values between -0.5 and +0.5 represented the mesocephalic type; and values lower than -0.5 established the dolichocephalic type (Figure 3).

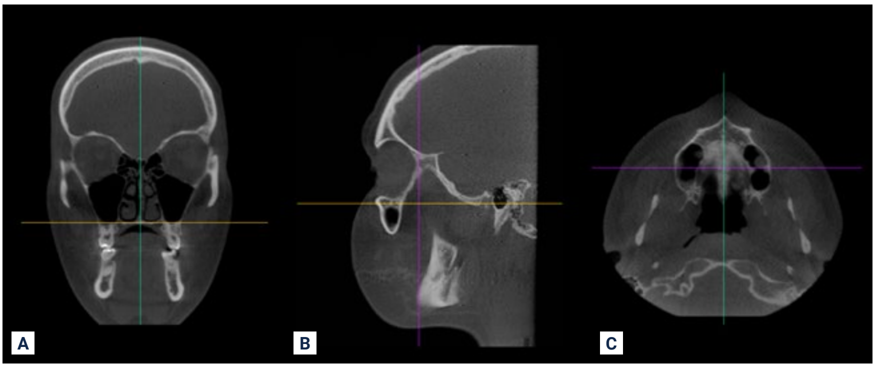

FIGURE 1 · Spatial reorientation of the CBCT multiplanar reconstructions. **(A)** - Coronal view - Vertical reference line positioned parallel to the median sagittal plane. **(B)** - Sagittal view: Frankfurt Horizontal Plane as reference. **(C)** - Axial view – Vertical reference line passing through the anterior and posterior nasal spines.

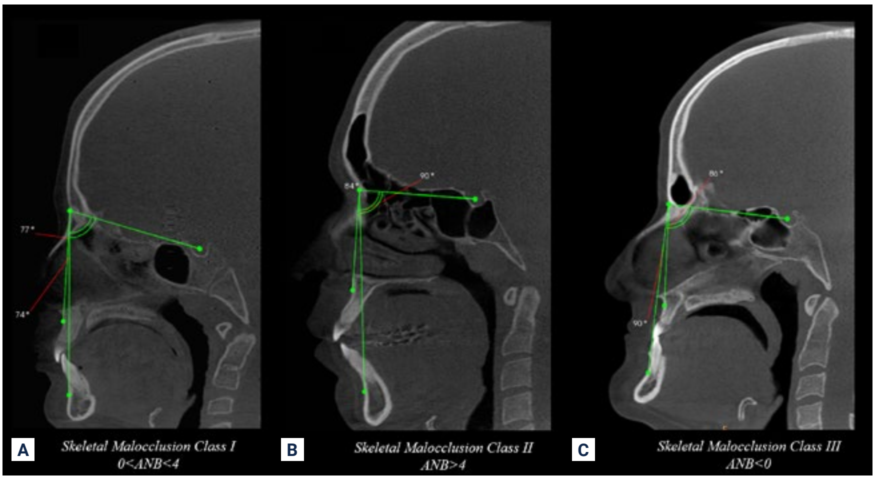

FIGURE 2 · Sagittal reconstructions of cone-beam computed tomography demonstrating patients' classification according to skeletal malocclusion, based on Steiner's cephalometric standards.

(A) - Class I: 0<ANB<4; (B) - Class II: ANB>4; (C) - Class III: ANB<0.

The classification of the breathing pattern (nasal or oral breathing) was obtained by using the "hyoid triangle" method, which is based on the location of the hyoid (Figure 4). Firstly, a line between the most inferior-anterior point of the third cervical vertebra (C_3) to the most posterior point of the mandibular symphysis (retrognathic cephalometric point—RGn) was traced,

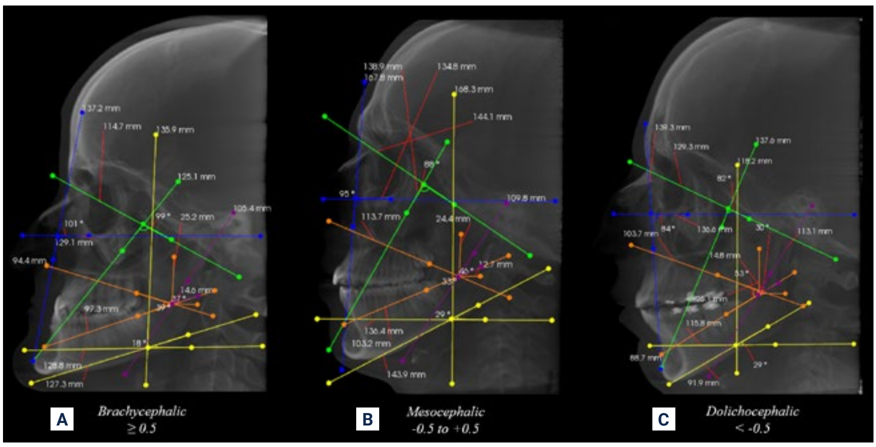

FIGURE 3 · Sagittal reconstructions of cone-beam computed tomography demonstrating patients' classification according to facial type, based on Vert index.

Representative colors of cephalometric measurements: facial axis – green ; facial depth – blue; mandibular plane – yellow; lower facial height – orange; and mandibular arch – purple.
(A) - Brachycephalic: ≥0.5; (B) - Mesocephalic: -0.5 to +0.5; (C) - Dolichocephalic: <-0.5.

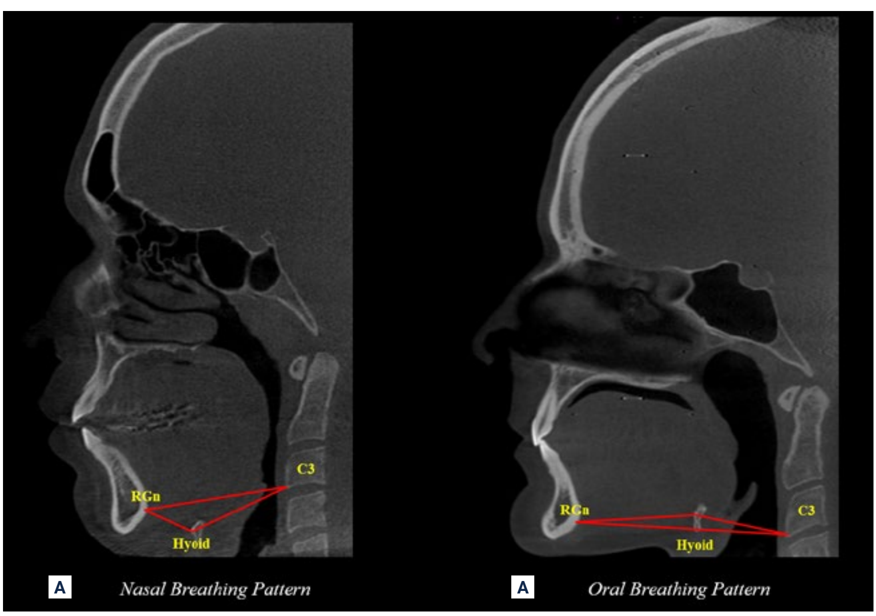

FIGURE 4 · Classification of patients by breathing pattern based on the hyoid triangle.

(A) - Nasal Breathing Pattern; (B) - Mouth Breathing Pattern.

establishing the base of the triangle. Then, a second line from C_3 to the most anterior point of the hyoid bone was drawn, and then to the RGn point, stablishing the hyoid triangle[11]. In case the hyoid bone was placed on or above the RGn-C_3 plane, that determined a higher position of the hyoid, establishing a negative triangular position and, therefore, an oral breathing pattern. Contrarily, if the hyoid bone was placed bellow the RGn-C_3 plane, that determined a lower position of the hyoid, establishing a positive triangular position and, therefore, a nasal breathing pattern.

Volumetric evaluation

The volumes of the nasopharynx, oropharynx, and their total volume (combination of the volumes of the naso and oropharynx regions) were assessed by two evaluators independently. The ITK-SNAP software version 3.0 (Cognitica, Philadelphia, PA) was used to obtain the volumes of the mentioned regions. The region of interest (ROI) was determined in accordance with the study of Brasil et. al (2016) [2]. Then, the beginning and end of the segmentation process was determined by setting a threshold

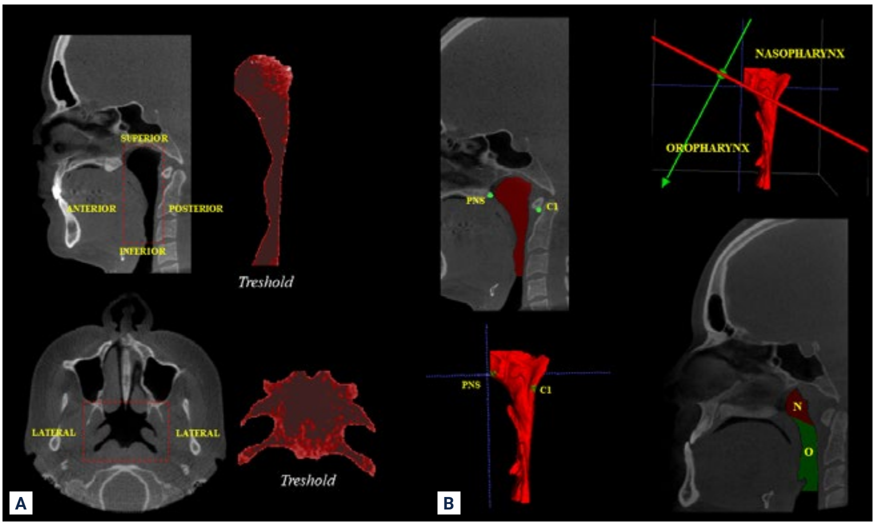

FIGURE 5 · Volumetric analysis of the nasopharynx and oropharynx.

1(A): Sagittal and axial images of CBCT – Establishment of the region of interest (ROI) and selection of the threshold for semi-automatic filling of the naso and oropharynx. 1(B): Total filling (naso + oropharynx), and individualization of the nasopharynx (N) (red area) and oropharynx (O) (green area).
Posterior nasal spine (PNS); first cervical vertebra (C1).

range: a value varying from -660 to -531 was established for the upper threshold and a value of -1000 was established for the lower threshold, meaning that all voxels with gray values into that interval were selected. Then, "bubbles" were added into the ROI to begin the segmentation process; after, the segmentation evolution was established by selecting its velocity and end. The nasopharynx and oropharynx volumes were obtained with the aid of the scalpel tool of the software. For this, an oblique cut line was drawn over the structures of reference: the lowest point of the first cervical vertebra (C1) and the posterior nasal spine. The nasopharynx, oropharynx, and their total volumes were calculated by the software in cubic millimeters (mm^3) (Figure 5).

Thirty days after the end of the assessments, 30% of the sample was randomly selected in the Microsoft Excel® software and reassessed to obtain the intraevaluator agreement.

Data analysis

Intra- and interevaluator agreements were determined by the intra-class correlation coefficient (ICC) test (greater than 0.90 – excellent; between 0.75 and 0.90 – good; between 0.50 and 0.75 – moderate; less than 0.50 – poor)[12]. Data normality was assessed by the Shapiro-Wilk test. Multi-way analysis of variance (ANOVA) was applied to investigate the relationship between the studied factors (sex, skeletal malocclusion, facial type, and breathing pattern) and the volumes of the nasopharynx, oropharynx, and their total volume. For each statistical test, the power analysis was measured considering the minimum difference among the groups, their standard deviation, and the number of patients within each group, which achieved a statistical power ranging from 70% to 75%. The Statistical Package for the Social Sciences software version 23.0 (*SPSS* Inc., Chicago, IL, EUA) was used for all analyses, with a significance level of 5% ($p<0.05$).

Results

Sample distribution after classification was as follows: skeletal Class I – n=126, skeletal Class II – n=108, and skeletal Class III – n=64; brachycephalic – n=122, mesocephalic – n=111, and dolichocephalic – n=65; nasal breathing – n=203 and oral breathing – n=95. The ICC results for intra- and inter-examiner agreements were good to excellent for nasopharynx region (0.94 and 0.77) and excellent for total volume and oropharynx region (0.98 and 0.96 - 0.94 and 0.94).

Table 2 presents the mean and standard deviation values of the total volume (combination of the volumes of the naso and oropharynx) according to sex, skeletal pattern, and breathing pattern. The factors studied did not influence the total volume (p>0.05).

On the other hand, the table 3 provides the mean and standard deviation values of the volume of nasopharynx region in relation to sex, skeletal pattern, and breathing pattern. A significant difference was found for sex (p=0.020), in which male, in general, have greater volume values on nasopharynx in comparison to female individuals, except for: Class III, brachycephalic and

TABLE 2 · Association between the total volume (Naso + Oropharynx regions) with sex, skeletal pattern, and breathing pattern

Total Volume (Nasopharynx + Oropharynx)							
		Facial Type					
		Brachycephalic		**Mesocephalic**		**Dolichocephalic**	
Sex	**Skeletal Malocclusion**	**Nasal**	**Oral**	**Nasal**	**Oral**	**Nasal**	**Oral**
		Mean (SD)	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*
Male	Class I	21.13 (6.09)	21.67 (11.87)	19.60 (9.50)	17.58 (8.51)	19.44 (8.61)	19.62 (5.65)
	Class II	21.11 (8.14)	-	20.76 (6.42)	21.89 (9.05)	19.69 (9.00)	20.26 (1.72)
	Class III	22.77 (8.41)	17.88 (5.82)	23.20 (8.21)	24.41 (8.51)	22.71 (2.83)	17.09 (0.00)
Female	Class I	18.86 (6.46)	22.60 (5.34)	19.44 (3.75)	21.36 (6.51)	14.99 (1.63)	13.51 (5.32)
	Class II	18.45 (4.76)	20.32 (3.59)	18.84 (7.31)	19.33 (4.01)	20.17 (6.74)	19.00 (5.04)
	Class III	19.57 (5.45)	23.73 (8.90)	22.24 (11.39)	17.70 (1.73)	10.93 (4.77)	19.93 (3.95)

SD: Standard deviation
p sex = 0.135; p skeletal malocclusion = 0.700; p facial type = 0.144; p breathing pattern = 0.809

oral breathing; Class I, mesocephalic, nasal and oral breathing; and Class II, dolichocephalic, and nasal breathing. Skeletal malocclusion (p=0.478), facial type (p=0.922), and breathing pattern (p=0.339) did not influence the volume of nasopharynx.

The table 4 shows the mean and standard deviation values of the volume of oropharynx region in relation to sex, skeletal pattern, and breathing pattern. A significant difference was found only for facial type (p=0.042), in which brachycephalic individuals had greater volume values in comparison to dolichocephalic individuals, and mesocephalic individuals showed intermediate values and did not differ from the other types, except for female individuals, Class III and nasal breathing; and male individuals, Class III, and oral berthing. Sex (p=0.554), skeletal malocclusion (p=0.899), and breathing pattern (p=0.755) did not influence the volume of oropharynx.

An additional consideration to be highlighted is in relation to the age variable, which did not show a significant relationship with the volume of the nasopharyngeal and oropharyngeal regions, or with the total volume (p>0.05).

TABLE 3 · Association between the volume of nasopharynx region with sex, skeletal pattern, and breathing pattern

Volume Nasopharynx							
		Facial Type					
Sex	**Skeletal Malocclusion**	**Brachycephalic**		**Mesocephalic**		**Dolichocephalic**	
		Nasal	**Oral**	**Nasal**	**Oral**	**Nasal**	**Oral**
		Mean (SD)	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*
Male*	Class I	9.13 (2.41)	9.06 (4.33)	8.17 (3.74)	7.17 (3.87)	8.51 (3.29)	8.71 (3.55)
	Class II	9.22 (6.63)	-	9.18 (3.84)	10.00 (4.64)	8.99 (3.38)	9.76 (0.41)
	Class III	8.67 (2.95)	7.96 (2.19)	10.51 (2.46)	10.38 (4.14)	10.10 (2.78)	10.22 (0.00)
Female	Class I	8.21 (2.20)	9.45 (2.67)	8.82 (1.79)	8.27 (2.21)	7.70 (0.84)	6.08 (1.81)
	Class II	6.85 (2.41)	9.17 (2.30)	7.86 (3.32)	8.59 (1.85)	9.10 (3.09)	8.54 (2.89)
	Class III	7.57 (2.67)	9.69 (3.87)	8.32 (4.99)	7.27 (1.39)	4.91 (2.67)	9.50 (3.10)

SD: Standard deviation
*differs from female in all cases
p sex = 0.020; p skeletal malocclusion = 0.478; p facial type = 0.922; p breathing pattern = 0.339

Discussion

In this study, we investigated if the volumes of the nasopharynx, oropharynx, and their total volume have a relationship with sex, skeletal pattern, and breathing pattern, using CBCT images. It was found that the volumes of the nasopharynx and oropharynx were associated with sex and facial type, respectively. The figure 6 presents illustrations on the differences between sexes and facial types, and the similarities among skeletal malocclusion and breathing pattern.

The volume of the nasopharynx showed to be significantly related to sex, with men presenting greater volumes than women, which corroborates the results of previous studies[4,13]. This result reinforces the existence of sexual dimorphism, which is present in several craniofacial structures, with men showing larger dimensions than women for most of them[14]. Furthermore, this result may be useful in the forensic area, in cases that demand post-mortem human identification but the primary methods of identification are impracticable.

TABLE 4 · Association between the volume of oropharynx region with sex, skeletal pattern, and breathing pattern

Volume Oropharynx							
		Facial Type					
Sex	**Skeletal Malocclusion**	**Brachycephalic(A)**		**Mesocephalic(AB)**		**Dolichocephalic (B)**	
		Nasal	**Oral**	**Nasal**	**Oral**	**Nasal**	**Oral**
		Mean (SD)	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*
Male	Class I	11.99 (5.62)	12.60 (7.85)	11.41 (7.14)	10.42 (4.82)	10.94 (6.35)	11.04 (5.04)
	Class II	11.92 (5.65)	-	11.58 (4.03)	11.89 (5.03)	10.79 (6.99)	10.27 (2.45)
	Class III	14.08 (6.80)	9.92 (3.77)	12.68 (6.08)	14.03 (5.40)	12.50 (2.45)	6.87 (0.00)
Female	Class I	11.41 (4.46)	13.15 (3.98)	10.62 (2.85)	13.10 (5.57)	7.28 (1.27)	7.43 (3.51)
	Class II	11.96 (3.75)	11.14 (1.30)	10.98 (4.85)	10.74 (3.33)	11.06 (4.40)	10.46 (3.13)
	Class III	11.99 (4.60)	14.03 (5.78)	13.92 (6.69)	10.43 (0.33)	6.02 (2.19)	10.50 (1.26)

SD: Standard deviation
capital letters indicate differences between facial types (horizontal)
p sex = 0.554; p skeletal malocclusion = 0.899; p facial type = 0.042; p breathing pattern = 0.755

No significant differences were found among the skeletal malocclusions for the volumes of the nasopharynx, oropharynx, and their total volume, which is also in line with prior studies[2,5,15,16]. On the other hand, a significant relationship between the volumes of the naso and oropharynx and the skeletal malocclusions were found by the studies of El and Palomo[17] (2011), Zheng *et al.* [18] (2014), and Paul *et al.*[19] (2015). However, it is not possible to directly compare the results because the methodologies applied in these studies are different from ours. The previously mentioned authors have included the epiglottis in the volumetric assessment and delimited the oropharynx up to the second cervical vertebra, in addition to evaluating patients younger than 18 years old. Also, Paul *et al.* [19] (2015) assessed only skeletal Class I and II patients. Anatomically, the oropharyngeal region extends from the lower third of the first cervical vertebra to the lowest region of the third cervical vertebra[2,4]. The studies mentioned above evaluated only up to the second cervical vertebra, which justifies the difference found between the results. The study by Zheng *et al.* [18] (2014) considered the epiglottis in the volumetric analysis, in which this structure is related to the hypopharynx

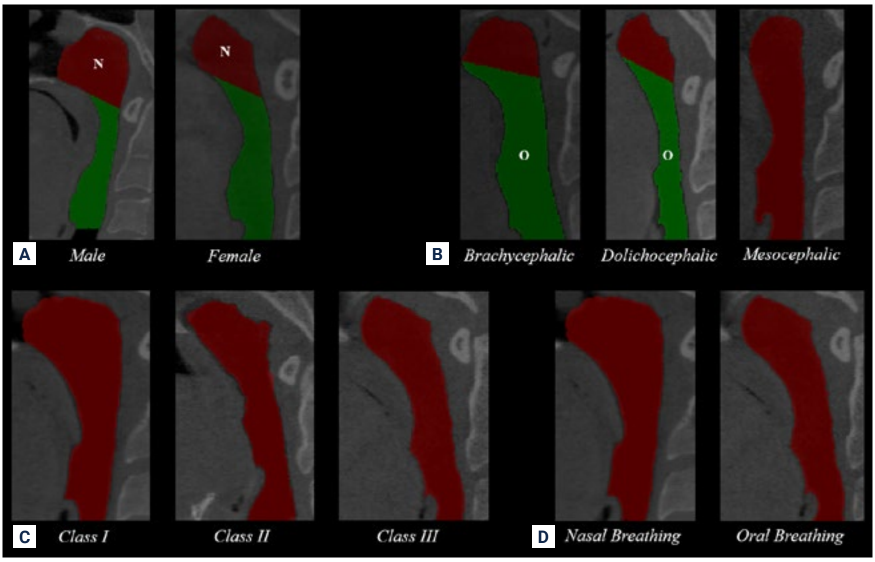

FIGURE 6 · Illustrations on the differences between the sex and facial type and the similarities among skeletal malocclusion and breathing pattern.

*There was a statically significant difference
(A) - Sex*; (B) - Facial type*; (C) - Skeletal Malocclusion; (D) - Breathing Pattern

region. It is important to highlight that the hypopharynx region was not evaluated in the present research. The reason for this is that the hypopharynx is the lowest region of the pharynx and, therefore, seems not to be related with the craniofacial development[2,16,19-21].

Regarding the facial type, there was a significant difference between the individuals in the oropharynx volume, with brachycephalics presenting greater volumes than dolichocephalics, which is in concordance with previous reports[6,23]. A possible explanation for the differences observed in the oropharynx volume between these facial types is that the craniomaxillofacial structures follow the vertical direction of craniofacial growth and development, because they are directly interconnected[23]. Thus, variations in the vertical patterns of craniofacial growth may lead to changes in the associated structures, such as the oropharynx region. Differently from our results, Brasil *et al.*[2] (2016) found no significant differences in the volume of the naso, oropharynx and their total volume (naso + oropharynx), among the different facial types, although they have employed a methodology similar to ours. We believe that the discrepancies sample sizes (n=74) and groups distribution (brachycephalic - 39; mesocephalic - 19; dolichocephalic - 16) may be related to the differences found between their findings and ours.

About the breathing patterns, we found no significant differences in the nasopharynx, oropharynx, and their total volumes between individuals of different breathing patterns, which disagrees with the study of Alves *et al.*[3] (2011). This disagreement may be related to the fact that this previous research had pediatric patients (5 to 10 years old) as part of the sample. According to the literature, during the craniofacial growth, the pharynx of pediatric patients (8 to 18 years old) undergo changes in length and volume over the years, which makes it difficult to compare patients in these age range[24,25].

Another aspect to be emphasized is that despite the variation between the ages of the patients in the present study - 18 to 64 years old for males and 18 to 76 for females - this factor did not show a significant relationship with the volume of the nasopharynx and oropharynx regions, or the total volume. According to the consulted literature[24,25], the morphological and/or volumetric changes in the airways occur during the childhood and/or adolescence. From the moment an individual reaches the age of 18, there are minimal changes as he or she gets older, and to a certain extent this development can be stagnated. What can in fact influence airway morphology are the changes that occur during the individual's developmental stages. Based on this knowledge, our results support the literature and for this reason a minimum age of 18 years was determined for the patients to be included in the sample of the present study, since from this time on there are no major changes in comparison to the stages of childhood and adolescence.

The present study has some limitations such as in relation to the study design, since it is cross-sectional, in which the associations do not imply causal relationships. Another one is the absence of questionnaires about the breathing function of the patients that composed the research sample. Since it is a study based on a convenience sample from an image database, information about the patient's medical record was incomplete and direct communication with the patient was limited. Despite this fact, questionnaire application in future studies is encouraged.

In view of the presented and discussed results, it is important to highlight that the sample size of this study was representative of the assessed population, and it was homogeneously distributed within each evaluated variable, which allowed to obtain reliable results and excellent intra- and interexaminer agreements - 0.96 to 0.98, and from 0.77 to 0.94, respectively. Thus, it can be considered that individual variations did not affect the results and conclusions of the study.

The results of the present study may add clinical information, since an influence of sex and facial type on the volume of the airways was found. Furthermore, these results may contribute to the diagnosis and/or treatment planning of orthodontic and surgical patients. We understand that this association shows the clinical and anatomical importance of this structure, which may provide clinical information for procedures involving the airways. Therefore, future studies investigating this clinical relationship in the areas of oral and maxillofacial surgery, orthodontics, and otorhinolaryngology are encouraged.

Conclusions

The volumes of the nasopharynx and oropharynx differ between individuals of different sexes and facial types, respectively. Conversely, there is no relationship between the volumes of these regions and the skeletal malocclusions and breathing patterns.

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O volume da naso e da orofaringe difere entre indivíduos de diferentes padrões esqueléticos e respiratórios? Um estudo utilizando imagens de TCFC

Resumo

Objetivo: Investigar se os volumes da naso e orofaringe têm relação com sexo, padrão esquelético e padrão respiratório. Materiais e Métodos: Imagens de tomografia computadorizada de feixe cônico de 298 indivíduos (144 homens e 154 mulheres) foram classificadas de acordo com má oclusão esquelética (Classes I, II ou III), tipo facial (braquicefálico, mesocefálico ou dolicocéfalo) e padrão respiratório (respiração nasal ou oral). Os volumes da nasofaringe, orofaringe e volume total (combinação dos volumes da naso e orofaringe) de cada indivíduo foram calculados por meio de segmentação semiautomática com o software ITK-SNAP. As imagens foram avaliadas por dois radiologistas dentomaxilofaciais de forma independente. A análise de variância multivariada comparou os dados a um nível de significância de 5% (α=0,05). Resultados: Os valores de concordância intra e interavaliadores variaram de 0,96 a 0,98 e de 0,77 a 0,94, respectivamente. O volume da nasofaringe esteve relacionado ao sexo, sendo que os homens apresentaram volumes maiores que as mulheres (p=0,0197). Para a orofaringe, os braquicefálicos apresentaram volumes maiores que os dolicocéfalos (p=0,0423); indivíduos mesocefálicos apresentaram volumes intermediários e não diferiram dos demais tipos (p>0,05). A má oclusão esquelética e o padrão respiratório não tiveram associação com nasofaringe, orofaringe e volume total (p>0,05). Conclusões: Os volumes da nasofaringe e orofaringe diferem entre indivíduos de diferentes sexos e tipos faciais, respectivamente. Por outro lado, não há relação entre o volume dessas regiões e as más oclusões esqueléticas e os padrões respiratórios.

PALAVRAS-CHAVE: Sistema estomatognático; Faringe; Tomografia computadorizada de feixe cônico.

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