The role of the nose in obstructive sleep apnea
O papel do nariz na síndrome da apneia obstrutiva do sono

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ABSTRACT
To evaluate the relationships between nasal obstruction and obstructive sleep apnea syndrome (OSAS), this report provides a simple review of the literature relating to this subject. Patients with OSA have exhibited a higher frequency of nasal abnormalities compared to controls, suggesting that these alterations play some role in the physiopathology of this disease. However, clinical or surgical treatment of these abnormalities has been shown to be limited in controlling OSAS. Nevertheless, nasal surgeries are capable of reducing therapeutic pressure levels for positive airway pressure devices; the real benefit of the nose procedures on the use of positive airway pressure devices in the long term must be further assessed. Nasal evaluation in patients who are candidates for the use of an intraoral device is seldom discussed in the literature, and only one study has reported a positive finding, opening the way for new studies with this focus. Thus, the nose takes on an important role in OSAS; however, some aspects of its impact in the clinical and surgical treatment of OSAS still remain controversial.

Keywords: obstructive sleep apnea, nose, nasal obstruction.

RESUMO
Para avaliar a relação da obstrução nasal e a Síndrome da apneia obstrutiva do sono (SAOS), foi realizada uma revisão simples da literatura acerca deste tema. Pacientes com SAOS apresentam maior frequência de alterações nasais quando comparados a controles, sugerindo que estas alterações exercem algum papel na fisiopatologia desta doença. Contudo, o tratamento clínico ou cirúrgico dessas alterações tem mostrado limitado no controle da mesma. Entretanto, o nariz desempenha um papel extenso na SAOS; porém, alguns aspectos de seu impacto no tratamento clínico e cirúrgico da SAOS ainda permanecem controversos.

Descritores: apneia do sono tipo obstrutiva, nariz, obstrução nasal.

INTRODUCTION
Obstructive sleep apnea syndrome (OSAS) is characterized by repeated episodes of reduced or complete cessation of air flow during sleep, stemming from the narrowing or the collapse of the pharynx, and is usually associated with fragmentation of sleep and reduction in oxy-hemoglobin saturation. OSAS affects approximately 2-4% of men and 1-2% of women in middle age.

However, the most recent epidemiological study performed in the adult population of the city of São Paulo showed a prevalence of OSAS of 32.9% (5). Young et al. (6) reported that the prevalences of mild to moderate OSAS are even higher, estimating that up to 26% of middle-aged men show a minimally symptomatic form of the disorder.

Among other factors, the fragmentation of sleep and the reduced saturation of oxy-hemoglobin associated with these respiratory events contribute to the elevated risk of developing high blood pressure and other cardiovascular diseases.

Risk factors for OSAS in adults include obesity, masculine gender, craniofacial dysmorphism, hypothyroidism, and nasal obstruction.

According to Suman et al. (3), deviation of the nasal septum and turbinate hypertrophy were the most commonly identified abnormalities in nasal anatomy, occurring in 78% and 28% of cases with OSAS and 73% and 45% of patients with primary snoring, respectively.

Various studies in the literature have correlated chronic nasal obstruction and OSAS, but the role of the nose in the physiopathology of OSAS is still a controversial topic in the literature. The aim of this report is to evaluate the role of the nose in OSAS through a simple review of the literature regarding this subject.

The role of the nose in the physiopathology of OSAS

The three main factors that contribute to the development of OSAS are the reduction of the strength of the muscles responsible for dilating the pharynx, the negative inspiratory pressure generated by the diaphragm, and the anatomical alteration of the upper airway (UA).

Nasal obstruction increases the negative inspiratory pressure and causes an alteration in the functional dynamic of the UA due to the consequent oral respiration. This increase in the inspiratory pressure causes the narrowing of the pharynx, which results in episodes of apnea and hypoxia, indicating that the UA is similar to the resistance model of Starling with a collapsible segment at the oropharynx.

Compared to oral respiration, nasal respiration is more efficient because the nasal cavity possesses a resistance, which is almost constant, and the stimulation of the
nasal receptors by air influx activates the dilating muscles of the pharynx (nasopharyngeal reflex)\(^{(18)}\).

The most frequent etiologies for nasal obstruction are septal deviation, turbinate hypertrophy, nasal polyps, and nasal valve insufficiency.

According to the literature from epidemiological studies, nasal congestion contributes to the pathogenesis of OSA\(^{(4,16)}\). However, when considering randomized and controlled studies, it was not possible to establish a positive correlation between nasal obstruction and OSAS\(^{(4)}\).

Various studies have shown that patients with OSAS had higher frequencies of nasal alteration compared to controls\(^{(59)}\). However, despite these studies, the role of the nose in the physiopathology of OSAS is still a matter of controversy\(^{(4)}\).

**THE IMPACT OF NASAL TREATMENT IN THE TREATMENT OF OSAS**

There are various procedures for the correction of nasal obstruction: septoplasty, turbinectomy, polypectomy, radiofrequency ablation/cauterization of the turbinates, and, in cases of nasal valve insufficiency, nasal alar reconstruction.

The use of nasal dilators, topical corticosteroids, and nasal decongestants to reduce nasal resistance has yielded only a small improvement in the symptoms and severity of OSA\(^{(4)}\).

In general, nasal surgeries are not curative, but they are able to improve snoring and quality of sleep and to reduce daytime sleepiness; additionally, they are frequently used to address multiple obstruction sites\(^{(2,20)}\).

However, in the absence of other significant anatomical abnormalities, the patients who most benefit from correction of nasal obstruction as a single intervention are likely those with mild forms of respiratory sleep disturbances, those with a low BMI, and those who are younger\(^{(2,18,20)}\).

**THE ROLE OF THE NOSE IN THE USE OF POSITIVE AIRWAY PRESSURE DEVICES**

The gold-standard treatment for OSAS is the use of positive airway pressure devices; CPAP (continuous positive airway pressure) devices are the most frequently used.

A CPAP device consists of a continuous airflow generator, which is connected to a nasal or oronasal mask by a flexible tube and is tightly adjusted to the face. The pressure generated in the mask is transmitted to the UA of the patient, creating a pneumatic cushion in its interior that increases its latero-lateral diameter and displaces the soft palate in the direction of the base of the tongue, which increases the sectional area of the pharynx\(^{(21)}\).

Low compliance of patients to the use of positive airway pressure devices has been the chief factor in the lack of success with this type of device. When evaluated subjectively, compliance to a CPAP device varies from 60% to 90%\(^{(20)}\); however, when measured objectively using a device that measures the hours of use with pressure in the mask (i.e., a pressure horimeter), this rate reaches 30% - 60%\(^{(23,24)}\).

Because the interface between the positive airway pressure device and the patient takes place through nasal and oronasal masks, the presence of nasal anatomical abnormalities can make use of the mask difficult. This difficulty may be due to increased resistance to the passage of air, so that these patients need higher therapeutic pressures, which are thus more uncomfortable. Alternatively, the difficulty may be because the patient breathes predominantly through the mouth, with consequent leaks of air, leading to removal of the device. Moreover, during episodes of nasal obstruction, the pressure may become subtherapeutic with residual symptoms. These factors can all be disincentives for use of the device\(^{(25-29)}\).

Nasal resistance caused by obstruction of the airway is reduced significantly by surgical treatment\(^{(20)}\). Thus, it is believed that with surgical correction of the nasal obstruction, the OSAS patient will have better compliance to positive pressure therapy, whether because its use becomes more comfortable or because of a reduction in the necessary level of pressure\(^{(2,20,29)}\).

Some studies have shown that nasal surgery is capable of reducing therapeutic levels for a CPAP device\(^{(20-32)}\); Nakata et al.\(^{(31)}\) reported a reduction in the therapeutic pressure of the CPAP device from 16.8 ± 1.1 to 12.0 ± 1.9 cm H\(_2\)O. However, only a single 11-patient study objectively evaluated compliance to CPAP treatment; it showed an average increase of 48.6 minutes/night in the use of the CPAP device after surgery\(^{(30)}\).

The clinical studies that have used acoustic rhinometry and/or rhinomanometry to evaluate the noses of patients with OSAS and that have indicated treatment with a positive airway pressure device are controversial with respect to compliance. Some studies have found an association between area and nasal resistance and compliance to CPAP treatment\(^{(26,27)}\), and others have not\(^{(25)}\). Haddad\(^{(33)}\) evaluated the nose through subjective measures (questionnaires), anatomical measures (rhinometry, nasofibroscopy, and acoustic rhinometry), and functional measures (nasal peak inspiratory flow) and did not identify an association between these parameters and compliance to CPAP treatment over a six-month tracking period.

Although nasal surgery may be useful in the reduction of therapeutic pressure in patients who cannot tolerate the use of positive airway pressure devices, the existing controversy between clinical studies suggests that the nose is perhaps only a co-factor in the compliance to CPAP treatment; thus, it is likely that the sum of these co-factors is the determinant in compliance to treatment.

**THE ROLE OF THE NOSE IN COADJUVANT TREATMENT WITH INTRAORAL DEVICES**

The use of intraoral devices for the treatment of OSA has been shown to be another possible therapeutic modality and is indicated principally for mild to moderate cases of the disease, with an evidence level of 1\(^{(2,3,4)}\).

Various predictors of the success of the use of intraoral devices have been reported, such as age, sex, OSAS related to sleeping in the supine position, the basal index of apnea and hypopnea, abnormalities in the curve of
flow and volume, and a series of craniofacial characteristics, such as long jaw, short soft palate, and reduced distance between the hyoid bone and the mandibular plane. Because elevated nasal resistance may exacerbate or even induce apnea in patients with OSAS, it is plausible that the same elevated nasal resistance can negatively affect compliance to treatment with an intraoral device. Further, elevated nasal resistance is associated with oral respiration, which potentially limits the beneficial effects of treatment with this device.  

Only one study in the literature has used rhinometry to evaluate the nasal cavity in patients using intraoral devices. Zeng et al. showed that only the BMI and the nasal resistance were significant predictors of success for the use of intraoral devices for advancing the jaw, suggesting that the nose can interfere with the success of this type of therapy. Moreover, there are no studies in the literature that have studied the relationship between nasal abnormalities and compliance to the use of intraoral devices.

Thus, this area deserves further study, and as yet, no conclusions can be made regarding this subject.

**FINAL COMMENTS**

Clearly, the nose plays an important role in OSAS, whether in the physiopathology of the disease or in the treatment, and the nose can work to attenuate the disease or to facilitate the use of positive airway pressure devices and intraoral devices. In fact, patients with OSAS have higher frequencies of nasal abnormalities compared to controls, suggesting that these abnormalities play some role in the physiopathology of the disease. However, the clinical or surgical treatment of these alterations has been shown to be of limited use in the control of OSAS.

The nose is the point of entry for the upper airway and serves as the interface between patients and positive airway pressure devices, which is the principal modality for the treatment of moderate and severe OSAS. Thus, abnormalities in the nose can impede compliance to these devices. Abnormal studies have shown that it is possible to attenuate therapeutic pressure levels for positive airway pressure devices, which can make their use more comfortable, but studies that measure long-term compliance are lacking. Further, the results studies performing nasal evaluations for patients who were candidates for the use of positive airway pressure devices are not conclusive. Thus, we are only able to conclude that nasal surgeries can reduce therapeutic pressure levels for positive airway pressure devices, but the real benefit for compliance to this modality of treatment over the long term must be further evaluated.

Nasal assessment in patients who are candidates for intraoral devices is a topic rarely addressed in the literature; only one study reported a positive finding, which demonstrates the need for new studies with this focus. This topic is the most insufficiently studied line of research among all of those that involve the nose and OSAS.

**REFERENCES**


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