The Laryngoscope

How I Do It

Exoscopic Transoral Supraglottic Laryngectomy

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INTRODUCTION

A substantial turning point in the surgical management of laryngeal squamous cell carcinomas (SCC) was the introduction of carbon dioxide transoral laser microsurgery (CO_2 TOLMS),[1] which involves the use of an operating microscope that provides an excellent magnified view of the surgical field.

Recently, the refinement of exoscopic systems has provided the head and neck surgeon with a new magnification tool, potentially competing with the operative microscope in various procedures, from microvascular free flap anastomosis[2] to transoral surgery.[3,4] In particular, coupling between a 4K-3D exoscopic system and CO_2 laser micromanipulator, when performing transoral laser laryngeal surgery, seems to be noninferior to the operative microscope in terms of surgical time, resection radicality, and precision, with some advantages in terms of intuitivism, maneuverability, ergonomics, and ease of alignment.[5] In this setting, the surgeon is in close contact with the laryngoscope inlet, looking at the surgical field in a 3D high-definition screen, without bulky instruments obstructing the space of maneuver, and without the need of keeping the head constantly in contact with the microscope eyepieces.[6] This subjectively improves the surgeon's comfort and ergonomics,[3] favoring bimanual tissue manipulation while maintaining an optimal magnified stereoscopic visualization of the larynx. Moreover, using 3D glasses, the surgeon's assistant(s), as well as all the operatory room staff, can easily follow the entire procedure with the same surgical field of view of the first operator. This improves the possibility for assistants to help during some crucial parts of the procedure. The significant magnification capability (up to 15× zoom) is particularly useful to approach supraglottic, glottic, and subglottic regions, keeping optimal illumination even at high depth of field. Furthermore, during magnification, it is possible to digitally move the field of view using a separate control joystick, without the need to physically move and adjust the exoscope. On the other hand, the robotic arm (ARTip cruise robotic system, Karl Storz, Tuttlingen, Germany), on which the exoscope is mounted in the most recent version of the VITOM 3D, makes it possible for the surgeon to easily modify the observant's perspective using a dedicated joystick (IMAGE1 PILOT, Karl Storz, Tuttlingen, Germany).

To date, no clinical video report has been published regarding the application of the CO_2 transoral laser exoscopic surgery (TOLES) for treatment of laryngeal SCC. In this case video, the authors sought to point out the feasibility and strengths of this technology in transoral surgery.

METHODS

In this case video, the authors sought to highlight the feasibility and strengths of transoral exoscopic laser resection for the treatment of a supraglottic laryngeal carcinoma. The exoscopic visualization guaranteed a bright and wide view of the surgical field during the entire procedure, thus simplifying the zooming process during the most challenging steps. In this setting, the surgeon is in close contact with the laryngoscope inlet, looking at the surgical field in a 3D high-definition screen, without bulky instruments obstructing the space of maneuver.

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The patient who underwent this procedure signed an informed consent to publication through Wiley standard form.

RESULTS

We proposed the employment of CO_2 TOLES as alternative to CO_2 TOLMS in treatment of a supraglottic cancer located in the supra-hyoid portion of the epiglottis and extended to the infra-hyoid epiglottis and to the left aryepiglottic fold (cT2N0). Endoscopic results, evaluated during follow-up (latest control has been performed 2 years after surgery), showed an excellent healing of surgical field without any macroscopic evidence of residual disease. Laryngeal phonatory and swallowing functions were completely preserved.

In our experience, CO_2 TOLES proved to be feasible for early-intermediate laryngeal SCC and represents a valuable alternative to TOLMS. The 3D visualization helped the surgeon and assistant to dominate the tumor at 360° and achieve en bloc removal within free resection margins and optimal postoperative results. Moreover, CO_2 TOLES provides a didactic gain, with ergonomics and optimal intraoperative visualization being well-perceived subjective benefits throughout the entire surgical procedure.

DISCUSSION

We present the case of an 85-year-old female, former smoker, who, 14 years after successful treatment by chemoradiation of an esophageal SCC of the cervical tract, presented with a biopsy proven second primary SCC of the supra-hyoid portion of the epiglottis with limited extension to the infra-hyoid epiglottis and to the left aryepiglottic fold, clinically staged as T2N0 (Fig. 1). Preoperative CT scans showed no extension to the pre-epiglottic space and no pathologic lymph nodes, while clinical evaluation showed normal motility of both vocal cords.

The procedure began with careful tumor inspection using a 0° rigid laryngeal telescope and tumor palpation, which revealed no submucosal extension. After that, using a contact diode laser fiber (Dornier MedTech, Germering, Germany) inserted into a holder with the capability to angle the fiber tip turning upward, the inferior resection margin was outlined from the level of the supra-commissural region to the aryepiglottic folds, first on the more involved side, and then on the contralateral one. At the more involved side, the high hemostatic power of the diode laser was useful to also delineate the superior margin against the hyoid bone and, more caudally, at the level of the hypopharyngeal mucosa up to the aryepiglottic fold.

At this point, the VITOM 3D (Karl Storz, Tuttlingen, Germany) maneuvered by a robotic arm (ARTip Cruise, Karl Storz, Tuttlingen, Germany) and coupled with a CO_2 laser micromanipulator (Lumenis, Yokneam, Israel) replaced the traditional hand-held rigid telescope (Figs. 2 and 3).

The resection started on the left side, keeping the thyro-hyoid membrane as the deep plane of resection. When the lateral aspect of the thyro-hyoid membrane was reached, careful exposure of the superior laryngeal neurovascular pedicle was provided by a combination of laser ablation and blunt dissection. At this point, the application of hemostatic clips at the level of both the main trunk and posterior branches of the superior laryngeal pedicle is crucial to avoid intra- and postoperative bleeding.

The resection then moved in front of the left arytenoid, following a lateral to medial direction. The initial outlining of the endolaryngeal inferior margin was of great help in maintaining proper orientation together

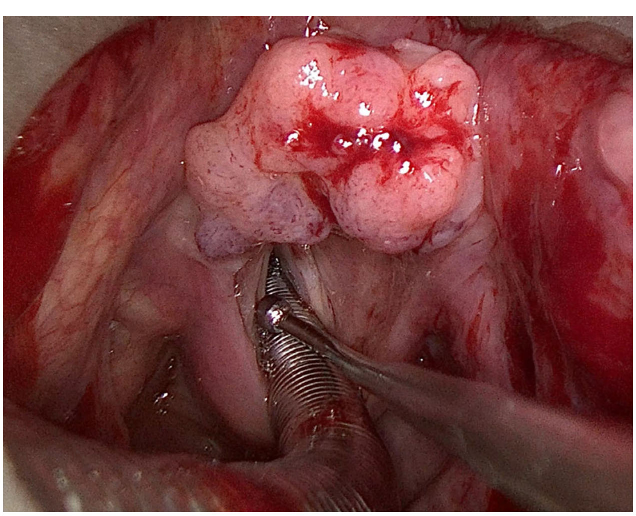


Fig. 1. Endoscopic appearance of the squamous cell carcinomas of the supraglottic larynx. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

Fig. 2. TOLES surgical setup. The VITOM® 3D-HD, maneuvered by the ARTip Cruise robotic arm, is coupled to the laser micromanipulator. The biggest 3D monitor is positioned at patient's legs. TOLES = transoral laser exoscopic surgery. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

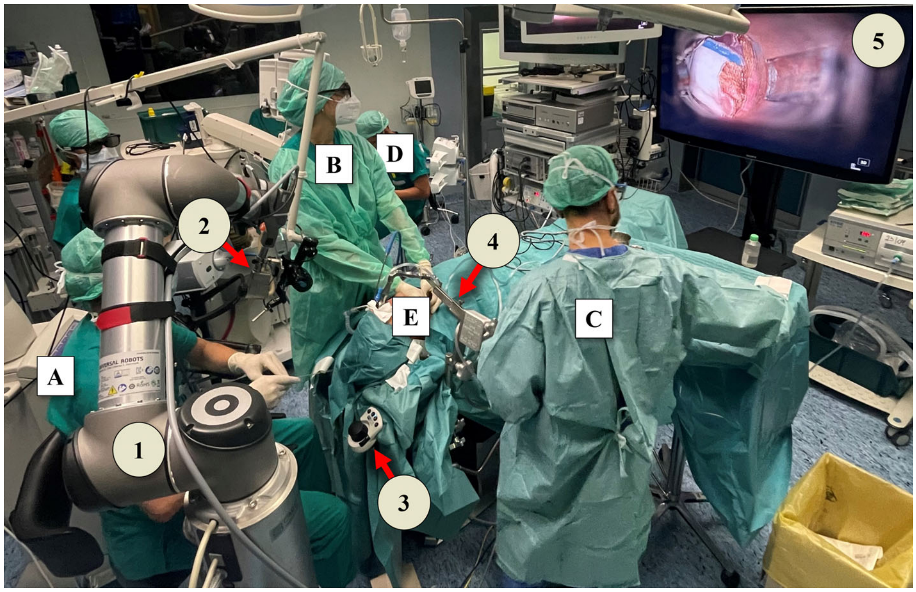


Fig. 3. Operative theatre setup during TOLES, with the position of the surgeon and his team (letters) and the TOLES tools (numbers). (A) Surgeon; (B) assistant surgeon; (C) scrub nurse; (D) anesthesiologist; (E) patient; 1, ARTip Cruise robotic arm; 2, VITOM® 3D-HD Exoscope coupled to the laser micromanipulator; 3, VITOM® IMAGINE1 PILOT; 4, suspension system with Zeitels Suspension Gallows (Endocraft LLC, Boston, MA, USA) and DEDO laryngoscope (Karl Storz, Tuttlingen, Germany); 5, 3D monitor. TOLES = transoral laser exoscopic surgery. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

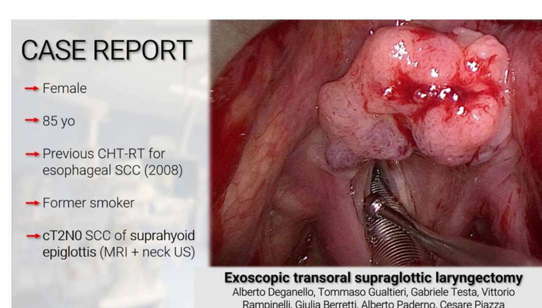
with a sound oncologic resection, and favored a posterior to anterior development of the resection itself.

Next, the superior margin at the hyoid bone was also completed at the less involved side. Careful 3D exoscopic inspection revealed that the initial incision with diode laser at the right aryepiglottic fold was a bit too close to the tumor. In order to obtain a safer surgical margin in front of the right arytenoid, an extra-mucosal margin was delineated with the CO_2 laser. Then, surgical steps at the right-hand side proceeded, as happened for the left side. When both sides had been freed, laser dissection proceeded by resecting the entire medial hyoepiglottic ligament that so far helped to maintain a cranial suspension of the surgical specimen by preventing its downward collapse into the laryngeal lumen. The resection was brought down until the level of petiole of the epiglottis, preserving the inner perichondrium of the thyroid cartilage.

The specimen was then twisted and a posterior to anterior resection proceeded over the superior paraglottic space toward the caudal insertion of the epiglottis. The removal of the specimen was then completed in an en bloc fashion. At this stage, a post-procedural endoscopic check was performed with the rigid telescope, which showed no bleeding spots. Exoscopic visualization greatly helped maintain a global view of the tumor throughout the entire procedure by allowing easy zooming in and out, as well as adjusting the line of sight through robotic movements of the ARTip.

The final histopathological examination confirmed a pT2 tumor with limited extension to the left aryepiglottic fold and infrahyoid epiglottis, within negative resection margins (closest margin at 7 mm). The case was discussed in our Multi Disciplinary Tumor Board (MDT); the group performed a revision of the previous radiation field, which included bilaterally levels II–IV. Considering patient's clinical history, her performance status and age and the clinical N0 stage, the MDT opted for a close follow-up of the cervical nodes with ultrasound (US) of the neck and, if necessary, US-guided fine needle aspiration cytology.

Two years after surgery, transnasal fiberoptic laryngoscopy revealed stable and functional long-term healing, with no signs of local recurrence (Video 1). Vocal cords showed normal motility and the patient presented optimal swallowing without aspiration, both with solid and liquid consistencies.



Video 1. Exoscopic transoral supraglottic laryngectomy, with histopathological examination details of the surgery specimen, and 2 years after surgery, endoscopic control during follow-up of the patient.
Video content can be viewed at https://onlinelibrary.wiley.com/doi/10.1002/lary.31767

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