Does Anterior Palatoplasty Performed in Addition to Expansion Sphincter Pharyngoplasty During Multilevel Surgery Affect the Results of Surgery in OSAS Patients?

OSAS Hastalarında Çok Düzyeli Cerrahi Srasında Ekspansiyon Sfinkter Faringoplastisine Ek Olarak Yapılan Ön Palatoplasti Ameliyatı Sonuçlarını Etkiler mi?

**ABSTRACT**

**Objective:** Multilevel surgery (MLS) has become one of the most preferred surgical methods for the treatment of obstructive sleep apnea syndrome (OSAS).

In this study, we aimed to present our results for MLS together with modified expansion sphincter pharyngoplasty (MESP) for the treatment of OSAS. We also investigated whether performing anterior-palatoplasty (AP) affected surgical results in these patients.

**Methods:** Fifty patients diagnosed with moderate-to-severe OSAS after polysomnography (PSG) were prospectively included in the study. The patients underwent MLS comprising; nasal surgery, MESP, and ablation of the tongue base with radiofrequency. In addition, AP was performed in 30 patients. Surgical success was determined using PSG data and Epworth sleepiness scale (ESS) scoring performed before and after surgery.

**Results:** There was a statistically significant improvement in ESS scores and postoperative PSG findings compared with preoperative means (p<0.001). Surgical success was achieved in 40 patients (80%) according to the Sher criteria. Surgical success ratio revealed exactly the same (p=1.000) compared with the patients who were not performed AP. Preoperative apnea index, apnea/hypopnea index (AHI), and supine AHI were significantly higher in surgically unsuccessful cases (p<0.05).

**Conclusion:** MLS, including MESP, performed together with nasal surgery and tongue base RF is an alternative procedure in the surgical treatment of OSAS with a postoperative success rate of 80%, according to our study results. In addition to MESP, AP may not affect the results of multilevel surgery.

**Keywords:** Obstructive sleep apnea syndrome, multilevel surgery, expansion sphincter pharyngoplasty and anterior palatoplasty
INTRODUCTION

Obstructive sleep apnea syndrome (OSAS) is a serious disease that may cause systemic side effects. Patients with untreated moderate-to-severe OSAS may suffer severe cardiovascular and central nervous system disorders and neurocognitive, psychiatric, and social problems (1); therefore, OSAS should always be diagnosed and treated promptly. Positive airway pressure (PAP) therapy is an effective treatment modality for patients with moderate-to-severe OSAS; however, the high number of patients who refuse or cannot tolerate PAP treatment poses a significant challenge (2). Various surgical procedures and oral appliances serve as alternative treatment methods for these patients.

There is an ongoing discussion in the literature regarding the appropriate surgical treatment modality for OSAS. Recurrent obstruction in the upper airway occurring during sleep is the major cause of OSAS symptoms. Therefore, single or multiple obstruction levels in the upper airway can be addressed in OSAS surgery. The efficiency of multilevel surgery (MLS) has been supported by various clinical studies in recent years (3). Multilevel OSAS surgery is a combination of surgical procedures addressing the nasal cavity, pharyngeal isthmus, and base of the tongue (4,5). However, there is still no consensus on the type of surgical procedure.

In most patients, OSAS symptoms are aggravated in the supine position because of nasopharyngeal, oropharyngeal, and hypopharyngeal collapse. Therefore, more than half of OSAS patients are supine position dependent (6). Evaluation of postoperative surgical success differs in clinical studies. Some authors suggested that the number of preoperative apnea and the presence of tonsillectomy in OSAS surgery are the main determinants of surgical success (7). AP is performed to reduce anterior-posterior collaps at the level of the soft palate (8). MESP is performed to reduce lateral pharyngeal collapse in patients with OSAS. MESP also provides anterior, superior, and lateral expansion at the level of the soft palate (9). In the literature, MLS is applied in various ways. However, no study has demonstrated the contribution of AP procedure performed together with MESP during MLS on surgical success. In this study, we aimed to investigate the effectiveness of a multilevel surgical modality comprising nasal surgery, modified expansion sphincter pharyngoplasty, and tongue base radiofrequency for the treatment of OSAS. We also investigated whether it changes the surgical results in patients in whom AP was added during MLS for the first time.

Surgical procedure

All patients underwent classical closed technique septoplasty, lower turbinate radiofrequency, and out-fracture. Thus, nasal obstruction was eliminated. Oropharyngeal surgery consists of modified expansion sphincter pharyngoplasty (MESP) and tongue base...
ablation with radiofrequency and anterior palatoplasty, if required.

Modified expansion sphincter pharyngoplasty (MESP); was performed as previously described by Ulualp (12). Tonsillectomy was performed using bipolar electrocautery. The palatopharyngeus muscle was identified and dissected from the tonsillectomy cavity after cutting the lower end. The free end of the palatopharyngeus muscle was then rotated superolaterally through the submucosal pocket created in the soft palate and fixed to the pterygoid hamulus with a mattress suture. We added AP operation in patients whose retropalatal plane could not achieve adequate anterior posterior expansion with MESP.

Anterior palatoplasty: Mucous and submucosa were removed in a rectangular approximately 3x2 cm² area is removed from the middle of the soft palate. The incision line was closed afterward as described by Pang et al. (8). Radiofrequency ablation of the tongue base was performed. The tongue base was given 500-700 joules of radiofrequency energy through three selected points, one around the circumvallate papilla of the midline and two points one cm lateral to this one (13).

Statistical Analysis

SPSS version 20.0 (IBM Inc., Chicago, IL, USA) was used for statistical analysis. Descriptive statistics are presented as mean ± standard deviation. Continuous variables were tested for normality using the Shapiro-Wilk test. Categorical variables were compared using the chi-square test. Paired samples t-test was used to compare parametric variables. The Wilcoxon signed rank test was used to compare pre-operative and postoperative PSG findings. Spearman correlation analysis was used to investigate the relationship between various PSG parameters and surgical success. P<0.05 was considered statistically significant.

RESULTS

Ten females (20%) and 40 males (80%), 50 patients, were included in the study. The mean age of the subjects was 42.1±11.0 years. Preoperative demographic data are shown in Table 1. The mean BMI before and after surgery were found to be 29.1±3.3 and 28.3±4.5, respectively (p=0.083). Preoperative and postoperative PSG data were compared between surgically successful and unsuccessful cases. Preoperative AI, AHI, and supine AHI were significantly higher in the surgically unsuccessful group (Table 3). Likewise, the relationship between preoperative PSG data and surgical success was analyzed using Spearman correlation analysis. Preoperative AHI (r=-0.326, p=0.021) supine AHI (r=-0.392, p=0.005), and apnea index (r=-0.345, p=0.014), were found to be weakly and negatively correlated with surgical success. We did not observe any major morbidity such as severe infection or compromised airway postoperatively. Six patients (12%) developed mild bleeding from the tonsillectomy cavity in the second postoperative week, which was managed with bipolar electrocauterization after local anesthesia. Only one patient required general anesthesia. Two patients (4%) suffered velopharyngeal insufficiency for one month postoperatively.

DISCUSSION

The need for MLS in the same session is evident, especially in patients with multilevel obstruction, and it accounts for more than 60% of OSAS patients. Many surgical procedures described for the treatment of OSAS are available in the literature. Surgical treatment is considered especially in patients who refuse or cannot tolerate PAP treatment regularly. In our clinic, PAP treatment was recommended as the primary treatment for patients diagnosed with moderate to severe OSAS, and some of them were titrated. Surgical treatment was offered to patients who refused or could not tolerate

<table>
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<th>Table 1. Demographic features of the patients</th>
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<tr>
<td>Age</td>
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<tr>
<td>Gender (male/ female)</td>
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<td>BMI</td>
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<td>Epworth sleepiness scale</td>
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BMI: Body mass index, SD: Standard deviation.

postoperatively. The mean pre-operative and postoperative ESS scores were shown to be 17.4±5.2 and 6.6±4.4, respectively (p<0.001). There was a statistically significant improvement in all postoperative PSG findings compared the preoperative means (p<0.001, Table 2). Surgical success based on the Sher criteria was achieved in 40 (80%) patients. The surgical success ratios were 90% and 77.5% in females and males, respectively. No statistically significant difference was found between genders (p=0.377). Likewise, no significant difference was found between patients with moderate and severe OSAS in terms of surgical success (p>0.05). Thirty (60%) patients additionally underwent anterior palatoplasty. The surgical success ratio was the same (p=1.000) compared with the patients who didn’t undergo anterior palatoplasty. Preoperative ESS and PSG data were compared between surgically successful and unsuccessful cases. Preoperative AI, AHI, and supine AHI were significantly higher in the surgically unsuccessful group (Table 3). Likewise, the relationship between preoperative PSG data and surgical success was analyzed using Spearman correlation analysis. Preoperative AHI (r=-0.326, p=0.021) supine AHI (r=-0.392, p=0.005), and apnea index (r=-0.345, p=0.014), were found to be weakly and negatively correlated with surgical success. We did not observe any major morbidity such as severe infection or compromised airway postoperatively. Six patients (12%) developed mild bleeding from the tonsillectomy cavity in the second postoperative week, which was managed with bipolar electrocauterization after local anesthesia. Only one patient required general anesthesia. Two patients (4%) suffered velopharyngeal insufficiency for one month postoperatively.

<table>
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<th>Table 2. Preoperative and postoperative PSG findings and ESS scores</th>
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<tr>
<td>AHI</td>
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<tr>
<td>Supine AHI</td>
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<td>REM AHI</td>
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<tr>
<td>pO2 desaturation ratio</td>
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<tr>
<td>Hypopnea index</td>
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<td>Apnea index</td>
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<td>Snoring loudness (dB)</td>
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*Wilcoxon signed rank test, PSG: Polysomnography, ESS: Epworth sleepiness scale, AHI: Apnea/hypopnea index.
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Table 3. Comparison of preoperative BMI, ESS, and PSG data between surgically successful and unsuccessful patients

<table>
<thead>
<tr>
<th></th>
<th>Successful</th>
<th>Unsuccessful</th>
<th>p-value</th>
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<tbody>
<tr>
<td>BMI</td>
<td>29.2±3.5</td>
<td>28.2±2.5</td>
<td>0.406*</td>
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<tr>
<td>ESS</td>
<td>17.2±5.2</td>
<td>18.2±5.5</td>
<td>0.723*</td>
</tr>
<tr>
<td>AHI</td>
<td>28.9±12.7</td>
<td>48.2±21.7</td>
<td>0.023*</td>
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<tr>
<td>Supine AHI</td>
<td>41.7±18.3</td>
<td>62.5±22.9</td>
<td>0.006*</td>
</tr>
<tr>
<td>REM AHI</td>
<td>23.1±13.4</td>
<td>32.5±25.3</td>
<td>0.376*</td>
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<tr>
<td>ODI</td>
<td>16.3±12.0</td>
<td>25.4±17.9</td>
<td>0.087*</td>
</tr>
<tr>
<td>Hypopnea index</td>
<td>13.6±6.0</td>
<td>18.9±11.7</td>
<td>0.280*</td>
</tr>
<tr>
<td>Apnea index</td>
<td>15.4±9.5</td>
<td>26.6±13.6</td>
<td>0.016*</td>
</tr>
<tr>
<td>Snoring loudness (dB)</td>
<td>73.0±5.2</td>
<td>73.9±5.2</td>
<td>0.472*</td>
</tr>
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</table>

*Mann-Whitney U-test, **Independent samples t-test, PSG: Polysomnography, ESS: Epworth sleepiness scale, AHI: Apnea/ hypopnea index, BMI: Body mass index.

PAP treatment.

MLS has been widely discussed among various surgical procedures for the treatment of OSAS. Clinical studies investigating the efficiency of MLS in OSAS treatment have increased in recent years (14,15).

The role of nasal surgery in sleep surgery is controversial. Septoplasty is most commonly performed to attenuate snoring or reduce resistance to PAP therapy. If patients undergo a multilevel surgery, nasal surgery must be considered as a part of it (16). In this study, we did not perform nasal surgery before the PSG study in cases of OSAS suspicion. If we offer PAP treatment after the PSG study, nasal surgery may reduce nasal resistance to PAP therapy. In case of patient refusal or intolerance to PAP treatment, we perform nasal surgery as part of the multilevel surgical treatment. Therefore, we believe that this approach is useful in terms of time, cost, and patient comfort. We most commonly perform endonasal septoplasty, inferior turbinate RF, lateralization, and concha bullosa surgery as a part of nasal surgery in multilevel OSAS surgery. Binar et al. (17) reported the results of a single-stage MLS addressing velopharyngeal and hypopharyngeal levels for OSAS surgery. The tongue base is one of the obstruction levels in OSAS; radiofrequency ablation of the tongue is a minimally invasive procedure used to target this obstruction level in OSAS surgery (13,18). Therefore, we performed radiofrequency ablation of the tongue base as part of MLS. We did not observe any significant complications that can be seen after tongue base surgery, including infection, hematoma, or hypoglossal nerve paralysis.

A multi-factor regression analysis conducted in the study of 144 MLS participants revealed that surgical success was mostly affected by preoperative AHI and tonsillectomy (7). We performed tonsillectomy in all 50 patients who underwent multi-level surgery. In contrast, in the correlation analysis, the most important parameter affecting surgical success was found to be preoperative AHI in our study.

Expansion sphincter pharyngoplasty has been successfully performed as a part of OSAS surgery since its introduction by Pang and Woodson (19) in 2007 (20). It is based on the anterolateral rotation and hanging of the palatopharyngeal muscle after classical tonsillectomy. Later, MESF modifications were developed (12,20). Lorusso et al. (21) reported a success rate of 65% in their series of 20 patients who underwent MLS with expansion sphincter pharyngoplasty. The surgical procedure we performed was MESF as described by Ulualp (12).

The reported results of surgical success for multilevel OSAS surgery vary between 42% and 78% in the literature (4). It has been shown that MLS is consistent with single-level surgeries in terms of reliability; therefore, they are preferable surgical modalities. Lin et al. (22) reviewed 49 articles regarding MLS for OSAS. The surgical success rate for MLS was found to be 66.4% after re-calculation of the findings of those studies. We performed a standard full-night PAP test at the same sleep center before and after the surgical procedure in our clinic. According to Sher’s criterion, 80% of our cases achieved surgical success in the early postoperative period (mean: 5.2 range: 3-8 months). In addition, symptomatic improvement in all patients was demonstrated by ESS.

Various postoperative complications may develop after OSAS surgery. The largest series on this issue is a review study of 487 cases. In this study, the postoperative complication rate has not been shown to increase in MLS (15). In our case series, all patients were hospitalized for one night postoperatively. No major complications or severe respiratory problems were observed. Six patients (12%) developed mild bleeding from the tonsillectomy cavity, and two patients (4%) suffered velopharyngeal insufficiency for one month postoperatively.

Anterior palatoplasty is a simple and effective method for the treatment of mild-to-moderate OSAS and can be a part of single-stage MLS for OSAS (8). Pang et al. (23) showed that the combination of expansion pharyngoplasty and anterior palatoplasty is a better surgical option than uvulopalatopharyngoplasty. However, in the literature, there is no study comparing the cases in which AT and MESF operations were performed together with the cases in which only MESF was performed. For the first time in this study, the addition of AP to the MESH operation in our MLS procedure did not provide any additional benefit for surgical success.

CONCLUSION

In conclusion, we achieved 80% surgical success in our series of 50 patients who underwent MLS including MESF, nasal surgery, and RF reduction of the tongue base for the treatment of moderate-to-severe OSAS. This type of surgery is a reliable and successful alternative to PAP treatment. In addition to MESF, anterior palatoplasty did not affect the results of MLS in patients with moderate-to-severe OSAS. Therefore, we claim that for moderate-to-severe OSAS cases with prominent retropalatal obstruction, anterior palatoplasty does not provide additional surgical success when performed together with expansion sphincter pharyngoplasty for OSAS treatment. We believe that further studies investigating the efficiency of MLS may be helpful in predicting the short- and long-term results for MLS in OSAS treatment and to clearly reveal the criteria affecting surgical success.

Ethics

Ethics Committee Approval: This study was performed by the Gazi University Faculty of Medicine, Department of Otorhinolaryngology.
between 2015 and 2020. This study was approved by the Gazi University Local Ethics Committee (approval number: 549, date: 07.09.2020).

Informed Consent: It was obtained.

Peer-Review: Externally peer-reviewed.

Authorship Contributions

Conflict of Interest: No conflict of interest was declared by the authors.

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REFERENCES