Methods and outcomes of radiofrequency ablation for obstructive sleep apnea

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Radiofrequency therapy has been applied to the nasal turbinates, soft palate, and tongue base in attempts to improve obstructive sleep disordered breathing. Both monopolar and bipolar devices are available, with only the monopolar device being temperature-controlled. Procedures are performed in the office setting under local anesthesia. Repeated radiofrequency treatment improves treatment effectiveness. Compared to traditional procedures, radiofrequency offers less post-treatment pain. This review article details the author’s experience and literature review of techniques, outcomes, and clinical pearls related to this mode of therapy.

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Radiofrequency ablation for obstructive sleep disordered breathing involves delivery of electrosurgical energy resulting in submucosal thermal injury and resultant scar contracture. Targeted areas in the upper airway include the nasal turbinates, soft palate, tongue, and tonsils. Two commercially available devices are currently in use, monopolar, which is temperature controlled (Gyrus ENT LLC, Bartlett, TN), and bipolar, which is not (ArthroCare, Corp, Austin, TX).

The temperature-controlled technique has been studied to a far greater extent and will be the primary focus of this article. Temperature-controlled device usage is currently Food and Drug Administration approved for turbinates, palate, and tongue treatments. Tonsil treatment remains under study. The bipolar device has the advantage of more rapid energy delivery than the temperature-controlled device but the theoretical disadvantage of smaller lesion size given the same amount of energy delivered. A controlled comparative study of the 2 different devices is lacking.

The primary advantage of submucosal radiofrequency ablation over traditional surgical therapy addressing velopharyngeal obstruction is reduced postoperative pain. Compared with traditional surgical treatments to address hypopharyngeal obstruction, radiofrequency ablation is an

Figure 1 The nasal turbinate handpiece for use with the monopolar radiofrequency generator. (Color version of figure is available online.)

Figure 2 The soft palate handpiece for use with the monopolar radiofrequency generator. (Color version of figure is available online.)
office-based procedure performed under straight local anesthesia. The primary limitation of radiofrequency ablation compared with traditional surgery appears to be the need for multiple treatments for optimal effect. However, the low morbidity translates into high patient acceptance of repeated treatments.

Nasal turbinates

Temperature-controlled radiofrequency ablation of the inferior nasal turbinates is simply performed in the office with the turbinate handpiece (Gyrus ENT LLC) (Figure 1). Topical anesthesia can be used with viscous lidocaine or Pontacaine (Hospira Inc, Lake Forest, IL) spray, followed by submucosal injection of 1% lidocaine. Lidocaine with epinephrine (1:100,000) may reduce bleeding but can increase blood pressure or induce a vasovagal response in those prone to cardiogenic syncope. Buffering the lidocaine with a small amount of bicarbonate will lessen the discomfort of the injection somewhat. The needle electrode is then advanced into the anterior inferior turbinate, and 500 J are delivered bilaterally at a target temperature of 75°C. If
treatment of the posterior portion of the turbinate is desired, it should be treated first, after topical decongestant spray is applied to the anterior portion.

**Soft palate**

Temperature-controlled radiofrequency ablation of the soft palate is slightly more difficult than the turbinates. For patients with an active gag reflex, topical Cetacaine (Cetyl-lite, Pennsauken, NJ) spray is recommended. The oral cavity is rinsed with Peridex (Zila Pharmaceuticals, Phoenix, AZ) for antisepsis. Systemic antibiotics are not necessary. Local anesthetic consists of 1% lidocaine with 1:100,000 epinephrine (with bicarbonate if desired). Injection of about 2 mL is performed in the midline about 2 cm above the base of the uvula, additional infiltration of 0.5 mL bilaterally, 1 cm above the free edge of the palate can be helpful. It is worthwhile to explain to patients that they may have nasal obstruction and a globus sensation until the anesthetic wears off.

The palate handpiece (Gyrus ENT LLC) (Figure 2) is then inserted submucosally in the midline such that the tip of the needle sits just above the base of the uvula (Figure 3). A tongue depressor is usually necessary for adequate visualization. Radiofrequency ablation is then performed with 650 J, target temperature 85°C, and a maximum power of 10 W. If the needle is placed too superficially, blanching of the mucosa may indicate mucosal thermal injury, and treatment should cease so the needle can be repositioned. Mucosal injury will result in mucosal slough and greater posttreatment discomfort. This can occur on either the anterior or posterior aspect of the soft palate.

Lateral treatment is accomplished by inserting the needle through the same midline mucosal insertion site and then directing the needle tip at a 45° angle inferolaterally such that the tip remains above the free edge of the palate (Figure 3). Less energy is delivered laterally because of the thinner tissue, and 325 J are recommended to minimize the risk of mucosal injury. The process is then repeated on the contralateral side.

**Figure 6**  Sagittal view of the tongue base showing the direction and depth of needle placement.

**Figure 7**  Ventral view of the floor of mouth, lingual frenulum, and paired submandibular duct orifices along with the suggested needle insertion point for ventral treatment of the genioglossus muscle.
Postoperative care includes over-the-counter and/or narcotic analgesics. Pain typically improves within 2-3 days. Prolonged or worsening pain suggests mucosal injury and slough, which can be confirmed on oropharyngeal or nasopharyngeal examination. If present, gargle with Carafate (Axcan Pharma, Birmingham, AL) and/or amoxicillin elixir may reduce pain until mucosal healing occurs. Maximum therapeutic effect may take 2 months or longer, but repeat treatment can be performed safely in 3-4 weeks in the absence of mucosal injury. Two or 3 treatment sessions are necessary to optimize therapeutic effectiveness. The same procedure is repeated with a new sterile handpiece using the same treatment settings. Alternatively, the midline 650 J delivery can be substituted with 500 J delivered to either side of midline at the uvular base.

Tongue base

Tongue base radiofrequency treatment is generally easier than palate but has the potential for tongue base abscess and airway obstruction. Pretreatment with an antiseptic oral rinse and systemic oral antibiotic directed toward oral flora significantly lessen this risk.4 Local anesthetic should be diluted 50:50 with sterile saline for injection to optimize therapeutic effect. It should be on the anterior tongue is held with a gauze pad in 1 hand. A patient is instructed to stick out his/her tongue, and the tongue should be gently held throughout the treatment to avoid injury to the neurovascular structures or salivary ducts. Using the bipolar device with an orthopedic wand, some investigators7 have described a suprahyoid external approach with ultrasound guidance and suture collapse of the genioglossus muscle.6 Care is taken to stay midline to avoid injury to the neurovascular structures or salivary ducts (Figure 7). Treatment energy is reduced to 500 J/site using the single channel handpiece. This is particularly useful in patients who have undergone multiple dorsal treatments such that the submucosal tongue base is becoming predominately fibrotic, and it is difficult to insert the needle for subsequent treatment. Using the bipolar device with an orthopedic wand, some investigators7 have described a suprahyoid external approach with ultrasound guidance and suture collapse of the defect. This more aggressive approach obviates the need for repeated treatment sessions but requires general anesthesia and, often, temporary tracheotomy. As such, it remains under investigation.

Radiofrequency treatment outcomes for obstructive sleep apnea

Temperature-controlled radiofrequency therapy has significantly improved obstructive sleep apnea in a placebo-controlled study.5 An extensive review of the numerous published studies has been performed elsewhere and is beyond the scope of this journal.9,10 Published outcomes from various case series are summarized in Table 1.

The wide variance may relate to technical differences, including the number of treatment sessions and/or patient

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### Table 1

<table>
<thead>
<tr>
<th>Radiofrequency treatment site</th>
<th>Investigator (yr)</th>
<th>Proportion with apnea hypopnea index (AHI) reduction ≥50% and AHI =20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft palate</td>
<td>Brown et al13 (2001)</td>
<td>17%</td>
</tr>
<tr>
<td>Tongue base</td>
<td>Blumen et al12 (2002)</td>
<td>66%</td>
</tr>
<tr>
<td></td>
<td>Powell et al13 (1999)</td>
<td>43%</td>
</tr>
<tr>
<td></td>
<td>Woolson et al7 (2001)</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Stuck et al4 (2002)</td>
<td>33%</td>
</tr>
<tr>
<td></td>
<td>Riley et al6 (2003)</td>
<td>68%</td>
</tr>
<tr>
<td>Palate and tongue base</td>
<td>Fischer et al16 (2003)</td>
<td>33%</td>
</tr>
<tr>
<td></td>
<td>Steward8 (2004)</td>
<td>59%</td>
</tr>
<tr>
<td></td>
<td>Stuck et al11 (2004)</td>
<td>33%</td>
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<tr>
<td></td>
<td>Nelson16 (2001)</td>
<td>50%</td>
</tr>
<tr>
<td>Uvulopalatopharyngoplasty and tongue base</td>
<td>Friedman et al11 (2003)</td>
<td>50%</td>
</tr>
</tbody>
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selection criteria. Two studies with extended follow-up have shown persistent improvements in subjective and objective measures of obstructive sleep apnea.\textsuperscript{18,19}

References