

Systematic Evaluation of the Upper Airway in the Adult Population of São Paulo, Brazil

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Abstract

Objectives. To study the prevalence of otorhinolaryngologic symptoms and findings of physical examination of the upper airway (UA) of a representative sample of the adult population of São Paulo, Brazil, and the association between these findings.

Study Design. Cross-sectional survey.

Setting. Population sample.

Methods. A total of 1101 randomly selected volunteers representing the adult population of São Paulo according to sex, age, and socioeconomic class were included in this study. Otorhinolaryngological evaluation included investigation of nasal complaints, physical examination of the UA, and a facial inspection.

Results. A total of 993 volunteers (53.9% women), with a mean age of 41.8 ± 0.89 years, underwent otorhinolaryngologic examination. The most prevalent symptoms were the following: symptoms suggestive of rhinitis (44.9%), snoring (42.8%), mouth breathing (39.3%), and nasal obstruction (33.3%). In physical examination, the most common findings were a web palate (redundant posterior pillar; 62.9%), septum deviation (56.9%), and inferior turbinate hypertrophy (37.7%). Significant associations were found between nasal obstruction and septum deviations, inferior turbinate hypertrophy, high-arched palate, and class II dental occlusion; between symptoms of rhinitis and inferior turbinate hypertrophy; and between snoring and obstructive deviated septum, modified Mallampatti grades III and IV, increased neck circumference, and age greater than or equal to 50 years.

Conclusions. The prevalence of otorhinolaryngologic symptoms and alterations in physical examination of the UA were high in the adult population of São Paulo, Brazil. The snoring and nasal symptoms were significantly associated with

findings from UA physical examination and inspection of the facial skeleton.

Keywords

physical examination, nasal cavity, pharynx, airway obstruction, nasal obstruction, adult

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A low nasal flow of air due to chronic nasal obstruction leads to mouth breathing, which can result in dentofacial deformities such as a high-arched palate, crossbite, and mandibular hypoplasia.^{1,2}

Chronic nasal obstruction can be related to various extranasal symptoms, such as headache, fatigue, sleep disorders, and diseases of the lower airway, and can lead to a decreased quality of life.^{3–5} Studies have shown a significant improvement in the quality of life of patients following chronic nasal obstruction treatments.^{3,4,6}

With the increased interest in recent decades in sleep-related breathing disorders, studies have used different methods to assess the upper airway (UA) to better understand the pathophysiology of snoring and obstructive sleep apnea (OSA). These studies also sought to improve the success rate

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of treating these conditions. A recent review found that several methods for assessing the UA have added to the knowledge of the pathophysiology of sleep disorders; however, none of these methods proved to be superior or more effective than a simple physical examination in the selection of treatment options and the success of surgical proceedings.⁷

Based on these data, it is important to understand the characteristics of the UA in the general population to be able to prevent and treat related diseases. The aim of this study was to evaluate the prevalence of otorhinolaryngologic symptoms and physical findings of the UA in a representative sample of the adult population of São Paulo, Brazil, and to determine potential associations between these findings.

Methods

In 2007, the Department of Psychobiology at the Universidade Federal de São Paulo (UNIFESP), Brazil, performed an epidemiological study of sleep disorders in an adult population sample of São Paulo, Brazil.⁸ Data obtained in the otorhinolaryngologic evaluation of volunteers from that study were analyzed for this study with the approval of the Ethics Committee of the UNIFESP (CEP 0767/09) and registered with ClinicalTrials.gov (identifier NCT00596713). All volunteers read and signed an informed consent form prior to participation in the project.

Study Population

A total of 1101 randomly selected volunteers were included to represent the adult population of São Paulo in terms of sex, age (from 20 to 80 years), and socioeconomic class. Sampling was based on population data obtained from the State Foundation for Data Analysis⁹ and estimates from Census 2000.

The sampling process was probabilistic and consisted of 3 stages.¹⁰ In the first stage, 96 of the 1500 districts defined by the Brazilian Institute of Geography and Statistics¹¹ were proportionately selected from 4 homogeneous regions of the economically active population of São Paulo.¹² In the second stage, 11 households were randomly selected from each sector. Households were chosen as long as they were permanently occupied for residential purposes, and hospitals, schools, hotels, and other commercial establishments were excluded. For apartment buildings, each apartment was considered a residence, and counting was performed from the top to the bottom floors. In the third stage, individuals from each household were randomly selected to be interviewed. Using the same criteria for random selection, a volunteer replacement was chosen from a neighboring household after 3 unsuccessful attempts to contact the first targeted individual or when one of the following situations occurred: total refusal to participate, physical or mental impairment, interference by a family member, or inability to participate because of travel, hospitalization, or scheduling conflicts. Pregnant women, infants, people with mental illnesses or physical impairments, and shift workers who slept during the day were excluded from study participation.

All volunteers were invited to visit the Sleep Institute to perform a full-night sleep study. Before the habitual sleep time,

volunteers were evaluated for socioeconomic and demographic data, and we performed the anthropometric and otorhinolaryngologic evaluation. A total of 1042 volunteers underwent the sleep study (refusal rate of 5.4%), and 49 volunteers did not perform the otorhinolaryngologic evaluation because of a delay in the habitual bedtime. The description of the epidemiological study was published by Santos-Silva et al.⁸

Otorhinolaryngologic Evaluation

The otorhinolaryngologic evaluations were performed by 6 trained otorhinolaryngologists. Investigations of nasal complaints addressed the presence of nasal obstructions (daytime and/or night), the side of the obstruction (right, left, or bilateral), nasal dryness of the mouth and/or throat, mouth breathing, habitual snoring complaints (3 days or more per week), and symptoms suggestive of rhinitis, such as nasal itching, runny nose and/or sneezing, and nasal treatments. Individuals who complained about such symptoms with a high frequency were considered positive.

The physical examination consisted of inspection of the face and oral cavity, oropharynx evaluation, and an anterior rhinoscopy. The body mass index (BMI) of subjects was calculated. The cervical circumference (CC) was measured at the level of the cricothyroid membrane. The CC was considered to be high when it was ≥ 43 cm in men or ≥ 38 cm in women.¹³ Nutritional status was classified as follows: healthy weight (BMI < 25 kg/m²), overweight (BMI ≥ 25 kg/m² and < 30 kg/m²), and obese (BMI ≥ 30 kg/m²).¹⁴

A facial inspection was conducted with the individual seated in a horizontal Frankfort position, and the distance between a virtual vertical line tangential to the outer edge of the lower lip and the more prominent spot of the chin was measured. Retroposition of the mandible (retrognathia) was defined as when the anterior prominence of the chin was 2 mm or more posterior to this virtual line.¹⁵

The bony structures in the oral cavity were evaluated for the presence of a high-arched palate and different types of dental occlusions. Dental occlusion class I corresponds to a normal occlusion; class II corresponds to a mandible that is in a posterior position in relation to the maxilla, suggesting retrognathia; and class III corresponds to a mandible that is in an anterior position in relation to the maxilla. Volunteers who were missing teeth were placed in a dental prosthesis or toothless group. Individuals who had at least 2 of the following were considered to have unfavorable facial skeleton structure: class II dental occlusion, retrognathia, or a high-arched palate.¹⁶

To investigate the soft tissues of the oral cavity and oropharynx, the volume of the tongue, soft palate, and uvula; the size of the tonsils; and a modified Mallampati classification (MMC) were assessed. The tongue was considered large when it was marked by teeth (tongue edge crenation).^{16,17}

The soft palate was considered posterior when it was near the posterior oropharyngeal wall. The soft palate was classified as “web” when it had a low insertion of the tonsil posterior pillar in the uvula (redundant posterior pillar), and it was considered to be thick when it presented with a swollen

Table 1. Age, BMI, and Cervical Circumference in a Sample of the Adult Population of São Paulo, Brazil, Student *t* Test

	Mean	95% CI	Standard Error	P
Age, y	41.8	40.0-43.8	0.89	
Male	40.6	39.3-41.9	0.67	<.001
Female	43.8	42.6-45.0	0.62	
BMI, kg/m ²	26.8	26.3-27.2	0.20	
Male	26.6	26.1-27.1	0.24	.259
Female	26.9	26.5-27.4	0.24	
CC, cm	36.4	35.8-36.9	0.18	
Male	39.4	38.3-40.0	0.31	<.001
Female	33.7	33.4-33.9	0.12	

Abbreviations: BMI, body mass index; CC, cervical circumference; 95% CI, 95% confidence interval.

component.^{16,17} Tonsil pillars were considered voluminous when they were close to the midline of the oropharynx (voluminous lateral wall).^{16,17} The uvula was considered long when it was near the base of the tongue and thick when it presented with a swollen component.^{16,17}

The MMC was performed with the patient seated with a maximum mouth opening and relaxed tongue position within the oral cavity. Patients were classified into 4 classes: class I (the entire oropharynx, including the soft palate, tonsil pillars, tonsils, and the tip of the uvula were in view), class II (the upper pole of the tonsils and the uvula were in view), class III (part of the soft palate and uvula were in view), and class IV (only the hard palate and part of the soft palate were in view).¹⁸

Tonsils were classified as grade I (intravelar), grade II (extending beyond the anterior tonsil pillar), grade III (extending up to three-quarters of the midline), or grade IV (completely blocking the throat).^{16,18} Grade 0 was used for tonsillectomized patients.

An oropharynx with at least 3 of the following observations was considered unfavorable: tonsils with grade III or IV, abnormal uvula (long and/or thick), abnormal palate (posterior and/or thick), web palate, and voluminous lateral wall.¹⁶

Through anterior rhinoscopy, the presence of deviations of the nasal septum and inferior turbinate hypertrophy (ITH) was investigated. Septum deviations were classified as grade I (deviation does not touch the side wall), grade II (deviation touches the side wall), and grade III (deviation touches the side wall, compressing it). ITH was classified as present or absent.^{16,17}

Nasal structure was considered to be unfavorable when grades II or III septum deviations were found, when septum deviation grade I was associated with a nasal obstruction or an ITH, or when an ITH was associated with complaints of nasal obstruction.

Statistical Analysis

The program used for data analysis was PASW Statistics 18. The normality of numerical variables was checked using the Kolmogorov-Smirnov test. For descriptive data analysis, we calculated the mean, standard error, and confidence interval for the numerical variables and the frequency and confidence intervals for categorical variables.

For associations between continuous and categorical variables, the Student *t* test was used. For associations between categorical variables, the χ^2 test was used. The results were considered significant when $P < .05$.

Results

A total of 993 volunteers underwent otorhinolaryngologic evaluation. Their ages ranged from 20 to 80 years (mean 41.8 ± 0.89 years), and 53.9% of the subjects were female. The mean age was higher in women (43.87 years) than in men (40.69 years; $P < .001$). The mean BMI was 26.8 ± 0.20 kg/m²; 40.5% of the subjects were normal, 37.5% were overweight, and 22% were obese. The mean CC was higher in men (39.4 ± 0.31 cm) than in women (33.7 ± 0.12 cm; $P < .001$; **Table 1**).

The most prevalent symptoms related to UA were the following: symptoms suggestive of rhinopathy (44.9%), habitual snoring (42.8%), mouth breathing (39.3%), and nasal obstruction (33.3%). Night and bilateral nasal obstructions were the most common (**Table 2**).

Nasal assessments (**Table 3**) found a septum deviation in 56.9% of the subjects, predominantly with degree I deviations (26.3%). ITH was found in 37.7% of individuals. Upon inspection of the facial skeleton (**Table 4**), a high-arched palate was present in 23.8% of individuals, a class II dental occlusion was present in 15.5%, and retrognathia was present in 14.2%. When examining the oropharynx (**Table 5**), the predominant finding was a web palate (62.9%). Tonsil size was primarily grade I (71.1%), and 61.1% of the cases had MMC classes III or IV. When grouping variables, an unfavorable nose was found in 51.1% of individuals, an unfavorable facial skeleton was present in 11.5%, and an unfavorable oropharynx was present in 25.8%.

The associations between symptoms and physical nasal examination variables (**Table 6**) showed that nasal obstruction and mouth breathing were significantly associated with obstructive septum deviations (grades II and III; $P < .001$ and $P = .047$, respectively) and ITH ($P < .001$). The presence of rhinitis symptoms and the presence of oronasal dryness showed a significant association with ITH ($P < .001$). Habitual snoring was associated with obstructive septum deviations ($P = .031$) and showed a tendency toward a significant association with ITH ($P = .056$).

Table 2. Prevalence of Symptoms Related to the Upper Airway in a Sample of the Adult Population of São Paulo, Brazil

	n	%	95% CI
Nasal obstruction	330	33.3	29.0-38.1
Day	49	4.9	2.2-6.1
Night	170	17.1	16.3-18.2
Day and night	111	11.2	9.6-12.3
Right	69	6.9	5.3-8.2
Left	68	6.8	4.9-8.1
Bilateral	193	19.5	16.2-23.3
Oral dryness	226	22.9	18.2-27.0
Nasal dryness	152	15.4	12.7-18.6
Oronasal dryness	148	15.0	12.1-18.8
Oral breathing	389	39.3	36.9-46.2
Symptoms of rhinopathy	442	44.9	42.7-52.9
Nasal treatment	82	8.3	6.1-11.6
Habitual snoring	425	42.8	40.1-48.1

Abbreviation: 95% CI, 95% confidence interval.

Table 3. Prevalence of Findings from Nasal Examinations in a Sample of the Adult Population of São Paulo, Brazil

	n	%	95% CI
Septum deviation	562	56.9	54.9-65.6
Grade I	260	26.3	22.8-30.5
Grade II	229	23.2	22.5-30.3
Grade III	73	7.4	5.8-10.1
Inferior turbinate hypertrophy	372	37.7	35.8-43.5
Unfavorable nose	507	51.1	50.8-60.8

Abbreviation: 95% CI, 95% confidence interval.

Table 4. Prevalence of Findings from Facial Skeleton Inspections in a Sample of the Adult Population of São Paulo, Brazil

	n	%	95% CI
Retrognathia	139	14.2	10.7-14.7
High-arched palate	236	23.8	18.3-24.6
Dental occlusion			
Class I	481	48.4	40.1-58.4
Class II	154	15.5	11.9-18.6
Class III	95	9.6	7.5-11.5
No teeth/dental prostheses	263	26.5	21.4-31.8
Unfavorable facial skeleton	114	11.5	10.3-14.9

Abbreviation: 95% CI, 95% confidence interval.

Associations between the nasal findings and the physical examination of the facial skeleton (**Table 7**) showed that the presence of nasal obstruction, ITH, and unfavorable nose was significantly associated with retrognathia ($P = .049$, $P = .002$, and $P = .008$, respectively), high-arched palate ($P < .001$, $P = .016$, and $P = .001$, respectively), class II dental occlusion ($P = .002$, $P = .001$, and $P < .001$, respectively), and unfavorable

Table 5. Prevalence of Findings from Oropharynx Examinations in a Sample of the Adult Population of São Paulo, Brazil

	n	%	95% CI
Web palate	625	62.9	58.0-64.9
Posterior palate	303	30.5	25.8-34.2
Thick palate	211	21.3	17.3-23.4
Voluminous lateral wall	195	19.7	15.2-20.2
Long uvula	277	27.9	24.1-33.2
Thick uvula	230	23.2	18.9-25.1
Palatine tonsils			
Grade 0 ^a	98	9.9	5.8-10.1
Grade I	706	71.1	68.5-76.4
Grade II	155	15.6	13.2-19.6
Grade III	34	3.4	2.1-5.9
Grade IV	0	0	
Tongue edge crenation	303	30.6	25.9-34.2
Modified Mallampati			
Class I	153	15.4	11.6-17.3
Class II	233	23.5	19.3-25.5
Class III	313	31.5	30.0-37.0
Class IV	294	29.6	26.8-33.8
Unfavorable oropharynx	256	25.8	22.0-29.4

Abbreviation: 95% CI, 95% confidence interval.

^aTonsillectomized.**Table 6.** Association between Symptoms and Nasal Physical Examinations in a Sample of the Adult Population of São Paulo, Brazil (%) ($n = 993$), χ^2 Test

	SD Grade I	SD Grade II + Grade III	Inferior Turbinate Hypertrophy
Nasal obstruction	9.3	14.1 ^a	14.8 ^a
Symptoms of rhinopathy	13.3	14.6	22.6 ^a
Oropharyngeal dryness	6.5	7.3	9.7
Nasal dryness	4.1	5.3	6.8
Oronasal dryness	4.8	5.5	7.1 ^a
Mouth breathing	10.4	13.4 ^b	18.7 ^a
Habitual snoring ^c	11.9	14.4 ^b	17.6

Abbreviation: SD, septum deviation.

^a $P < .001$.^b $P < .05$.^cAdjusted to body mass index.

facial skeleton ($P < .001$). There were no significant associations between snoring and the facial skeleton inspection variables. Obstructive septum deviations and mouth breathing were associated with high-arched palate ($P = .004$ and $P = .019$, respectively).

Table 8 summarizes the associations between snoring and the physical examination of the oropharynx. Significant associations were found between snoring and MMC classes III and IV ($P = .008$), unfavorable oropharyngeal anatomy ($P < .001$), and an altered CC ($P = .006$).

Table 7. Association between Nasal Symptoms and Physical Examinations of the Facial Skeleton in a Sample of the Adult Population of São Paulo, Brazil (%) (n = 993), χ^2 Test

	Retrognathia	High-Arched Palate	Class II Dental Occlusion	Unfavorable Facial Skeleton
Nasal obstruction	5.7 ^a	11.0 ^b	6.8 ^a	5.9 ^b
Oral breathing	6.0	11.1 ^a	6.8	5.4
SD grade II + grade III	4.0	9.0 ^a	5.5	4.4 ^a
Inferior turbinate hypertrophy	7.1 ^a	10.6 ^a	7.6 ^b	6.7 ^b
Unfavorable nose	8.7 ^a	14.4 ^b	10.0 ^b	8.2 ^b
Habitual snoring ^c	6.2	9.3	6.9	4.9

Abbreviation: SD, septum deviation.

^aP < .05.^bP < .001.^cAdjusted to body mass index.**Table 8.** Association between Snoring and Examinations of the Oropharynx and the Cervical Circumference in a Sample of the Adult Population of São Paulo, Brazil (%) (n = 993), χ^2 Test

	Modified Mallampati Grades III and IV	Grade III Tonsil	Unfavorable Oropharynx	Increased CC
Habitual snoring ^a	28.2 ^b	2.0	13.6 ^c	4.7 ^b

Abbreviation: CC, cervical circumference.

^aAdjusted to body mass index.^bP < .05.^cP < .001.**Table 9.** Association between Snoring and Age in a Sample of the Adult Population of São Paulo, Brazil (%) (n = 993), χ^2 Test

	Age, y				
	20-29	30-39	40-49	50-59	>60
No snoring	16.2 ^b	14.5	13.2	7.3	6.5
Habitual snoring ^a	6.2	9.8	10.7	8.3 ^b	7.0 ^b

^aAdjusted to body mass index.^bP < .001.

When investigating the association between snoring and age, we found a significantly lower prevalence of snoring in the 20 to 29 year-old age group ($P < .001$) and a higher prevalence in patients aged 50 to 59 years and >60 years ($P < .001$; **Table 9**).

Discussion

Epidemiological data on the characteristics of UA are scarce in the literature. Different methods are used, and representative populations are often not sampled, making it difficult to compare data between studies.

In this study, 33.4% of patients reported nasal obstruction. These results are similar to data described by Montnémy et al⁵ showing that, from a sample of 8469 people, 33% had significant nasal symptoms and 21% had nasal obstruction. Åkerlund et al¹⁹ studied the prevalence of symptoms of the upper and lower airways in a population sample of 1900 individuals in Sweden and found nasal obstruction in 33% of these cases. In the current study, other symptoms that may be

related to a nasal obstruction also had high prevalence rates, including mouth breathing (39.3%), dry mouth (22.9%), oronasal dryness (15%), and rhinitis symptoms (44.9%). Despite the high prevalence of nasal symptoms, only 8.3% of individuals reported undergoing any nasal treatment.

Rhinitis symptoms can worsen quality of life, leading to fatigue, headaches, attention difficulties, learning disorders, and sleep disorders.^{3,20} Brazil has one of the highest prevalence rates of allergic rhinitis in the world.²¹ According to Solé et al,²² in 2006, the prevalence of symptoms of allergic rhinitis in Brazil was 29.6% in adolescents. A study published in 2004 found that in Europe, the prevalence of rhinitis symptoms in adults between 20 and 44 years of age was 21%.²³

In the physical nasal examination, we found a high prevalence of nasal septum deviations and ITH (56.9% and 37.7%, respectively). However, septum deviations that were considered obstructive, classified as grades II and III, were present in 23.2% and 7.4% of the population, respectively. When studying the prevalence of anatomic variations in computed

tomography scans of the paranasal sinus, Lerdlum and Vachiranubhap²⁴ found septum deviations in 56.4% of these cases. Min et al²⁵ assessed nasal septum deviations by anterior rhinoscopy in a representative sample of the Korean population and found a prevalence rate of 22.38%.

There are no well-structured epidemiological studies in the literature that describe physical examination of the oropharynx and inspection of the facial skeleton. In a study published in 2005, Zonato et al¹⁷ evaluated the UA of individuals without OSA in a sleep laboratory. These results were compared with a sample of individuals with OSA who were evaluated in a study published in 2003.¹⁶ In the sample of subjects without OSA, the authors found that the prevalence of the following variables was much lower than in our study: a high-arched palate (11% vs 23.8% in our sample), retrognathia (6% vs 14.2% in our sample), modified Mallampati class III and IV (46% vs 61.1% in our sample), and tonsil grades III and IV (1% vs 3.4% in our sample). These differences in results may be due to the absence of OSA patients in that sample. The authors found significant differences between samples with and without OSA patients.

The prevalence of snoring in epidemiological studies varies widely, likely because of the different criteria used in each study. Population studies conducted in European countries show large differences in the prevalence of snoring, which ranges from 9% to 63.7%.²⁶ Teculescu et al²⁶ studied the prevalence of snoring in a sample of 334 married adult male employees of a university in France and classified 32% of them as habitual snorers because they reported that they snored every night or almost every night. In an epidemiological study on sleep-related complaints in a sample of 2110 individuals over the age of 16 years in different Brazilian cities, Bittencourt et al²⁷ found that 29% were snorers. In both studies, age was significantly associated with snoring. In the current study, the prevalence of snoring that occurred 3 times or more per week was 42.8%, and age was also significantly associated with snoring.

We observed a significant association between snoring and obstructive septum deviations, an unfavorable oropharynx, MMC classes III and IV, and a high CC, and we observed a tendency toward a significant association with ITH ($P = .056$). This corroborates a study by Teculescu et al²⁶ that showed a significant association between snoring and nasal obstruction and thick palate.

Some authors have studied the association between symptoms of nasal obstruction and objective findings on physical examination of the nose. Saunders et al²⁸ and Stewart et al⁶ did not find significant associations between subjective and objective evaluations of septum deviations. Zonato et al¹⁶ and Åkerlund et al¹⁹ found a significant association between nasal obstruction symptoms and objective signs of obstruction.

In this study, we found a significant association between nasal obstruction and findings from physical examination of the nose and facial skeleton. In addition, we also found a significant association between findings from physical examination of the nose and inspection of the facial skeleton. These significant associations reinforce the importance of nasal breathing for the development of the face.

D'Ascanio et al²⁹ studied 98 children with chronic mouth breathing due to nasal septum deviations. The children had no other causes of nasal obstruction, such as adenotonsillar hypertrophy and allergic rhinitis. The authors found changes in the children's craniofacial development that lead to an increased incidence of retrognathia, class II dental occlusion, high-arched palate, crossbite, and overjet. The authors noted that the results were comparable to those found by other authors who studied children with adenotonsillar hypertrophy and allergic rhinitis.

The current study is a cross-sectional population study, and the volunteers were evaluated only once. There may be discrepancies in single-case evaluations. However, Brazil has a tropical climate without major climate changes throughout the year. Volunteers were asked about the presence of symptoms within the past month, so the physical examination findings covered the same time period as the reported symptoms.

Epidemiological studies, such as this report, are fundamental to the understanding of the pathophysiology and the clinical and social impact of the various disorders and can be used as a parameter in future studies that evaluate a specific disease in a given population.

The high prevalence of symptoms of the UA and the high percentage of anatomical variations observed (>50%) in physical examination of this population are highlighted in this study.

Conclusions

The prevalence of otorhinolaryngologic symptoms associated with the UA and alterations in physical examination of the UA are high in the adult population of São Paulo, Brazil. The snoring and nasal symptoms were significantly associated with findings from UA physical examination and inspection of the facial skeleton.

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Author Contributions

Renato Stefanini, acquisition of data, analysis and interpretation of data, drafting the article, editing; **Sergio Tufik**, conception and design, critical review, final approval; **Maria Claudia Mattos Soares**, acquisition of data, analysis and interpretation of data, drafting the article, critical review; **Fernanda Louise Martinho Haddad**, interpretation of data, drafting the article, critical review, final approval; **Lia Rita Azeredo Bittencourt**, analysis and interpretation of data, critical review, final approval; **Rogério Santos-Silva**, conception and design, critical review, final approval; **Luis Carlos Gregorio**, conception and design, interpretation of data critical review, final approval.

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