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Limited palatal muscle resection with tonsillectomy: A novel palatopharyngoplasty technique for obstructive sleep apnea

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ABSTRACT

Objective: The ideal palatal surgery for obstructive sleep apnea (OSA) and snoring must maintain the airway patency and correct anatomic abnormalities without complications. The purpose of this study was to investigate the efficacy of limited palatal muscle resection (LPMR) to improve OSA severity.
Subjects and methods: Twenty-three patients with OSA underwent LPMR. The LPMR was initiated with a bilateral tonsillectomy in patients with tonsil size 2 and 3. The LPMR consisted of partial resection of palatal muscles (levator veli palatini, palatoglossus, and musculus uvulae) with preservation of the uvula and a simple double layer suturing. The retropalatal space and the length of soft palate were evaluated by magnetic resonance imaging. Subjective outcomes using visual analog scales, Epworth Sleepiness Scale, and overnight polysomnography (PSG) data were assessed.
Results: Six months after the operation, there was significant symptomatic improvement in snoring, morning headaches, tiredness, and daytime sleepiness. Postoperative magnetic resonance images showed upward and forward movement of uvula and soft palate after LPMR. The length of the soft palate was significantly shortened and the retropalatal space was significantly increased. Postoperative PSG revealed significant improvement in apnea–hypopnea index (AHI) and the total sleep time spent with oxygen saturation below 90%, and reduction in AHI following PMR was found in all patients. Furthermore, no patient experienced velopharyngeal insufficiency, voice changes, and pharyngeal dryness at 6 months follow-up.
Conclusions: The LPMR obtained significant improvement in subjective and objective outcomes in OSA, with preserved pharyngeal function. PMR is an effective and safe technique to treat oropharyngeal obstruction in OSA surgery.

1. Introduction

The ultimate goal of surgical treatment for obstructive sleep apnea (OSA) is to improve symptoms and decrease cardiovascular morbidity and mortality by correcting anatomic obstruction and decreasing pharyngeal collapsibility [1]. Upper airway abnormalities amenable to surgery include those within nasal cavity, nasopharynx, oropharynx, and hypopharynx [2].

The oropharynx is one of the major areas of obstruction in the upper airway contributing to OSA. Consequently, uvulopalatopharyngoplasty (UPPP) that consists of removal of palatine tonsil, uvula, a portion of the soft palate, and the lateral pharyngeal wall is the most common surgical procedure performed for the treatment of OSA [3]. Although subjective improvement of symptoms including excessive daytime sleepiness and snoring is common [4], the response rate on objective assessment based on polysomnography (PSG) has been no greater than 50% [3,5]. Furthermore, UPPP has been associated with complications such as velopharyngeal insufficiency and nasopharyngeal stenosis [6,7]. Therefore, many modifications of UPPP have been proposed to

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contend with anatomical variations of the pharynx and minimize morbidities [8–12].

The soft palate is a complex structure composed of numerous pharyngeal muscles and connective tissues. The soft palate and uvula play an important role in the pathogenesis of OSA, however their function seems to be associated with oropharyngeal mucosa humidification [13,14]. Since the feeling of dryness in the throat is one of the most frequent complaints after UPPP, modifications in the original standard surgical technique, such as Han-UPPP [15], lateral pharyngoplasty [9], transpalatal advancement pharyngoplasty [12], and palatal implant [16], in order to preserve the uvula have been described.

The purpose of this study was to present the authors' preliminary results in the treatment of OSA patients using the technique known as limited palatal muscle resection (LPMR), which involves advancement and stiffening of the soft palate.

2. Subjects and methods

2.1. Patient selection

This study was approved by the Institutional Review Board of Pusan National University Hospital, and conducted from June 2010 to April 2011.

2.1.1. Inclusion criteria

Twenty-three consecutive patients who met all inclusion and exclusion criteria were considered candidates for LPMR. They must have experienced significant clinical symptoms of snoring, morning headaches, tiredness, daytime sleepiness and have been diagnosed with OSA, with an apnea–hypopnea index (AHI) >5 events/h.

All patients failed to respond to conservative measures, such as changes in sleep position and sleep hygiene, and were either intolerant or unwilling to use continuous positive airway pressure therapy.

2.1.2. Anatomic criteria for LPMR

Anatomic criteria for selection of LPMR candidates included (1) redundant posterior pharyngeal mucosa with formation of folds and low-hanging soft palate in the physical examination, (2) collapse of retropalatal space of 50% or more in midazolam-induced sleep endoscopy, and (3) classification of all patients as Friedman stage I and II [17] with Friedman tongue position I, II, or III and tonsil size 1, 2, or 3 (Table 1).

Table 1
Demographic characteristics of the OSA patient for LPMR.

Age (years)	36.8 ± 8.7
BMI (kg/m^2)	24.5 ± 5.6
AHI (events/h)	32.0 ± 10.2
FTP	
I	4 (17.4)
II	14 (60.9)
III	5 (21.7)
Tonsil size	
1	4 (17.4)
2	6 (26.1)
3	13 (56.5)
Stage	
I	12 (52.2)
II	11 (47.8)

Data are expressed as the number (percentage) except age, BMI, and AHI (mean ± SD). Bilateral tonsillectomy was performed only in patients with tonsil size 2 and 3. AHI: apnea–hypopnea index; BMI: body mass index; FTP: Friedman tongue position; PMR: palatal muscle resection.

2.1.3. Exclusion criteria

Subjects older than 60 years, morbid obesity (BMI > 35 kg/m^2), gross maxillary and mandibular deformities (mainly retrognathia) by the lateral cephalometry, macroglossia, and suggested presence of hypopharyngeal narrowing during midazolam-induced sleep endoscopy were excluded. Macroglossia was determined by the Friedman tongue position IV allowing the visualization of the hard palate only, and hypopharyngeal narrowing was defined by partial or complete obstruction of the hypopharynx and a portion of the oropharynx posterior to the tongue.

2.2. Surgical procedure

All the procedures were performed by the same surgeon under general anesthesia with oral endotracheal intubation. The patient was placed in the supine position and operative exposure was obtained with a Dingman mouth gag (Pilling Instrument CO., Philadelphia, PA). The LPMR was initiated with a bilateral tonsillectomy in patients with tonsil size 2 and 3. Tonsillectomy was not performed in patients with tonsil size 1, implying tonsils hidden within the pillars. The areas to be surgically excised were injected with small amounts of epinephrine (1:100,000) solutions (Fig. 1A). Oval shaped incision was designed using the monopolar electrocautery with a fine needle tip (Fig. 1B). The boundaries of resection were as follows: superior margin was 2 cm posterior to the hard–soft palate junction, inferior margin was the base of the uvula, and lateral margin was the superior extension of an imaginary line from tonsillar anterior pillar (Fig. 1C). The tissue in the oval shaped area including mucosa, submucosal adipose tissue, and partial layer of palatal muscles (levator veli palatini, palatoglossus, musculus uvulae) were dissected from the underlying muscles and removed using the monopolar electrocautery with a fine needle tip. The levator veli palatini was resected partially and superficially, with preservation of the deep layer (Fig. 1D). The palatal muscle was grasped and approximated with 2-0 Vicryl (Ethicon, Somerville, NJ) through an interrupted suture (Fig. 1E). Finally, simple suture of incised mucosal margin was done with 2-0 Vicryl (Fig. 1F).

2.3. Outcomes assessment

Each patient was evaluated preoperatively and at 6 months after the surgery. Outcome measures included subjective improvement in OSA-related symptoms based on the VAS and improvement in sleepiness as indicated by the Epworth Sleepiness Scale. Subjective OSA symptom scores were assessed with VAS ranging from 0 (irrelevant) to 10 (severely affected) for snoring, morning headache, tiredness, and daytime sleepiness. Bed partners of all subjects were requested to participate in the latter measurement.

The distance between the tip of uvula and posterior pharyngeal wall and the length of soft palate were evaluated in 10 patients who completed the magnetic resonance imaging preoperatively and at 6 months after surgery (Fig. 2).

Objective changes were assessed by the polysomnographic findings. Polysomnographic variables included the AHI, average oxygen saturation, minimal oxygen saturation, and the cumulative percentage of the total sleep time spent with oxygen saturation below 90% (CT90).

2.4. Statistical analysis

Data were presented as mean ± SEM. The data were analyzed using SPSS for Windows (version 16.0; SPSS Inc., Chicago, IL). Changes

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