Nasal Septoplasty in Patients with Obstructive Sleep Apnea Syndrome: Effects on Polysomnographic Parameters

Sergio Henrique Kiemle Trindade1,2, José Vicente Tagliarini1, Inge Elly Kiemle Trindade3, and Silke Anna Theresa Weber1,2*

1Department of Otorhinolaryngology and Head and Neck Surgery Discipline, Medical School of Botucatu, Brazil
2Laboratory for Diagnostic and Therapeutics of Sleep Disordered Breathing, Medical School of Botucatu, Brazil
3Physiology Laboratory Sleep Studies Unit, Hospital for Rehabilitation of Craniofacial Anomalies, Brazil

Abstract

Introduction: The influence of septum deviation on the Obstructive Sleep Apnea Syndrome (OSAS) is controversial. It is believed that septoplasty improves the air flow in the nasal cavities, reducing the resistance of the upper airway and, thus, possibly lowering the severity of OSAS.

Aims: To compare polysomnographic parameters of OSAS patients before and after septoplasty.

Methods: In a preliminary and retrospective study, a comparison was made between the data on type I polysomnography collected from the pre- and postoperative assessments of 23 patients of both genders aged 20-60 years, who suffered from different levels of OSAS and underwent septoplasty. The polysomnographic parameters evaluated were: Apnea and Hypopnea Index (AHI), Obstructive Apnea Index (AI), Hypopnea Index (HI), Sleep Efficiency (SE) and Mean O2 Saturation.

Results: The results showed a tendency towards the decrease of the preoperative AHI (14.6 ± 11.5) compared to the postoperative AHI (9.9 ± 7.3); however, the difference was not statistically significant (p = 0.07). On the other hand, there was a significant decrease in the AI of the preoperative (6.6 ± 5.3) compared to the postoperative (3.4 ± 3.6) assessment (p < 0.005) as well as an improvement in sleep efficiency of the preoperative (81.5 ± 12.8) in relation to the postoperative assessment (85.9 ± 12.5) (p < 0.00). The analysis of the other parameters showed no significant differences.

Conclusion: In this preliminary report, septoplasty showed significant effects on several polysomnographic parameters, with a positive effect on the respiratory aspects and on the sleep macroarchitecture.

INTRODUCTION

The obstructive sleep apnea syndrome (OSAS) is a disorder that has a high prevalence rate. In the earlier literature it was described as affecting 8% of men and 3% of women in the general population [1-3]. In their middle age, around 20 to 50% of men were diagnosed with primary snoring and 26% had milder, but symptomatic forms of OSAS [4]. Recently, in Brazil, a study evaluated the prevalence of OSAS in the population of São Paulo and observed polysomnographic criteria consistent with the diagnosis of OSAS in 32.8% of the adult population [5]. Several studies suggest a possible association between nasal obstruction and OSAS [6-8]. As the nasal cavities are the gateway of the upper airway, their obstruction due to nasal pathologies, such as septum deviation and hypertrophic turbinates, may significantly contribute to the generation of turbulent airflow, inducing a higher resistance in the upper airway and consequently promote the onset of OSAS [9]. Other studies have shown that individuals with chronic nasal obstruction complain of more important daytime sleepiness resulting from sleep fragmentation. The treatment of nasal obstruction significantly improved their daytime sleepiness rates [10]. These findings provide further evidence that the degree of nasal patency plays an important role in the pathophysiology of OSAS and its associated daytime symptoms. Surgical correction of nasal septum deviation (septoplasty) can improve the airflow and reduce the resistance in the upper airway, and thus provide a decrease in the intensity of snoring and of OSAS [11,12]. Other studies have shown that septoplasty increased the adherence of OSAS patients to CPAP (Continuous Positive Airway Pressure) and lowered the optimal pressure levels for treatment [12,13]. Although recent studies have contributed to significant advances in understanding the relationship between nasal obstruction and OSAS [6-8], several aspects still remain controversial. Only few studies have evaluated the effects of the treatment of nasal obstruction in OSAS patients [9-12]. Our hypothesis was that OSAS patients with septum deviation would improve their...
obstructive respiratory disorders and their sleep quality after nasal surgery. Thus, the aim of this study was to evaluate the effects of septoplasty in OSAS patients on objective parameters, which were measured by polysomnography, the gold standard for diagnosis of respiratory sleep disorders. We evaluated the effects of the surgery in patients with nasal obstruction caused by nasal septum deviation, and who concurrently presented with OSAS, on the following polysomnographic parameters: Apnea and Hypopnea Index (AHI), Obstructive Apnea Index (AI), Hypopnea Index (HI), Sleep Efficiency and Mean O₂ Saturation.

**MATERIAL AND METHODS**

In a retrospective study, from January 2006 to January 2007, an investigation was conducted on the pre and postoperative polysomnographic data of 23 OSAS patients, both genders, aged between 20-60 years, who underwent septoplasty. The study was approved by the local Ethics Committee on Research; all patients were located and signed a Written Consent (Protocol 498/2007). The criteria for inclusion were patients with the main complain of nasal obstruction due to nasal septum deviation and indication of nasal septoplasty, who concomitantly had sleep apnea. In this special and selected group of patients we aimed to evaluate the isolated effects of nasal septoplasty on sleep apnea polysomnographic parameters.

Polysomnographies were performed in all patients up to one month before surgery and four months after septoplasty to assess the postoperative effects. After post-operative polysomnographic evaluation, patients who presented clinically significant residual disease underwent complementary treatment. In this selected group of patients, nasal obstruction due to nasal septum deviation could be a major problem in CPAP (continuous positive airway pressure) adaptation. Treatment of nasal obstruction in a clinical setting is a common step when treating sleep apnea patients. Isolated septoplasty in selected patients with primary snoring and mild sleep apnea can be the single treatment modality.

The exclusion criteria: other nasal obstruction factors, such as nasal polyps, hypertrophy of the adenoid and/or of the nasal turbinates; complementary septoplasty surgical treatments, such as turbinectomy, tonsillectomy, or uvulopalatopharyngoplasty; variation in body mass index of more than 2 kg/m² before and after the postoperative control polysomnography, use of CPAP during the second polysomnography; patients with neurological or syndromic craniofacial alterations. Patients with complaints of other sleep problems or only snoring were also excluded. Aspects regarding daytime somnolence were not evaluated in this study.

The septoplasty surgeries were performed by the same senior surgeon, using a similar technique, which varied only according to the types of septal deviations in the patients studied.

The evaluation of the following parameters of the pre and postoperative polysomnographies focused on Apnea and Hypopnea Index (AHI), Apnea Index (AI), Hypopnea Index (HI), Sleep Efficiency and Mean O₂ Saturation.

The respiratory events were analyzed according to the criteria recommended by the Task Force of the 2012 American Academy of Sleep Medicine [14]. Polysomnographic records were obtained before these new criteria established in 2012. In this way all the recordings analyzed in the present study were re-staged in order to set the polysomographic data in accordance with these new criteria recommended. Obstructive apneas were defined as a cessation of airflow greater than 90% for at least 10 seconds accompanied by a breathing effort and hypopneas were defined as a reduced airflow greater than 30% for at least 10 seconds, associated to a desaturation equal or greater than 3% or an arousal. The desaturations were characterized as a fall in peripheral oxygen saturation of at least 3% or more. The classification of OSAS was established according to the apnea and hypopnea index: mild (AHI between 5 and 15), moderate (AHI between 15 and 30) and severe (AHI greater than 30) [14]. Sleep efficiency was calculated using the following formula: total sleep time/total recording time x 100.

After analysis of normal distribution, the paired t-test (two-tailed) was used for statistical comparison of all the variables. The results were considered significant at p < 0.05.

**RESULTS**

A total of 23 patients were analyzed, 18 males, aged between 20 and 60 years, with a mean age of 37.3 ± 14.4 years. Of these, 15 were diagnosed mild OSAS or primary snoring (AHI between 5 and 15, or lower than 5), six moderate OSAS (AHI 15 to 30), and two severe OSAS (AHI > 30).

Regarding the Apnea and Hypopnea Index (AHI), there was a downward trend in the preoperative values (14.6 ± 11.5) in relation to the postoperative values (9.9 ± 7.3) (p < 0.07), but with no statistical significance. For the Apnea Index (AI), a significant decrease from the preoperative values to the postoperative values was noted, ranging from 6.6 ± 5.3 to 3.4 ± 3.7 (p < 0.009*). The analysis of the Hypopnea Index (HI) and Mean O₂ Saturation showed no significant difference between pre and postoperative (9.5 ± 7.7 to 7 ± 4.3 and 94.7 ± 2.2 to 94.8 ± 2.9, respectively) (p > 0.05). However, the measurement of Sleep Efficiency showed a significant increase of the preoperative values compared with the postoperative values, 81.6 ± 12.8% to 85.9 ± 12.6% (p < 0.04*). The results are shown in Table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>SD ±</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-op AHI</td>
<td>14.61</td>
<td>11.52</td>
<td>p &lt; 0.07</td>
</tr>
<tr>
<td>Post-op AHI</td>
<td>9.91</td>
<td>7.32</td>
<td></td>
</tr>
<tr>
<td>Pre-op AI</td>
<td>6.6</td>
<td>5.29</td>
<td>p &lt; 0.05*</td>
</tr>
<tr>
<td>Post-op AI</td>
<td>3.37</td>
<td>3.65</td>
<td></td>
</tr>
<tr>
<td>Pre-op HI</td>
<td>9.51</td>
<td>7.68</td>
<td>p &gt; 0.05</td>
</tr>
<tr>
<td>Post-op HI</td>
<td>7.07</td>
<td>4.30</td>
<td></td>
</tr>
<tr>
<td>Pre-op SE (%)</td>
<td>81.57</td>
<td>12.76</td>
<td>p &lt; 0.05*</td>
</tr>
<tr>
<td>Post-op SE (%)</td>
<td>85.86</td>
<td>12.56</td>
<td></td>
</tr>
<tr>
<td>Pre-op O₂ Sat</td>
<td>94.75</td>
<td>2.18</td>
<td>p &gt; 0.05</td>
</tr>
<tr>
<td>Post-op O₂ Sat</td>
<td>94.80</td>
<td>2.86</td>
<td></td>
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SD: standard deviation
The individual analysis of the data revealed that after septoplasty, the AHI values decreased in 15 patients, nine of which reached normal values after the surgery (AHI < 5). All the patients with severe OSAS showed a decrease in their AHI, maintaining, however, levels that are classified as moderate. In seven patients there was mild increase in their AHI.

Considering sleep efficiency (SE) values greater than 88% as normal [16], only nine patients showed preserved sleep efficiency at first polysomnography. After septoplasty, there was an increase of the SE values in 13 patients, six reaching normal values.

In relation to Mean O₂ Saturation, none of the patients showed a mean value below 90%. Postoperatively, 10 patients showed increase in Mean O₂ Saturation while the remaining patients showed no changes in Mean O₂ Saturation.

**DISCUSSION**

Nasal obstruction is frequent in patients with OSAS, and the presence of septum deviation is a significant cause of nasal complaints in this group of patients [16]. The impact of surgical treatment of nasal obstruction due to septum deviation in patients with snoring and OSAS remains controversial due to the lack of randomized controlled trials that address such aspects.

The rationale for indicating septoplasty in patients with OSAS lies in the fact that the upper airway is similar to a Starling resistor, where the pharynx is the collapsible segment and the nose and the larynx correspond to the two rigid extremities. The greater the resistance to airflow in the fixed segments (nasal cavity and larynx) and the greater the sagging of the flexible segment (pharynx), the more intense is the collapse of the collapsible segment [17,18]. Thus, the association between nasal obstruction and OSAS gains biological plausibility as well as our hypothesis that the decrease of the nasal resistance might reduce the pharyngeal collapsibility and, consequently, the severity of OSAS.

Other factors reinforce the idea that improvement of nasal patency to the airflow can have a positive effect, reducing respiratory events in OSAS. Studies have shown that the nasal mucosa is provided with receptors, sensitive to airflow, which play a role in the ventilation reflex and in the muscle tone of the upper airway [9]. Douglas et al. [19] demonstrated that the minute ventilation volume and the respiratory rate at rest were higher in subjects who were required to breathe only through their nose. A study conducted by McNicholas et al. [20] reported that individuals with no nasal obstruction had higher spontaneous ventilation during exclusively nasal breathing than during exclusively oral breathing. Data on electromyographic studies showed that the tone of the muscles of the upper airway is reduced in oral breathers, suggesting that receptors sensitive to nasal airflow present in the nasal mucosa regulate the patency of the upper airway, characterizing the nasopharyngeal reflex [21].

In addition, the mucosa of the nasal cavity and of the paranasal sinuses produces nitric oxide (NO) [22], which, when inhaled, participates in the regulation of muscle tone, promoting stabilization of the pharyngeal walls and consequently in increasing the patency of the upper airway. In the lungs, nitric oxide acts as a potent vasodilator, promoting the regulation between ventilation and perfusion, thus improving tissue oxygenation [23]. Nasal obstruction and mouth breathing drops the amount of inhaled NO dramatically, reducing the homeostatic actions of this mediator. Despite the evidence of the significant role of NO in the regulation of breathing, its role in the genesis of OSAS is still poorly understood and investigated [24]. In this study, we found that septoplasty caused significant effects on the polysomnographic parameters investigated. For the AHI, still being used as a criterion of severity of the SAOS [14], a clinically important average reduction was noted; however, such reduction did not achieve statistical significance, probably due to the small number of patients enrolled. Nevertheless, the fragmented analysis of respiratory events showed a statistically significant decrease in the average value of the AI in the postoperative assessment after 4 months. Moreover, there was a normalization of the AHI in 9 out of 19 patients with previous mild or moderate OSAS and a significant decrease of the AHI in patients with severe OSAS, but who still required complementary treatment.

Other studies have also verified changes in the AHI after nasal surgery in OSAS patients. Verse et al. [25], concluded that nasal surgeries have some efficacy in patients with respiratory sleep disorders. Considering the criteria of success as a reduction of the AHI of at least 50% the authors reported a 15.8% success rate. Additionally, in the group studied by those authors, there was a decrease in the number of arousals and a significant improvement in daytime sleepiness. Virkula et al. [12], on the other hand, showed that despite the significant improvement in nasal patency after septoplasty, surgery was not effective in reducing the frequency or the intensity of snoring nor improving mean values of O₂ saturation and sleep efficiency. Moreover, Hsueh-Yu Li et al. [26], showed significant improvement in quality of life in OSAS patients who underwent nasal surgery, according to questionnaires on generic and disease-specific quality of life, in which the patients’ emotional, physical, mental, and social aspects were evaluated. The authors also reported preserved sleep efficiency in nine patients at the beginning of the study, according to the criteria of normality [15]. After septoplasty, 13 patients improved their sleep efficiency, six achieving normal values. The mean oxygen saturation improved in 10 patients. However, 50% of the patients showed no significant reductions in the postoperative AHI assessment, requiring complementary treatment. These results also reinforce the need for polysomnography examination after septoplasty in OSAS patients. We consider that despite the importance of surgical treatment of nasal obstruction in the OSAS, the indication of nasal surgery as the only treatment for respiratory sleep disorders must be carefully planned. OSAS patients who may benefit from nasal surgery have to be selected judiciously. Our findings suggest that in patients with mild to moderate OSAS, and that concurrently presents nasal obstruction due to nasal septal deviation, septoplasty may be indicated as an initial treatment, since 50% of these patients obtained a normal AHI after the surgery. In patients with severe OSAS, surgery should be considered as a complementary treatment as, despite the reduction in more than 50% of the initial AHI, their levels were still classified as moderate.

In addition, the data of our study strengthen the need for postoperative follow-up of the OSAS patients submitted to nasal surgeries.

CONCLUSIONS

Nasal septoplasty as a treatment of mild to moderate OSAS patients, that concurrently presents nasal obstruction due to nasal septal deviation, seems to improve sleep respiratory parameters, mostly the apnea index. Moreover, it showed positive effects on the sleep macroarchitecture, significantly increasing sleep efficiency. In patients with severe OSAS septoplasty should only be performed as part of the treatment in patients with nasal obstruction complaints due to nasal septum deviation. Due to the small sample size, this study should be interpreted as preliminary report, and the results should be evaluated cautiously. The inclusion of more patients may confirm the benefits of nasal septoplasty in patients with OSAS.

REFERENCES