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Robotic-assisted oropharyngeal reconstruction with local flaps

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Robotic surgical systems have been developed to augment the capabilities of the surgeon when applied to limited access surgical situations. The adaption of robotic technology to the management of oropharyngeal pathology may represent a paradigm shift in the management of early stage oral malignancies that have commonly been treated with chemoradiation due to the morbidity associated with standard open surgical techniques. The creation of a surgical defect with this approach also creates the need to develop and adapt techniques for reconstruction. Fortunately, the surgical robot is easily applied to the transposition of local flaps to meet these reconstructive needs.

Since its introduction in the mid 1990s, the use of robotic assistance in the operating room has allowed the development and refinement of minimally invasive alternatives to a number of surgical procedures with applications in urology, gynecology, cardiac surgery, and general surgery.[1,2] Hospitals are investing in robotic technology and its applications continue to expand. In head and neck surgery, robotic assistance, by virtue of its combination of magnification, illumination, and stereoscopic vision, provides unsurpassed minimally invasive surgical access to the pharynx, soft palate, and base of tongue. The frequent need for lip and mandible splitting procedures to address malignant lesions involving the oropharynx and base of tongue has led many to approach these lesions with primary chemoradiation therapy.[3,4] The advent of robotic assistance for surgical ablation of oral malignancies without the need for morbid access incisions has made surgical options more reasonable as a primary treatment, and the effectiveness of transoral robotic surgery (TORS) in the management of oropharyngeal and supraglottic carcinoma has been demonstrated in studies by O'Malley and others.[5-8] This has resulted in what some feel is a paradigm shift in the treatment of early-stage oral malignancies. A natural extension of this experience is to apply robotic technology to the reconstruction of the defects left by tumor extirpation and to the treatment of benign conditions for which a minimally invasive approach is appropriate. Initial descriptions of use of the surgical robot for oropharyngeal reconstruction have been provided by Genden, Selber, and others.[1,9-12] This report reviews the details of current management of soft-tissue defects created in the treatment of malignant and nonmalignant conditions of the oropharynx with local flaps using the surgical robot.

Indications

The TORS approach is used for the management of patients with primary and recurrent malignant tumors of the oropharynx and base of tongue as well nonmalignant conditions involving this area.

Examples include squamous cell carcinoma, nonsquamous cell tumors, and conditions such as pharyngeal stenosis. For tumors that are limited in their extent to the oral mucosa anterior to the anterior tonsillar pillars, standard approaches are usually adequate. In this situation, the extra

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time required for the robotic set-up and the extra cost do not appear to be justified. For lesions that extend posterior to the anterior tonsillar pillars, the visualization, magnification, and illumination provided by the surgical robot give the surgeon unparalleled access and precision in tumor extirpation and reconstruction.

Indications for reconstruction include the need to provide coverage of the carotid artery and jugular vein, to prevent pharyngeal-cutaneous fistulae when an external neck incision is present, and for defects of the soft palate to decrease the risk of velopharyngeal insufficiency. The robot allows the surgeon minimally invasive access for extirpation and reconstruction of lesions that involve the area extending from the pharyngeal inlet to the vallecula. The robot adapts easily to primary repair as well as to the elevation and insetting of local flaps and provides particularly good access and visualization at the juncture of the soft palate with the lateral pharyngeal wall and the tongue base, where standard closure techniques with long rigid instruments are particularly difficult. The mobility afforded by the robotic instruments, which are capable of 540° of rotation, and the fact that vision is not obstructed to the same degree within the limited space available by the surgeon's or assistant's instruments enhance the ability to achieve precise excision and closure in these areas.

The robot can also be used for more complex reconstructive applications, such as the insetting of free flaps. The anastomosis in these cases is generally performed in standard fashion to vessels in the neck with the flap vessels brought through a tunnel created from the site of reconstruction to the anastomosis site in the neck. The robot has been used to perform the microvascular anastomosis, and eventually, it may be possible to perform anastomosis within the oropharynx.

Technique

After induction of anesthesia and positioning the patient, the operating table is rotated 180° and a shoulder roll is placed.

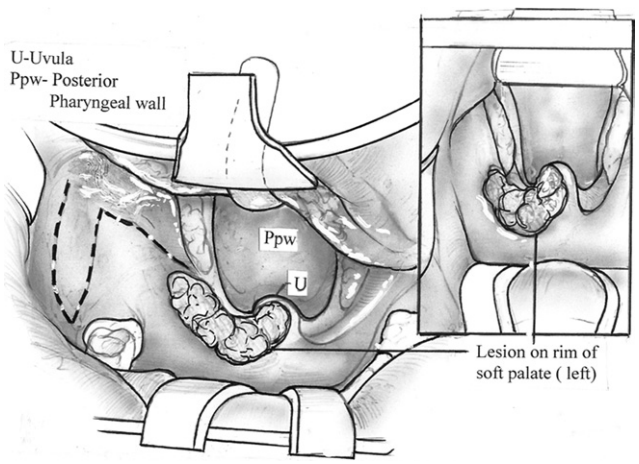

Figure 1 View of lesion involving posterior margin of the left soft palate with retractors in place and a facial artery musculomucosal (FAMM) flap diagrammed on the left buccal mucosa.

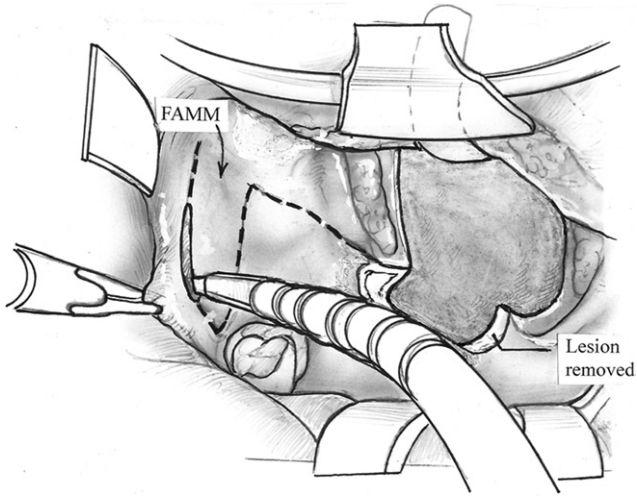

Figure 2 Dissection is begun with Maryland forceps on arm 2 and monopolar cautery on arm 1.

A mayo stand is positioned over the patient's chest and a Dingman (V. Mueller Surgical Instruments) or Feyh-Kastenbach retractor (Gyrus ACMI) is inserted. Teeth are protected by application of thermoplastic wafers over the upper and lower incisors before insertion of the retractor (Figure 1). The robotic patient cart is positioned to the patient's left at an angle of roughly 30°-45° to the bed. The monitor is positioned to the left of the head of the bed, where it can be easily seen by the surgical assistant, and the surgical technician is positioned to the right side of the head of the bed. A mayo stand is positioned above the patient's chest and the end of the retractor may be hooked over the edge of the stand to aid in positioning. The resection or other indicated procedure is performed and after confirmation of complete tumor removal by frozen section examination, the resulting defect is assessed. Meticulous hemostasis is important and this can be aided with the application of hemostatic agents such as Floseal (Baxter Healthcare, Deerfield, IL). Maryland forceps, loaded onto the number 2 arm, and monopolar cautery, on the number 1 arm, are used for dissection (Figure 2). The cautery scissors are a useful alternative to the standard cautery tip for dissection. Maryland forceps and either 5- or 8-mm needle holders are used most commonly for suturing the flap in place. Sutures are passed to the surgeon-controlled instruments by a bed-side assistant. Braided sutures can be somewhat difficult to use owing to their tendency to fray during tying, and 3-0 monocryl (Ethicon/Johnson & Johnson, New Brunswick, NJ) on a small, curved, tapered needle cut to lengths of about 15 cm seems to work well. Full-length sutures are more difficult to handle owing to the limited field of vision in the oropharynx.

Small defects, particularly those involving the lateral and posterior pharyngeal walls and the base of the tongue, which do not expose critical structures such as vessels and nerves, can be allowed to heal by spontaneous mucosalization. Defects in the range of 1-1.5 cm can often be reapproximated with undermining and advancement of simple mucosal flaps. Relaxing incisions can sometimes be helpful.