RADIOFREQUENCY TONGUE BASE REDUCTION IN SLEEP-DISORDERED BREATHING

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Radiofrequency has been an evolving technology in volumetric reduction of tissues in the upper airway, including the nasal turbinates, soft palate, and tongue. Radiofrequency tongue base reduction is an alternative technique of improving upper airway patency by reducing the size of the tongue in sleep-disordered breathing. This modality is a multiple-staged procedure separated by approximately 4 weeks, performed in an outpatient setting using local anesthesia with minimal discomfort and morbidity. Short-term results appear promising using the present treatment protocol, but our practice recommends caution using this new technology until long-term results and multicenter findings are available to determine the modalities efficacy.

Sleep-disordered breathing (SDB) is upper airway collapse during sleep, which includes upper airway resistance syndrome, and obstructive sleep apnea syndrome. SDB often has a hypopharyngeal or tongue base component to the upper airway collapse. Several procedures have been developed to address this level of obstruction including uvulopalatopharyngoglossoplasty, laser midline glossectomy, partial glossectomy, lingualplasty, mandibular osteotomy with genioglossus advancement, hyoid myotomy and suspension, maxillomandibular advancement, and radiofrequency volumetric tissue reduction (RF) of the tongue.

Research into the application of radiofrequency energy ablation of soft tissues in the upper airway has shown that this technology is effective for treating the nasal turbinates in nasal obstruction,[1] the soft palate for snoring and SDB,[2] and the tongue base for SDB.[3] We will describe the indications and technique of radiofrequency tongue base reduction.

CURRENT INDICATIONS FOR TREATMENT

Identification of base of tongue obstruction as the suspected cause of SDB is paramount. The current treatment indications that our practice implements is based on the initial pilot study. All patients in this study underwent some form of conventional surgical therapy, which did not completely relieve their obstruction. Presently, we give patients all surgical treatment options, but we recommend conventional surgical procedures as the initial form of treatment in most cases. Some patients have preferred radiofrequency of the tongue base as the primary modality of treatment. There is no data on the success rate with this approach. Multicenter data as to the success of primary radiofrequency of the tongue base will aid in future recommendations. All patients treated with RF of the tongue base require either nasal continuous positive airway pressure or a tracheotomy. Future studies may reveal that those with less severe disease do not require perioperative airway protection, but at this time we feel that it is prudent. Patients should be given all possible treatment options with their success rates, cost, and possible complications.

Those who have chosen surgical treatment are further evaluated systematically to establish if other sites of airway obstruction exists, specifically the nasal cavity or soft palate. The evaluation includes a comprehensive physical examination, fiberoptic nasopharyngoscopy with the Mueller manuever, and a lateral cephalometric radiograph.

RATIONALE FOR RADIOFREQUENCY REDUCTION OF THE TONGUE BASE

Surgical treatment of SDB is accomplished by one of 3 premises: (1) excising or reducing the size of tissue obstructing the airway (2) constructing a larger airway or (3) providing neural stimulation or preventing neural relaxation to the supporting muscles of the airway. Radiofrequency tongue base reduction provides a minimally invasive, technically uncomplicated, cost-effective, outpatient, local anesthetic technique that has provided effective clinical outcomes with minimal discomfort and morbidity in patients with base of tongue collapse in SDB.

The biophysical properties of radiofrequency has previously been introduced in the article concerning radiofrequency of the soft palate. An elliptical lesion measuring approximately 2 cm × 6.6 mm is created at each site.[4] Previous data on RF energy disbursement in the homogeneous tissues of the porcine tongue indicate that as energy

TABLE 1. RF of the Tongue Base: Current Indications for Treatment*

Upper airway resistance syndrome
Obstructive sleep apnea syndrome

*All patients determined to have tongue base collapse.

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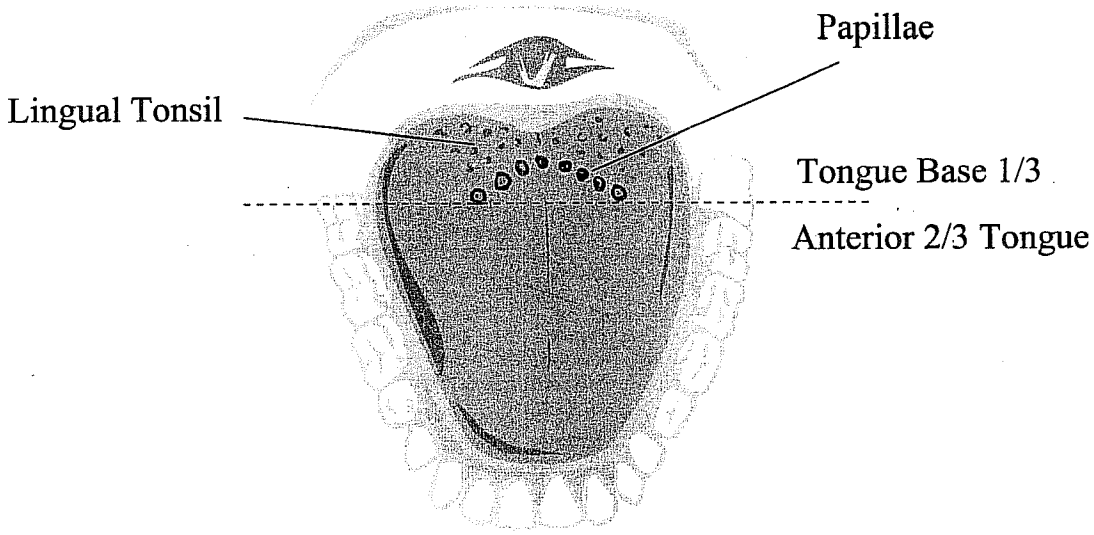

FIGURE 1. Diagram of the dorsum of the tongue.

increases so does lesion size. This study also evaluated the lesions histologically and revealed neural and vascular structures remained viable in the tissues surrounding the lesion.[4] Optimal temperatures were attained in the range of energy we were delivering with minimal collateral spread of tissue destruction.

THE STANFORD TECHNIQUE OF RADIOFREQUENCY OF THE BASE OF TONGUE

The base of tongue was sprayed with 20% benzocaine as a topical anesthetic. A 25 or 27 gauge needle was used to inject 3.0 to 5.0 mL of 0.5% bupivacaine along the treatment site. Lingual nerve blocks may be used to augment the local injections. A 22 gauge RF needle electrode (10-mm active length with a 10-mm protective sheath) in a custom-fabricated device allowed placement of the electrode under the tongue mucosa in the area selected for treatment. RF energy was then delivered to the tongue with 750 J at any 1 focus and a total of 1,500 J per treatment session. Either treating the midline tongue anterior and posterior to the circumvallate papillae, or 2 paramedian sites are performed (Fig 1). The lateral aspect of the tongue is not treated to minimize the risk of injuring the neurovascular bundle (Fig 2). This technique minimizes posttreatment pain and edema. No sedative premedication is given unless a significant gag response is noted on pretreatment evaluation. Corticosteroids are not presently used, but may be contemplated in certain individuals who have previously been treated with the recommended dosage of radiofrequency and experienced significant posttreatment tongue swelling.

RESULTS

The pilot study investigating the efficacy of RF tongue base reduction in 18 humans revealed a reduction in the objective criteria of obstruction, decrease in size of the tongue, and an increase in the airway diameter posttreatment.[3] The pretreatment indices revealed a mean respiratory disturbance index (RDI) of 39.6, apnea index (AI) of 22.0, and lowest oxyhemoglobin saturation (LSAT) of 81.9% compared with postoperatively with an RDI of 17.8, an AI of 4.1, and a LSAT of 88.1%. Tongue volume decreased by 17% whereas the posterior airway space increased by 14.6%. The mean total energy delivered to the tongue was 8,490 J per patient. Patients who were not

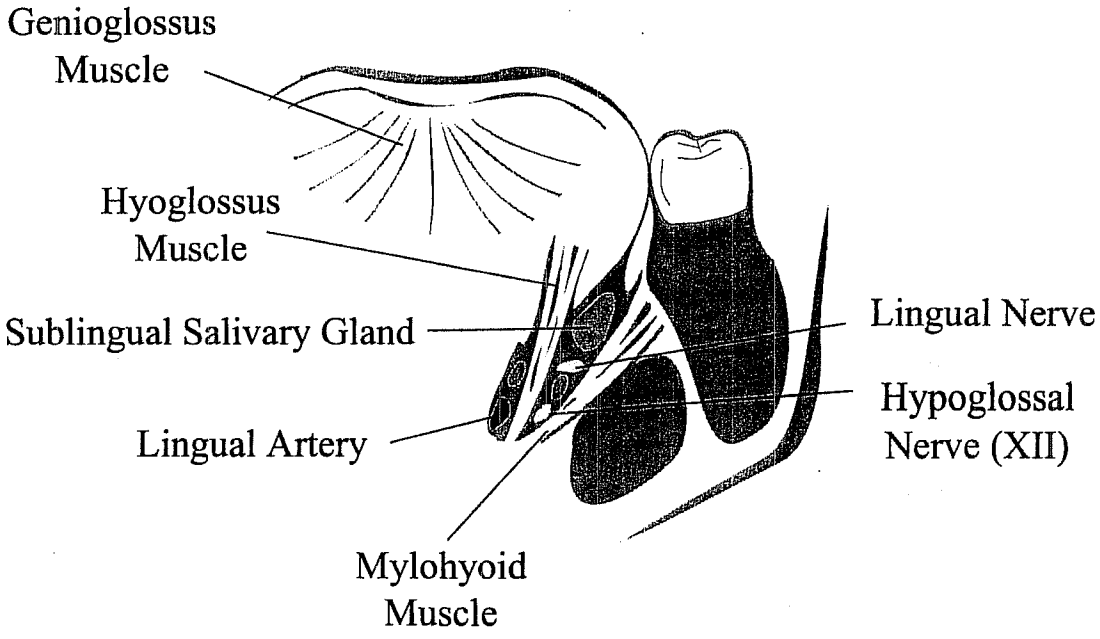

FIGURE 2. Cross sectional view of the tongue.

completely relieved of obstruction may need additional energy to the tongue.

ADVERSE EFFECTS AND COMPLICATIONS

There were 3 adverse effects noted in the pilot study group. One patient had prolonged odynophagia after the second treatment session. A work-up with physical examination and computer tomography revealed no infection etiology although the patient's white blood cell count was mildly elevated. These symptoms resolved without incident. One patient had a superficial ulceration caused by a leak in the protective electrode sheath from excessive flexing of the electrode during treatment. The lesion healed without incident. There was one infection, an abscess, in 180 individual treatment sites for an incidence of 0.6%. This patient underwent an incision and drainage in the operating theater and a tracheotomy for airway protection.

In an attempt to lower the infection rate even more the following recommendations are suggested: (1) do not treat with much more than 750 J at any 1 focus, (2) pretreatment oral rinsing with chlorhexidine, (3) short course antibiotic therapy such as cephalexin 500 mg 4 times a day or clindamyacin 300 mg 3 times a day for 3 days, or (4) no posttreatment steroid use. Close follow-up is essential with specific attention to patient's complaining of tongue discomfort, since the diagnosis of a tongue abscess by physical examination alone can be difficult.

The present protocol was established after attempting higher levels of radiofrequency energy and having the patient's experience significant pain inhibiting adequate oral intake of fluids or producing potentially airway obstructing tongue edema. Airway protection for a minimum of five days posttreatment with nasal continuous positive airway pressure is recommended.

CONCLUSION

Tongue base radiofrequency ablation offers an alternative treatment option for tongue and hypopharyngeal upper airway collapse in sleep-disordered breathing. The preliminary results reveal its efficacy, its cost effectiveness being the only outpatient technique currently available, its low morbidity and its high patient acceptance related to the low level of discomfort, and no loss of work time. Future studies are necessary to document the optimal treatment protocol and long-term results.

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