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Association of Systematic Head and Neck Physical Examination With Severity of Obstructive Sleep Apnea–Hypopnea Syndrome

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Objectives/Hypothesis: **To identify upper airway and craniofacial abnormalities is the principal goal of clinical examination in patients with obstructive sleep apnea–hypopnea syndrome. The aim was to identify anatomical abnormalities that could be seen during a simple physical examination and determine their correlation with apnea–hypopnea index (AHI).** ***Study Design:*** **Consecutive patients with obstructive sleep apnea–hypopnea syndrome who were evaluated in a public otorhinolaryngology center were studied.** ***Methods:*** **Adult patients evaluated previously with polysomnography met the inclusion criteria. All subjects underwent clinical history and otolaryngological examination and filled out a sleepiness scale. Physical examination included evaluation of pharyngeal soft tissue, facial skeletal development, and anterior rhinoscopy.** ***Results:*** **Two hundred twenty-three patients (142 men and 81 women) were included (mean age, 48 ± 12 y; body mass index, 29 ± 5 kg/m^2; AHI, 23.8 ± 24.8 events per hour). Patients were distributed into two groups according to the AHI: snorers (18.4%) and patients with sleep apnea (81.7%). Sleepiness and nasal obstruction were reported by approximately half of patients, but the most common complaint was snoring. There was a statistically significant correlation between AHI and body mass index (P <.000), modified Mallampati classification (P = .002), and ogivale–palate (P <.001). The retrognathia was not correlated to AHI, but the presence of this anatomical alteration was much more frequent in patients with severe apnea when compared with the snorers (P = .05). Other correlations with AHI were performed considering multiple factors divided into two groups of anatomical abnormalities: pharyngeal (three or more) and craniofacial (two or more) abnormalities. There was a statistically significant correlation between pharyngeal landmarks and AHI (correlation coefficient [r] = 0.147, P = .027), but not between craniofacial landmarks and AHI. The combination of pharyngeal anatomical abnormalities, modified Mallampati classification, and body mass index were also predictive of apnea severity.** ***Conclusions:*** **Systematic physical examination that was used in the present study indicated that, in combination, body mass index, modified Mallampati classification, and pharyngeal anatomical abnormalities are related to both presence and severity of obstructive sleep apnea–hypopnea syndrome. Hypertrophied tonsils were observed in only a small portion of the patients. The frequency of symptoms of nasal obstruction was high in sleep apnea patients. Further studies are needed to find the best combination of anatomical and other clinical landmarks that are related to obstructive sleep apnea.** ***Key Words:*** **Sleep apnea, physical examination, anatomical abnormalities, nasal obstruction.**

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INTRODUCTION

Since obstructive sleep apnea–hypopnea syndrome (OSAHS) was initially described by Guilleminault[1] in the 1970s, its pathogenesis has not been completely understood. However, some understanding was well established over these 30 years: First, the upper airway (UAW), specifically the pharynx, is the site of obstruction; second, the UAW obstruction occurs because of a misbalance between intrapharyngeal pressure and outward forces generated by pharyngeal soft tissue and muscles; and third, specific anatomical abnormalities or a disproportional anatomy, which can compromise pharyngeal lumen and size, is present in patients with OSAHS.[2] Changes in pharyngeal size and its configuration during sleep are a multifactorial

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consequence having direct participation of anatomical and neural disorders.[3–5] The pharyngeal patency during wakefulness is attributed to continuous neuromuscular control by the central nervous system, but during sleep this control is physiologically decreased and pathologically increased in some patients. The occurrence of both anatomical abnormality and neuromuscular disorder can facilitate the narrowing and closure of the pharynx during sleep.[2] Therefore, pharynx obstruction in patients with OSAHS can be associated with both smaller and more collapsible UAW when more than one site of obstruction may be involved. Identifying sites of anatomical abnormalities to predict the levels of obstruction is the principal goal of the clinical examination by otolaryngologists. Nonetheless, this issue is difficult because the disease has a multifactorial etiology and the pathophysiology is incompletely understood. The relation between anatomical abnormalities with the presence and severity of sleep apnea is not well established in the scientific literature. We cannot ignore the relevant physical alterations (craniofacial abnormalities, dental occlusion, oropharyngeal soft tissue, UAW size and shape) that can be easily recognized even by simple visual inspection and physical examination as described by some authors.[6–8] In addition to physical examination, other methods have been used to evaluate the airway including, principally, fiberoptic pharyngoscopy with or without the Mueller maneuver (MM) and cephalometry. Also, fluoroscopy, computed tomography (CT), magnetic resonance imaging (MRI), acoustic reflection, and UAW manometry are more used in research than in clinical evaluation.[6,7]

Anatomical abnormalities are not the only cause of OSAHS in most patients, but identification of the abnormalities is part of a patient's investigation and therapeutic evaluation. Selection of proper treatment is crucial. Clinicians must recognize patients who might benefit from a surgical procedure by identifying anatomical areas in which surgery could increase airway size and/or reduce airway resistance, thus contributing to a less collapsible pharynx during sleep. In a attempt to identify the patients' physical aspects that could predict the presence and severity of OSAHS, Friedman et al.[9] studied four parameters, of which three had a correlation to sleep apnea. The positive physical characteristics that were predictors of OSAHS were modified Malampatti classification, tonsil size, and body mass index (BMI).

It has been well demonstrated in the literature that OSAHS diagnosis must always be confirmed by polysomnography (PSG), but the suspicion comes from the patient's interview and physical examination.[10–12] Symptoms of OSAHS such as snoring, nocturnal gasping, observed apneas, restless sleep, daytime fatigue, excessive daytime somnolence, and lack of memory and concentration are well known and can represent a clinical model for this disease.[10–12] Regarding BMI, there is no consensus about physical findings associated with OSAHS. Initially, the pharyngeal anatomy including lateral wall, soft palate, uvula, and tongue volume were the focus of otolaryngology examination. Also, facial skeletal characteristics of maxilla, mandible, and dental arch occlusion have been found to be important.[2,7]

According to the literature and our experience with patients with sleep apnea, we established a systematic head and neck physical examination that is easy for an otolaryngologist to perform, can be used daily, and takes only a few minutes. Our effort was to identify anatomical abnormalities that could be seen during a simple otorhinolaryngological examination and correlate all of them to the apnea–hypopnea index (AHI) as possible predictors of both presence and severity of OSAHS.

PATIENTS AND METHODS

Study Design

Consecutive patients with OSAHS who were seen in a public otorhinolaryngology clinic at Hospital São Paulo–Universidade Federal de São Paulo (São Paulo, Brazil) during the period from January 2001 to October 2001 were included in the present study. Adult patients with OSAHS (including snore) who had been evaluated with overnight standard polysomnography (PSG) met the inclusion criteria. The PSG parameters were electroencephalogram, electrocardiogram, right and left eye movements, submental and anterior–tibialis electromyogram, nasal and oral airflow limitations, thoracic and abdominal movements, and oxygen saturation by pulse oximetry. Patients were distributed according to the AHI in snorers (AHI <5), with mild sleep apnea being AIH equal to 5 to 15; moderate sleep apnea, AHI equal to 15 to 30; and severe sleep apnea, AHI greater than 30.[13] All patients underwent clinical history and otolaryngological examination and completed a sleepiness scale (Epworth Sleepiness Scale [ESS]). Clinical evaluation included investigation of hypertension, other cardiovascular disease, diabetes mellitus, hypothyroidism, nasal obstruction, and rhinitis. Physical examination assessed facial, oral cavity, and oropharynx characteristics and findings on anterior rhinoscopy. The prospective investigation of all patients was performed by two different otorhinolaryngological investigators (A.I.Z., L.C.G.).

Parameters of Physical Examination

Facial morphology. Observation of the patient's facial profile was performed to recognize developmental disorders of the mandible and maxilla. The mandible retrognathism was investigated by placing the patient seated in the Frankfort horizontal position with a virtual vertical line dropped from the vermilion border of the lower lip to the chin. If the anterior prominence of the chin (soft tissue pogonion) is great than 2 mm behind this line, mandibular retrodisplacement may be present[14] (Fig. 1).

Oral cavity. Initially, we assessed dental occlusion, classifying patients into the following categories: class I, orthognathic relationship or normal occlusion; class II, possibility of mandibular retrognathism due to a small mandible (Fig. 2); class III, possibility of mandibular prognathism because of a large mandible or a maxillary-retrusive; and total or partial edentate. Examination of oral cavity continued with inspection of relative position of the palate and base of tongue inside the mouth using the modified Mallampati classification (MMC).[9,15] By asking the patients to open their mouths with the tongue relaxed inside the mouth, the MMC can be graded according to palatal length and tongue size as class I, all the oropharynx including tonsils, pillars, soft palate, and the tip of uvula can be easily visible; class II, tonsils' upper polo and the uvula are visible; class III, part of the uvula and soft palate are visible; and class IV, the hard palate and part of soft palate are barely visible (Fig. 3). The tongue inspection is the next step; because the estimation of tongue size is difficult, we used the presence of edge crenations in consequence of teeth pressure as a nondirective sign of "excessive tongue volume." This characteristic is observed with the tongue

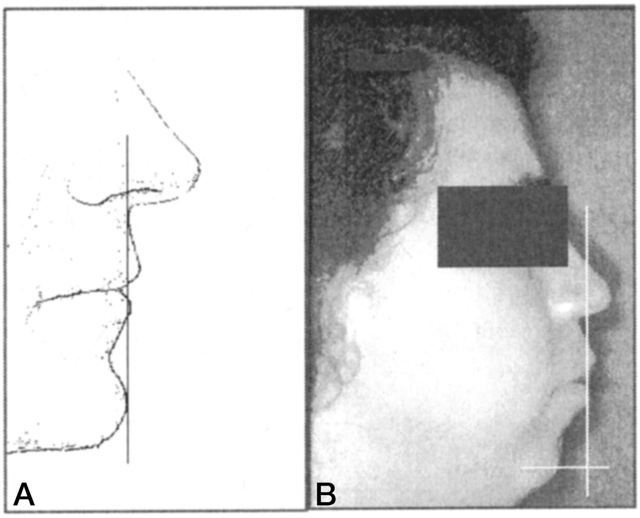

Fig. 1. (**A**) Vertical line from the vermilion border of lower lip to the chin. If the anterior prominence of the chin (soft tissue pogonion) is greater than 2 mm behind this line, mandibular retrodisplacement may be present. (**B**) Patient with retrognathia.

relaxed at the same plane of mandibular teeth without tension (Fig. 4).

Oropharynx. The observation of soft palate, uvula, tonsils, and lateral wall was included. The soft palate was classified as posteriorly placed, thick, and webbed (web-palate attributable to redundant posterior pillar); the lateral wall as voluminous with wrinkling pillars; and uvula as thick and long. Tonsils were classified by degree according to hypertrophy as follows: grade I, tonsils inside the tonsillar fossa lateral to posterior pillars; grade II, tonsils occupying 25% of oropharynx; grade III, tonsils occupying 50% of oropharynx; grade IV, tonsils occupying 75% or more of oropharynx, almost meeting in the midline; and grade 0, previous tonsillectomy (Fig. 5).

Nasal examination. Nasal examination was performed by anterior rhinoscopy using a speculum with the patient seated with the head slightly back. The inspection was to detect septal deviation, turbinate hypertrophy, nasal polyps, other masses, and internal nasal pathway.

Statistical Analysis

Basic descriptive statistical analyses were performed for all variables, including mean, SD, and minimum and maximum values. Correlation between AHI and all other variables was carried out by the Spearman correlation test. The χ^2 test was used to determine the association between AHI severity and otolaryngological alterations. Nonparametric analysis of variance (ANOVA) (Kruskal-Wallis test) was used in the comparison among different AHI severity groups. For all tests, the level of significance was set at a *P* value less than or equal to .05. The data were analyzed using software Statistica for Windows, release 5.1 (Statsoft Inc., 1997).

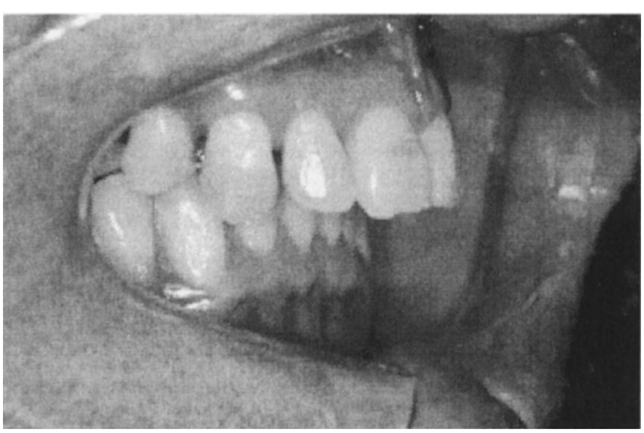

Fig. 2. Class II occlusion resulting from retrognathia.

RESULTS

Two hundred twenty-three patients (142 [63.7%] men and 81 [36.3%] women) were included in the protocol (mean patient age, 48 ± 12 y [age range, 14–75 y]; BMI = 29 ± 5 kg/m^2 (range, 18–45 kg/m^2). All 223 patients had recordings by standard polysomnogram with a mean AHI of 23.8 ± 24.8 events per hour (Table I). Patients were distributed into two groups according to the AHI: "snore" (AHI $<$5) (18.4% of the patients) and "sleep apnea" (AHI $\geq$5) (81.7% of the patients) groups. According to the degree of AHI, 84 (37.7%) patients had mild sleep apnea, 37 (16.6%) had moderate sleep apnea, and 61 (27.4%) had severe disease. Mild apnea was the most prevalent degree of the disease representing one-third of the group (Table II).

At the clinical evaluation, hypertension was present in 71 (31.8%) patients, cardiovascular disease in 13 (5.8%), diabetes mellitus in 16 (7.2%), and hypothyroidism in 11 (4.9%). In addition, nasal obstruction was reported by 143 (64.1%) patients and symptoms of rhinitis by 90 (40.4%) patients. Daytime sleepiness was reported by 107 (48%) patients and snore by 206 (92.4%) patients; the ESS score was 11.1 ± 6.2 (range, 0–24). Sleepiness and nasal obstruction were reported by approximately half of the patients, but the most common complaint was still the snoring.

Facial skeletal examination detected retrognathism in 44 (19.7%) patients. Evaluation of dental occlusion showed that class II was observed in only 26.3% of patients, but almost one-third of the patients in the entire group were totally or partially edentate, reflecting a social health problem in Brazil and preventing a real evaluation of occlusion. The MMC showed 7 patients (3.5%) in class I, 35 (17.7%) in class II, 83 (41.9%) in class III, and 73 (36.9%) in class IV. Classes III and IV, which are considered a sign of difficult tracheal intubation, represented the larger part of our group (78.8%) against the minority of patients in classes I and II (21.2%). Ogivale–palate was observed in 56 (25.1%) patients, and tongue edge crenations by teeth in 81 (36.3%). The oropharynx evaluation showed web-palate in 101 patients (45.3%), posteriorly placed and/or thick soft palate in 131 (58.7%), uvula as thick and/or long in 113 (50.7%), and voluminous lateral wall with wrinkling pillars in 69 (30.9%). The scores for evaluation of degree of tonsil hypertrophy were as follows: grade 0, 41 (20.4%); grade I, 75 (37.3%); grade II, 56 (27.9%); grade III, 26 (12.9%); and grade IV, 3 (1.5%) patients. The combined group of patients with low degree of tonsil hypertrophy (grades I and II) and patients with previous tonsillectomy represented the great majority of patients (85.6%), against the minority group (14.4%) with greater degrees of tonsil hypertrophy (grades III and IV).

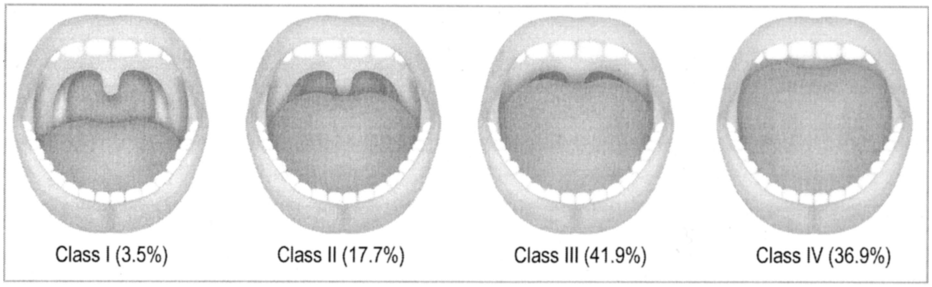

Fig. 3. Modified Mallampati classification ranging from class I to class IV, including the percentage of patients in each class.

Anterior rhinoscopy detected some degree of septal deviation in 141 (63.2%) patients and turbinate hypertrophy in 111 (49.8%) patients. Among patients with the symptom of nasal obstruction, 84.6% had septal deviation and/or turbinate hypertrophy during physical examination. Therefore, the nasal obstruction complaint was significant in patients with septal deviation or turbinate hypertrophy ($P = .008$).

All the investigated physical variables that are listed in Table III and Table IV were correlated to the AHI. There was a statistically significant correlation between AHI and BMI (correlation coefficient [r] = 0.364, $P < .0001$), MMC ($r = 0.210$, $P = .002$) (Fig. 6), and ogivale–palate ($P < .001$), with a tendency toward tonsil hypertrophy ($r = 0.210$, $P = .088$). None of the other individual correlations was statistically significant. We observed that none of the snore patients had ogivale–palate, this physical aspect being associated only with patients with sleep apnea. Thus, comparison of the snore group with other apneic groups (mild, moderate, and severe apnea) showed a statistical difference, with $P = .0004$, $P = .001$, and $P < .0001$, respectively, for the presence of ogivale–palate. Also, the largest statistical difference was between patients in the snore group and patients with severe apnea. The retrognathia was not associated to AHI, but the presence of this anatomical characteristic was much more frequent in patients with severe apnea when compared with patients in the snore group ($P = .05$). In addition, presence of retrognathism was greater in patients categorized as MMC class IV when compared with class II ($P = .003$) and class III ($P = .01$).

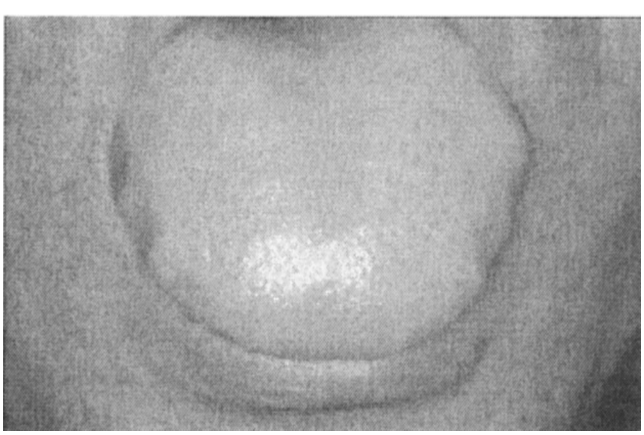

Fig. 4. Tongue edge crenations resulting from tooth pressure.

Other correlations to AHI were performed considering multiple factors divided in the following groups of anatomical abnormalities: 1) pharyngeal abnormalities with three or more of the five pharyngeal characteristics (tonsil size [grade III or IV], abnormal palate, abnormal uvula, voluminous lateral wall, or web-palate) and 2) craniofacial abnormalities (two or more of the three skeletal characteristics [ogivale–palate, retropositioned mandible, or class II occlusion]) (Table V). There was a statistically significant correlation between pharyngeal landmarks to AHI ($P = .027$), but there was not correlation with craniofacial landmarks. Using the physical features, we analyzed them as a possibly predictive of the severity of OSAHS. The combination of pharyngeal anatomical abnormalities, MMC, and BMI were also predictive of severity (Table VI).

DISCUSSION

Most of our patients were men in the fourth decade of life. Snoring was the principal symptom, and daytime sleepiness was reported by only half of the group; the ESS score was little higher than normal. Snoring can be the most common reason for consulting a physician, but simple snoring without sleep apnea was found in only 18% of the entire group. Obstructive sleep apnea was the principal sleep-related breathing disorder. Mild apnea was the most frequent, followed by severe and moderate groups. The patients can be clinically divided into two large groups: 1) patients with only snore or mild apnea (56%), which could represent a softer form of disease, and 2) patients considered clinically more complicated presenting moderate or severe apnea (44%) (Table II). Although snore and mild apnea were frequent, we cannot ignore that half of the patients (moderate and severe cases) had a more serious degree of the disease with possible consequences to cardiovascular system.[3] In our group, just a small part (5.8%) reported cardiovascular disease, but hypertension was present in one-third of the patients. One important point was related to nasal obstruction, which has received little attention for many years. Nasal obstruction was present in 64.1% of patients with a high frequency of septal deviation and/or turbinate hypertrophy ($P = .008$) when comparing patients with and without nasal obstruction. Some authors have shown a limited role of nasal obstruction in the physiopathology of OSAHS, but an important relation to continuous positive airway pressure (CPAP) compliance and pressure. According to the literature, the incidence of nasal obstruction in patients treated with CPAP devices varies from 21.9% to 66% of

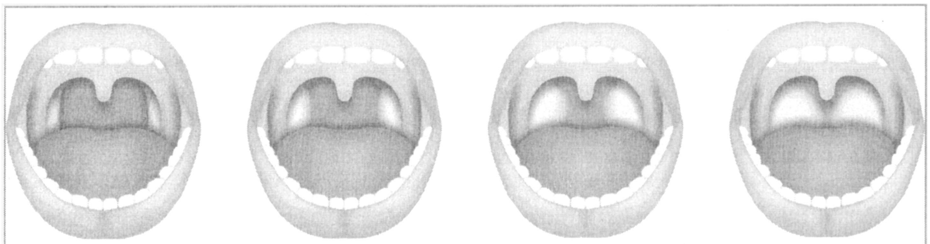

Fig. 5. Degrees of tonsil hypertrophy ranging from degree I to degree IV, including the percentage of patients having hypertrophy of each degree. The percentage of patients with previous tonsillectomy is 20.4%.

patients.[16–19] In our sample, half of the patients had moderate or severe disease, and usually the first treatment choice can be nasal CPAP. The presence of a blocked nose can interfere with CPAP acceptance and compliance, leading to the need for a higher pressure that can be uncomfortable for the patients. Sériès et al.[20] and Friedman et al.[21] reported that nasal surgery has a partial influence on the AHI but it is effective to reduce nasal CPAP pressure. Nasal obstruction leads to mouth breathing; as a consequence, the mandible is placed downward and backward, which facilitates obstruction of the base of the tongue. Some authors have reported that breathing by mouth instead of by nose creates a higher resistance in the UAW, which can contribute to the pathogenesis of sleep apnea.[22–24] Regardless of whether or not the patients with sleep apnea will use nasal CPAP, free nasal airways are essential. We think that nasal obstruction must be investigated during the patient's initial visit, and if it is present, a specific examination and treatment must be performed.

Since the early 1980s, a major effort has been made to identify the sites of obstruction in the UAW during sleep. Since the concept was introduced by Fujita[25] of dividing the UAW into two great segments (velopharynx and hypopharynx), placing the obstruction in one or both of these anatomical segments, physical evaluation of the head and neck in patients with sleep-related breathing disorders has been conducted to recognize the segments with obstruction. The principal methods used in this endeavor are nasopharyngeal endoscopy with Mueller maneuver and cephalometry. Mueller maneuver performed during nasopharyngeal endoscopy was initially used to identify the site of UAW obstruction acting as a predictor of success of surgical treatment by guiding the surgeon to treat one or more specific pharyngeal obstruction sites. However, data from a prospective study showed that Mueller maneuvers do not predict either good or poor candidates for surgical outcome of uvulopalatopharyngoplasty (UPPP).[26] Cephalometric measurements were initially used to characterize craniofacial shape and abnormalities by dentists and oral surgeons analyzing skeletal lines and angles and has to date been an excellent method for this purpose. The use of this method as a alternative to evaluate UAW size and points of narrowing in patients with OSAHS was introduced by Riley et al.[27] in 1983. Using head and neck lateral cephalograms, Shepard et al.[7] observed that patients with OSAHS have craniofacial skeletal deformities when compared with normal subjects. The facial lateral x-ray gives a precise view in which it is possible to see the changes in size of the UAW after pharyngeal or craniofacial surgical treatment. We think that the combination of the patient's physical examination and complementary methods are important for understanding the pharyngeal narrowing and collapsibility by recognizing the anatomical abnormalities in soft tissue and facial skeleton rather than just the shape and size. The presence of relevant anatomical alterations can influence (but not always) the UAW patency during sleep, although the absence of physical findings does not protect the patient from obstructive disorder during sleep. The imbalance between intrapharyngeal pressure and outward forces generated by pharyngeal soft tissue and muscles causing partial or total obstruction has a multifactorial consequence. The disproportional anatomy of head and neck, obesity, and neural disorders act together; the first two can be recognized in an awake patient, but the neural aspects can be manifested solely during sleep. Because we evaluate our patients while they are awake, we might have missed something when trying to identify the site(s) of obstruction(s).

Our effort was to identify all possible physical abnormalities (skeletal and soft tissue) and their relation

TABLE I.
Polysomnography Data in 223 Patients.

	AHI (no./hr.)	Stage 1 (%)	Stage 2 (%)	Stages 3/4 (%)	REM Sleep (%)	Lowest O_2 (%)
Mean	23.8	10.9	58	15.6	15.9	78
Range	0–124	0–63	8–94	0–52	0–37	30–97
SD	±24.8	±9.9	±12.9	±9.8	±7.1	±13.6

AHI = apnea-hypopnea index; SD = standard deviation; lowest O_2 = lowest arterial oxygen saturation.

TABLE II.
Sleep Disorder Breathing Classification of the Entire Group According to AHI.

AHI	No. = 223	Percent
Snore (AHI <5)	41	18.4%
Mild (AHI = 5–15)	84	37.7% (56%)*
Moderate (AHI = 15–30)	37	16.6%
Severe (AHI >30)	61	27.4% (44%)†**

* Snore plus mild apnea groups. **Moderate plus severe apnea groups.
† AHI = apnea-hypopnea index.

TABLE III.
Analysis Between AHI and the Variables Below.*

	r	*P* Value
Body mass index	0.364	<.0001
Mallampati classification	0.210	.002
Tonsils hypertrophy	0.120	.089

* Spearman rank order correlations.
AHI = apnea-hypopnea index.

to the presence of obstructive sleep apnea. Among all investigated physical parameters listed in Tables III and IV, only BMI, MMC, and ogivale–palate had a positive association with the AHI. When combining anatomical characteristics into two groups of pharyngeal and skeletal findings, we observed that only the pharyngeal anatomical abnormalities in combination had a predictive value. In the present study, the BMI, MMC, and pharyngeal abnormalities in combination are predictive of both presence and severity of OSAHS. Other authors had correlated physical findings and complementary examinations with sleep apnea. Using cephalometric analysis to find predictive factors that could benefit good results from UPPP in 30 patients, Petri et al.[26] reported that low hyoid bone position was the only variable correlated to the severity of sleep apnea. Using recorded modified Malampatti grade, degree of tonsil size, BMI, and low cervical measurements (thyroid–mental distance and hyoid–mental distance), Friedman et al.[9] tried to identify in a series of 172 patients physical findings that could predict the presence and the severity of OSAHS. The researchers' results showed a statistically significant correlation between MMC, tonsil size, and BMI to AHI, without correlation with cervical measurements. Considering only the anatomical abnormalities, according to the study just cited, tonsil size and MMC are highly predictive of presence and also severity of OSAHS. During evaluation of 42 patients using data from three methods to evaluate UAW obstruction (recorded physical examination, videotape endoscopy, and lateral cephalometric x-ray), Woodson and Naganuma[28] observed that AHI was related to BMI, posterior wall redundancy, and retropalatal size on endoscopy. The only concordance between the present study with Friedman and Woodson's studies, as abovementioned, is regarding BMI, whereas MMC is common to the present study and the results of Friedman et al.[9]

TABLE IV.
Association Between Physical Examination Variables and AHI (snore; mild, moderate, and severe apnea).

	Percent	*P* Value
Ogivale-palate	25.1	<.001*
Retro-positioned mandible	19.7	NS
Class II occlusion	26.3	NS
Tongue edge crenation	36.3	NS
Web-palate	45.3	NS
Abnormal palate	58.7	NS
Abnormal uvula	50.7	NS
Voluminous lateral wall	30.9	NS
Septal deviation	63.2	NS
Turbinate hypertrophy	49.8	NS

*Between snore and all grades of apnea severity.

Among the physical abnormalities investigated in our patients, it was possible to observe that abnormal craniofacial characteristics (Table IV) were less frequent, being present in less than one-third of the group. Conversely, pharyngeal landmarks and nasal alterations were frequent. Classes III and IV on MMC were present in most of our patients with an incidence of 78.8%, indicating that most apneic patients can have a small oropharynx and a difficult endotracheal intubation.[14,29] Originally, the Mallampati classification was used in planning of anesthesia to predict risks of intubation. In addition to the high class on MMC, patients with sleep apnea have other anatomical factors that can contribute to complications during endotracheal intubation such as obesity, abnormal maxillomandibular development, long soft palate, tonsil hypertrophy, and excessive tongue volume. This point must be considered by the surgeons and anesthesiologists because difficulties in achieving a patent airway can have serious consequences to the patient, and most of sleep apnea patients have a high class on MMC.

An interesting aspect of our results is that high degree of tonsil hypertrophy was not common. Large tonsils (grade III or IV) were present in only 14.4% of the group compared with 20.4% of those who had previously had surgery and compared with more than half with a low grade of hypertrophy (grades I and II, 65.2%). The results of Friedman et al.[9] also showed that only 13% of the group had tonsil grade III or IV. Since the early 1980s, the traditional UPPP has been the most frequent surgery used to treat patients with sleep-related breathing disorder. In 1996, Sher et al.[30] published an important study determining the efficacy of various operations, and the rate of success of UPPP was 40.7% to 52.3% of treated patients. We think that the great advantage of this surgical technique is in a pharynx with voluminous lateral wall and grade III or IV of tonsil size, rather than in a patient with long palate and uvula. Considering the results, there is questioning about the use of UPPP as the principal surgery if most of the patients do not have high degree of tonsil hypertrophy. Perhaps the unsatisfactory results with only this technique of surgical treatment can be related in part to this fact.

The presence of ogivale–palate in our patients was associated with the presence of sleep apnea, and none of the simple snorers had these characteristics. If this is true, prevention of abnormal development of maxilla during childhood may protect from later sleep apnea. As with ogivale–palate, retrognathia was related to patients with severe apnea when compared with the patients in the snore group ($P = .05$) and, further, its presence was more frequent in patients categorized as MMC class IV when compared with class II ($P = .003$) and with class III ($P = .01$). Ogivale–palate, retrognathism, and MMC class IV can reflect a disproportional

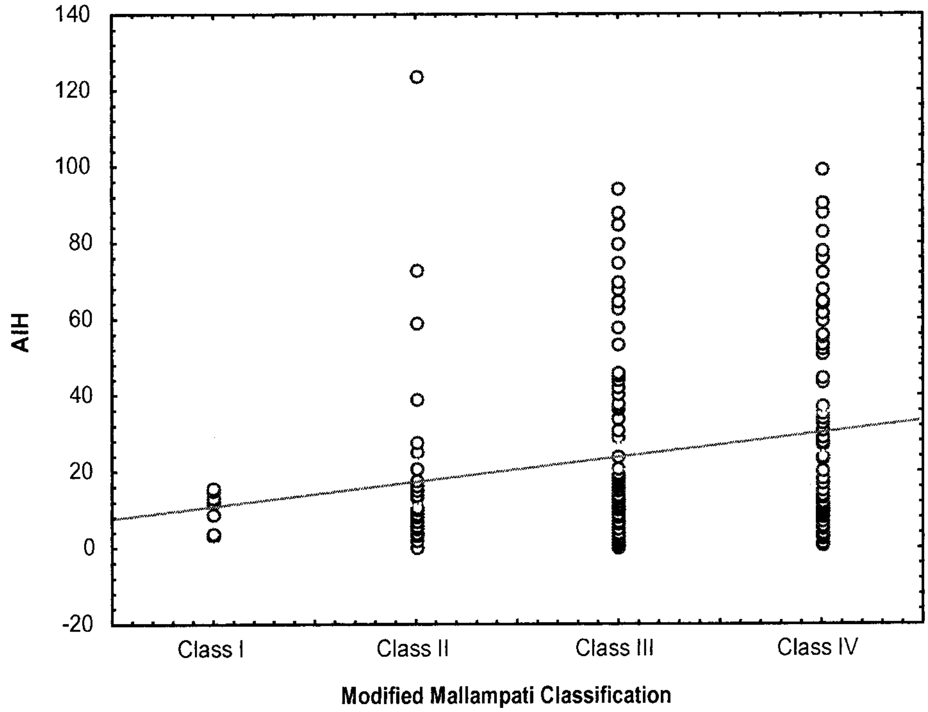

Fig. 6. Graph demonstrating positive correlation between modified Mallampati classification and apnea–hypopnea index.

relation between "continent and contents," having as consequence a small mouth and oropharynx. Instead of negative correlation of these aspects to AHI, these anatomical alterations are important because they reflect a small mouth. We think that further investigations of the participation of craniofacial abnormalities in OSAHS are still necessary and promising.

CONCLUSION

The systematic physical examination used in the present study indicates that BMI, MMC, and pharyngeal anatomical abnormalities in combination (presence of at least three abnormalities) are related to both presence and severity of OSAHS. Ogivale–palate was a physical characteristic observed in patients with sleep apnea but not in simple snorers. The hypertrophied tonsil, which was for decades the most frequent objective of surgical treatment, was observed in only a small portion of the patients (14%). Pharyngeal abnormalities were more frequent than craniofacial alterations; besides this aspect, a suggestive sign of small mouth (ie, MCC classes III and IV) was present in most of the patients with obstructive sleep apnea (80%). Other aspects were the high frequency of symptoms of nasal obstruction (64%) and the positive statistical significance of the presence of septal deviation or turbinate hypertrophy. This situation reflects the need to investigate nasal obstruction in patients with sleep apnea who benefit from nasal breathing instead of mouth breathing. The results indicate that the systematic and simple physical examination suggested in the present study can be used to identify patients with obstructive sleep apnea and their most important anatomical abnormalities, but we think that further studies about patient's anatomy are still needed to find the best clinical correlation of sleep apnea.

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TABLE V.
Analysis Between AHI and Pharyngeal/Craniofacial Abnormalities.*

	No. (%)	r	*P* Value
Pharyngeal abnormalities†	84 (37.7)	0.147	.027
Craniofacial abnormalities‡	34 (15.2)	0.075	.260

* Spearman rank order correlations.
† Pharyngeal abnormalities: 3 or more of pharyngeal characteristics among tonsil size (grade III or IV), abnormal palate, abnormal uvula, voluminous lateral wall and web-palate.
‡ Craniofacial abnormalities: 2 or more of skeletal characteristics among ogivale-palate, retropositioned mandible, and class II occlusion.
AHI = apnea-hypopnea index.

TABLE VI.
Analysis of Variance Between Physical Examination Variables and Sleep Apnea Severity.*

	P Value
Body mass index	<.000
Mallampati classification	.007
Tonsils hypertrophy	.417
Pharyngeal abnormalities	.0003
Craniofacial abnormalities	.500

* Kruskal-Wallis test and Chi-square test.

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