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Gustatory Function after Radiofrequency Tongue Base Reduction in Patients with Obstructive Sleep Apnea

Young Gyu Eun, MD, PhD1, Seung Youp Shin, MD, PhD2, Jae Yong Byun, MD, PhD2, Myung Gu Kim, MD, PhD1, Kun Hee Lee, MD, PhD2, and Sung Wan Kim, MD, PhD2

No sponsorships or competing interests have been disclosed for this article.

Abstract

Objectives. To investigate the changes in gustatory function as a complication after radiofrequency tongue base reduction (RTBR) in patients with obstructive sleep apnea (OSA).


Setting. Academic tertiary medical center.

Subjects and Methods. Thirty-four patients with suspected velopharyngeal collapse only underwent uvulopalatopharyngoplasty (UPPP group). Twenty-five patients with velopharyngeal and retrolingual collapse underwent concurrent UPPP with RTBR (RTBR group). All patients were evaluated before surgery and at 1 and 4 weeks after surgical treatment. A questionnaire was given to assess symptoms of hypogeusia, dysgeusia, hyposmia, and sensation of the tongue. Electrogustometry (EGM) in 4 areas was used to determine gustatory function.

Results. Postoperative values for subjective symptoms did not significantly change following surgical treatment in either group. EGM thresholds of all tested in both groups did not significantly change 1 week and 4 weeks after surgery.

Conclusions. Gustatory function remained unchanged after RTBR in patients with OSA. The authors suggest that RTBR is a safe procedure in terms of taste sensation in OSA patients.

Keywords

obstructive sleep apnea, radiofrequency, tongue base, surgery, gustatory function

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Obstructive sleep apnea (OSA) is very common and is increasingly recognized as a major health problem.1 Although a variety of surgical techniques have been described to manage OSA, multilevel pharyngeal surgery is required to overcome collapse at multiple levels of the pharyngeal airway. Among the currently available tongue base procedures that alleviate lower pharynx obstruction, radiofrequency tongue base reduction (RTBR) is being widely used because of its minimal invasiveness and simplicity.2-8 There are reported complications after RTBR, such as ulceration, hematoma, dysphagia, abscess, and change of taste.7-9 Gustatory dysfunction can lead to significant distress and can alter food choices and patterns of consumption, resulting in weight loss and compromising quality of life.10 There are reports on gustatory dysfunction following surgery (eg, palatal surgery, tonsillectomy, microaryngoscopy, and otologic surgery).10-15 The causes of gustatory dysfunction after oropharyngeal surgery for OSA may include damage to the lingual branch of the glossopharyngeal nerve, excessive excision of taste receptors on the soft palate, mechanical pressure to the tongue, or lack of dietary zinc.14 Gustatory dysfunction as a complication following surgery for OSA has been rarely reported in the literature. Four studies reported that gustatory dysfunction comprised 4.6% to 10% of all postuvulopalatopharyngoplasty (UPPP) complications.16 To the best of our knowledge, there are no reports on gustatory outcomes following surgery of the tongue base for OSA. Among various gustatory function tests (the 3-drop method, impregnated taste strips, electrogustometry, spatial taste test, and anesthesia of localized tongue surface regions), electrogustometry (EGM) is a quicker and more reliable, objective, and quantifiable method.17 The aim of this study is to investigate the changes in gustatory function as a complication after RTBR in patients with OSA.
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**Methods**

**Subjects**

This is a prospective controlled study of 59 OSA patients consecutively treated with surgery at the Kyung Hee University Hospital. All patients were preoperatively evaluated through history taking, physical examination, cephalometry, fiber optic nasopharyngoscopy with Mueller’s maneuver, and an overnight polysomnography. Patients with an apnea-hypopnea index <5; age <18 years; taste or olfactory dysfunction history; previous surgical history such as tonsillectomy, otologic surgery, microlaryngoscopy, or OSA surgery; and head and neck cancer history were excluded. Surgical procedures were chosen based on the presence of velopharyngeal airway or retrolingual airway narrowing of the tongue base on cephalometry and fiberoptic nasopharyngoscopy during Mueller maneuver. Patients with only velopharyngeal collapse underwent UPPP and constituted the UPPP group. Patients with velopharyngeal and retrolingual collapse underwent concurrent UPPP and RTBR and constituted the RTBR group. Blood tests for zinc, which is related to the taste function, were also performed before surgery and 4 weeks after surgery. This study was approved by the institutional review board of Kyung Hee University Hospital.

**Surgery**

In the UPPP procedure, tonsillectomy was performed first with electrocautery (setting: cutting and coagulation; power: 20), and the oral soft palate mucosa and submucosa were then debrided, preserving as much of the palatopharyngeus, palatoglossus, and uvula muscles as possible. The uvular tip was trimmed prior to reflecting the palate anteriorly and superiorly. The denuded flap was made by cold knife dissection and imbricated and sutured to the residual mucosa of the soft palate. The approximation of posterior and anterior pillars was achieved by sutures with maximal lateralization for creating more retropalatal airway space. RTBR was performed using a CelonProSleep (Celon AG Medical Instruments, Berlin, Germany) to accomplish stiffening and volume reduction of the tongue base. A total of 9 lesions were selected for treatment. Three of these lesions were at the midline of the circumvallate papillae and were 1 cm anterior and posterior to the middle of the circumvallate papillae. The next 6 lesions were 1 cm right or left of the first 3 lesions. The setting on the probe tip. The delivery energy at this power setting was approximately 60 J per punctum. All surgical procedures were performed by a single surgeon (S.W.K.). The time of using the McVor mouth retractor during surgery was recorded. The time of using the stainless steel probe, as previously described.8 An ascending threshold procedure was used to measure the threshold. A 500-millisecond anodal stimulation was presented unilaterally, beginning at ~8 dB and proceeding to 34 dB. The value of the lowest stimulation for which the metallic or sour taste perceived was recorded, and the value obtained after applying a stimulus 3 times with 2 positive answers was defined as the threshold value.

**Statistical Analysis**

Data are expressed as the mean ± standard deviation (SD) for normally distributed data. All statistical analyses were performed using SPSS for Windows, version 11.5 (SPSS, Chicago, Illinois). Differences between groups were assessed by independent t tests. Paired t tests were used to compare the changes after surgery. The difference in the proportion of subjective hypogeusia between both groups was assessed by Fisher exact test. Statistical significance was defined as P < .05.

**Results**

There were 34 patients (32 men and 2 women) in the UPPP group and 25 patients (21 men and 4 women) in the RTBR group. The 2 groups were similar in terms of age and tongue height. Some patients do not recognize a metallic taste but only a touch sensation of the probe. To avoid this technical error, patients were first acquainted with the feel and faint taste of the stainless steel probe, as previously described.9 An ascending threshold procedure was used to measure the threshold. A 500-millisecond anodal stimulation was presented unilaterally, beginning at ~8 dB and proceeding to 34 dB. The value of the lowest stimulation for which the metallic or sour taste perceived was recorded, and the value obtained after applying a stimulus 3 times with 2 positive answers was defined as the threshold value.

**Gustatory Testing**

All patients were evaluated before surgery and at 1 and 4 weeks after surgical treatment. A questionnaire was given to assess subjective symptoms of hypogeusia, dysgeusia, hyposmia, and sensations of the tongue using a traditional 10-cm visual analog scale (VAS) that ranged from 0 (no problem) to 10 (severe problem).

EGM was used to assess gustatory function. EGM analysis was performed using EG-IIB (Nagashima Medical Instrument Co, Tokyo, Japan) with a single, flat, circular stainless-steel stimulus probe (5-mm diameter). Subjects were asked not to eat or drink anything except water 1 hour before testing. The stimulus rod was placed on the tongue with the stimulus probe resting 2 cm laterally from the anterior midline and 2 cm from the tip of the tongue (region dominated by the chorda tympani nerve) and the most lateral circumvallate papillae visible (region dominated by the glossopharyngeal nerve). In normal subjects, electric stimulation usually causes a metallic taste. At the beginning of the electrogustometric threshold measurement, some patients do not recognize a metallic taste but only the touch sensation of the probe. To avoid this technical error, patients were first acquainted with the feel and faint taste of the stainless steel probe, as previously described.9 An ascending threshold procedure was used to measure the threshold. A 500-millisecond anodal stimulation was presented unilaterally, beginning at ~8 dB and proceeding to 34 dB. The value of the lowest stimulation for which the metallic or sour taste perceived was recorded, and the value obtained after applying a stimulus 3 times with 2 positive answers was defined as the threshold value.
experienced mild hypogeusia (all 1 or 2 score on the 10-cm VAS) before surgery. Seven patients (20.6%) in the UPPP group and 2 patients (8%) in the RTBR complained of postoperative hypogeusia (all 1 or 2 score on the 10-cm VAS). There was no significant difference in the proportion of postoperative hypogeusia between both groups ($P = .278$). Postoperative values for other subjective symptoms did not significantly change after surgical treatment in either group (Table 2).

EGM results of all tested sites of the tongue before and after surgery are presented in Table 3. Results indicated no significant difference in thresholds between the UPPP group and the RTBR group before surgery and at 1 week and 4 weeks after surgery. No tested sites of the tongue in both groups were significantly changed at 1 week and 4 weeks after surgery.

**Discussion**

We evaluated change in gustatory function after RTBR in patients with OSA and did not find significant change in gustatory function 1 week and 4 weeks after surgery.

We tested the gustatory function at both anterior and posterior sides using EGM. Chemosensory-based gustatory testing is useful in the research setting for testing taste, but it is time-consuming and cumbersome.\(^{18,19}\) EGM has emerged as a quick, repeatable, and quantifiable method of assessing taste.\(^{18,19}\) Its reliability and validity have been evaluated in previous clinical studies.\(^{20,21}\)

Radiofrequency application to achieve coagulation effect at the tongue base tissue can injure taste bud or sensory nerves. The causes of gustatory dysfunction after RTBR may include mechanical pressure to the tongue by the retractor and combined palatopharyngeal surgery. Li et al\(^{12}\) reported that 4.6% of patients lost at least 1 of the 4 basic tastes after palatopharyngeal surgery for OSA. In another study, gustatory dysfunction comprised 7% to 10% of all UPPP complications. Also, tonsillectomy, which is included in UPPP, can cause gustatory dysfunction.\(^{13,14}\) Postoperative gustatory dysfunction after tonsillectomy or UPPP could be caused by direct or indirect injury to the lingual branch of the glossopharyngeal nerve or by lack of dietary zinc.\(^{14}\) To exclude the effect of UPPP, we chose patients who underwent UPPP combined with RTBR as the subject group and patients who underwent only UPPP as the control group. Transient and reversible gustatory dysfunction can be caused by mechanical pressure of the tongue.\(^{35}\)

In this study, tongue compression time was similar between both groups. We could therefore exclude the tongue compression effect. Zinc deficiency is often seen in patients with dysgeusia.\(^{22}\) Taste disturbance due to dietary zinc deficiency provoked by tonsillectomy has also been reported.\(^{14}\) However, serum zinc levels were within the normal range before and after surgery in both groups.

The mean VAS scores of subjective symptoms did not change significantly after surgery in both groups. Twenty percent of the UPPP group and 8% of the RTBR group experienced postoperative hypogeusia. They complained of slight hypogeusia with a score of 1 or 2. In the present study, the EGM thresholds in both groups remained unchanged at 1 week and 4 weeks after surgery. To the best of our knowledge, this study is the first study to investigate changes in gustatory function after RTBR in patients with OSA. The present study showed that radiofrequency application at the tongue base might result in subjectively slight taste dysfunction, and the outcomes suggest that in terms of taste, RTBR is a safe procedure when performed in the midline of the tongue.

This study has several limitations. First, the study population was not large. Although this study did not have a large population, the results might be clinically significant because no confidence interval for changed score contained significant values. Second, the questionnaire used for subjective symptoms was not validated in this survey. Although there is no

### Table 1. Comparison of Age, Zinc Level, and Tongue Compression Time

<table>
<thead>
<tr>
<th></th>
<th>UPPP Group</th>
<th>RTBR Group</th>
<th>PValue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>36.3 ± 12.6</td>
<td>42.7 ± 13.4</td>
<td>.062</td>
</tr>
<tr>
<td>Zinc, µg/dL</td>
<td>98.2 ± 18.9</td>
<td>94.2 ± 9.9</td>
<td>.501</td>
</tr>
<tr>
<td>Tongue compression</td>
<td>24.8 ± 10.8</td>
<td>28.3 ± 13.0</td>
<td>.378</td>
</tr>
<tr>
<td>time, min</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: RTBR, radiofrequency tongue base reduction; UPPP, uvulopalatopharyngoplasty.

### Table 2. Changes of Subjective Symptoms in Both Groups after Surgical Treatments

<table>
<thead>
<tr>
<th></th>
<th>1 Week after Surgery</th>
<th>4 Weeks after Surgery</th>
<th>PValue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UPPP Group</td>
<td>RTBR Group</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PValue</td>
<td>PValue</td>
<td></td>
</tr>
<tr>
<td>Hypogeusia</td>
<td>−0.18 (−0.43 to 0.07)</td>
<td>.160</td>
<td>.024</td>
</tr>
<tr>
<td></td>
<td>to 0.07</td>
<td>0.22 (−0.59 to 0.13)</td>
<td>.264</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.01</td>
<td>.071</td>
</tr>
<tr>
<td>Dysgeusia</td>
<td>−0.03 (−0.21 to 0.15)</td>
<td>.744</td>
<td>.056</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.27 (−0.55 to 0.11)</td>
<td>.359</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.15</td>
<td>.214</td>
</tr>
<tr>
<td>Hyposmia</td>
<td>−0.12 (−0.23 to 0.00)</td>
<td>.054</td>
<td>.266</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.14 (−0.38 to 0.11)</td>
<td>.251</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.10</td>
<td>.181</td>
</tr>
<tr>
<td>Sensations of tongue</td>
<td>−0.03 (−0.09 to 0.03)</td>
<td>.325</td>
<td>.162</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.18 (−0.44 to 0.08)</td>
<td>.328</td>
</tr>
</tbody>
</table>

Abbreviations: RTBR, radiofrequency tongue base reduction; UPPP, uvulopalatopharyngoplasty.

All data are expressed as the mean of the individual change scores from the preoperative score (95% confidence interval for the change score).
gold standard test for gustatory function, studies using various tests will be needed for evaluating the effect of tongue base surgery. A validated survey for evaluating subjective gustatory function will need to be developed. To further evaluate our results, analyses of large population studies will be needed.

**Conclusion**

Gustatory function remained unchanged after RTBR in patients with OSA. We suggest that RTBR is a safe procedure in terms of taste sensation in OSA patients.

**Author Contributions**

Young Gyu Eun, study design, acquisition of data, interpretation of data, writing the article; Seung Youp Shin, study design, acquisition of data, interpretation of data; Jae Yong Byun, study design, acquisition of data, interpretation of data; Myung Gu Kim, study design, acquisition of data, interpretation of data; Kun Hee Lee, study design, acquisition of data, interpretation of data; Sung Wan Kim, corresponding author, study design, surgery, acquisition of data, revising the article, final approval of the version to be published.

**Disclosures**

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Sponsorships: None.

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**References**


