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Robotic glossectomy for obstructive sleep apnea technique

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Transoral robotic glossectomy for obstructive sleep apnea offers a safe and effective alternative to conventional approaches for the treatment of hypopharyngeal obstruction. The robotic approach enables increased operative visualization, allows for greater control of tissue removal, and facilitates more aggressive volume reduction at the base of tongue.

Anatomical abnormalities of the upper airway are the major component in the development of obstructive sleep apnea (OSA). Although many factors play a role, persistent hypopharyngeal obstruction is an important impediment to cure. Unfortunately, surgical correction of OSA has a poor success rate.[1-4] Treatment by carbon dioxide lasers, coblation, and radiofrequency tissue ablation has been used to relieve retrolingual obstruction. However, these techniques provide limited control of tissue reduction, as they rely on tissue vaporation or cell breakdown. Additionally, open procedures that allow for definitive resection of tongue-base tissue are rarely preformed.

Head and neck robotic surgery using the da Vinci surgical robot (Intuitive Surgical, Inc, Sunnyvale, CA) has recently become an available tool for transoral surgery. In December 2009, the Food and Drug Administration has approved robotic surgery for benign lesions of the oral cavity, larynx, and pharynx and all T1 and T2 malignancies. Several authors have reported successful treatment of head and neck pathology using the robotic approach.[5-10] We present a new robotic surgical technique for midline glossectomy for surgical management of OSA in patients with hypopharyngeal obstruction.

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The objective of midline glossectomy is to enlarge the hypopharyngeal airspace and relieve obstruction. Glossectomy is performed at the midline to allow for aggressive tongue-base resection without potential compromise of the hypoglossal nerve and lingual artery. This procedure is reserved for patients with moderate to severe OSA with significant symptoms who have failed treatment with continuous positive airway pressure. The Friedman tongue staging system is used to estimate hypopharyngeal obstruction. Patients with Friedman tongue position III and IV on preoperative examination are considered appropriate candidates for glossectomy. Lingual tonsillectomy may also be performed in appropriate patients.

Anatomy

The tongue forms the floor of the mouth and is divided into 2 portions: the anterior ⅔ in the oral cavity and the posterior ⅓, the base of the tongue, which lies in the pharynx. The oral and pharyngeal surfaces are separated by the V-shaped sulcus terminalis. At the apex of the sulcus terminalis is a shallow depression, the foramen cecum. Eight to twelve 1- to 2-mm dome-shaped projections, the circumvallate papillae, form 2 V-shaped rows along the dorsal surface at the junction of the anterior and posterior portions of the tongue, anterior to the terminal sulcus.

The pharyngeal portion of the tongue widens posteriorly and descends vertically to form the root of the tongue. The root attaches to the mandible and hyoid bone through the genioglossus, hyoglossus, and the hyoglossal membrane and is continuous with the epiglottis by the glossoepiglottic folds. The hypoglossal nerve and lingual artery neurovascular bundle are located on the lateral edges of the posterior tongue. The lingual artery runs medially to the hypoglossal nerve.

On the dorsum of the tongue, a mucous membrane covers a submucous fibrous layer, into which the intrinsic muscles of the tongue attach. The mucous membrane on the anterior tongue is thin and adherent to the fibrous layer, whereas the mucous membrane on the posterior tongue is thick and freely moveable. The mucous membrane on the posterior tongue is continuous with lymphoid structures, the lingual tonsils. The valleculae are depressions between the epiglottis and the root of the tongue.

Technique

Patients undergoing midline glossectomy also undergo Z-palatoplasty or other palatal procedures, which are performed before glossectomy. Performing the uvulopalatopharyngoplasty or Z-palatoplasty first enlarges the oropharynx and thereby creates extra space for the camera of the robotic arms.

The patient is placed in a supine position, with the patient's head placed at the foot of the bed. Patients are placed under general anesthesia and undergo nasotracheal intubation. After intubation the bed is rotated 180°. The anesthesiologist and anesthesia equipment are then located at the patient's feet (Figure 1). The oral cavity is rinsed with 0.12% chlorhexidine gluconate. The patient's eyes are protected using sterile drapes and eye covers, and the teeth are protected with a dental guard (Figure 2).

The course of the lingual arteries is identified bilaterally and marked using Doppler ultrasonography. After the lingual artery is identified, 10 mL of saline with epinephrine (1:100,000) is injected into the tongue base. The lingual artery must be identified before injection of epinephrine, as the epinephrine will cause vessel spasm. A small amount (1-2 mL) of bupivacaine may be injected for pain control. Anesthetic is not used with epinephrine for local primary injection because of the potential risk of bilateral hypoglossal paralysis. Although temporary, bilateral hypoglossal paralysis will obstruct the airway in the postoperative period.

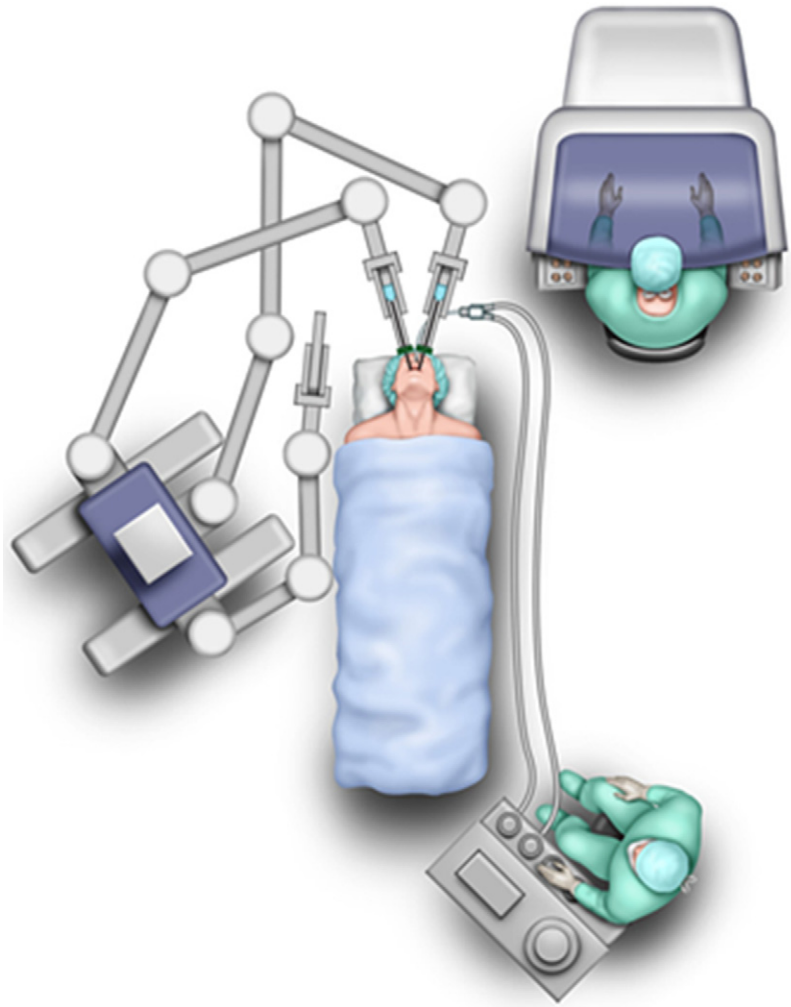

Figure 1 After intubation, the table is rotated 180° so that the anesthesiologist is at the foot of the bed. The robot is brought into position at a 30° angle to the operating table.