

# Atypical reconstruction of the larynx: functional assessment after enlarged supratracheal laryngectomy with cricoglossohioidopexy

## Reconstrução atípica de laringe: avaliação funcional pós-laringectomia supratraqueal ampliada com cricoglossohioidopexia

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### ABSTRACT

In transglottic tumors extended to the base of the tongue, the indication for resection of the hyoid bone rules out the possibility of performing a classic horizontal partial laryngectomy due to the high risk of pulmonary complications resulting from severe dysphagia. This study aims to describe the functional aspects of swallowing and voice of a patient undergoing an enlarged supratracheal laryngectomy with cricoglossohioidopexy. This is a 69-year-old man with a transglottic tumor in the right hemilarynx, who underwent an extended supratracheal laryngectomy with enlargement to the base of the tongue, hyoid bone and right arytenoid. In swallowing videofluoroscopy, silent aspiration was observed in fine liquid and residue on the basis of tongue, vallecula, arytenoid, upper esophageal sphincter and pyriform recesses in all consistencies and volumes. In videolaryngoscopy, a voice was observed through the vibration of the left cricoarytenoid unit associated with the base of the tongue and constrictors of the pharynx. The Consensus Auditory-Perceptual Evaluation of Voice (CAPE V) showed a moderate degree of hoarseness and breathiness. The patient had partial preservation of laryngeal functions, with a moderate degree of dysphonia and exclusive oral feeding and hydration with soft solids and thickened liquid in nectar without impairing lung health until the study.

**Keywords:** Head and neck cancer; Laryngectomy; Dysphagia; Voice; Case reports

### RESUMO

Em tumores translóticos estendidos para base de língua, a indicação para ressecção do osso hioide descarta a possibilidade de realização de uma laringectomia parcial horizontal clássica, devido ao grande risco de complicações pulmonares oriundas de uma disfagia grave. O objetivo deste estudo foi descrever os aspectos funcionais de deglutição e voz de um paciente submetido à laringectomia supratraqueal ampliada com cricoglossohioidopexia. Trata-se de um homem de 69 anos, com tumoração translótica na hemilaringe direita, submetido à laringectomia supratraqueal ampliada, com ampliação para base de língua, osso hioide e aritenóide direita. Na videofluoroscopia da deglutição, observou-se aspiração silente para líquido fino durante a deglutição e resíduo em base de língua, valécula, aritenóide, esfíncter esofágico superior e recessos piriformes em todas as consistências e volumes. Na videolaringoscopia, observou-se voz por meio da vibração da unidade cricoaritenóidea esquerda, associada à base de língua e constritores da faringe. No protocolo Consensus Auditory-Perceptual Evaluation of Voice (CAPE V), notou-se grau moderado de rouquidão e sopro. O paciente apresentou preservação parcial das funções laringeas, grau moderado de disfonia e alimentação e hidratação exclusivas por via oral, com sólidos macios e líquido espessado em néctar, sem prejuízos à saúde pulmonar, até o momento.

**Palavras-chave:** Neoplasias de cabeça e pescoço; Laringectomia; Disfagia; Voz; Estudo de caso

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## INTRODUCTION

The different forms of treatment developed in the 20th century have enhanced care and significantly increased the survival of patients with head and neck cancer<sup>(1,2)</sup>. Due to the negative outcomes resulting from the permanent loss of laryngeal voice, dysphagia and lower quality of life, organ preservation protocols do not indicate total laryngectomies<sup>(3)</sup>.

Supracricoid partial laryngectomy (SCL) was introduced by Majer in 1959<sup>(4)</sup> and improved over the years as an option for total laryngectomy<sup>(2)</sup>. With the improvement of the technique and its consolidation through adequate oncological control and reproducibility, new attempts at adaptations have emerged to expand the indicated patient profile. Supratracheal partial laryngectomy (STL) is a current surgical intervention similar to SCL as an adaptation for the treatment of laryngeal tumors with subglottic extension and with invasion in the intermediate/advanced cricoid cartilage<sup>(2-5)</sup>. The surgical technique, originally described in the literature by Laccourreye in 1994, consists of the resection of the entire thyroid cartilage and paraglottic space, with the preservation of part of the cricoid cartilage and hyoid bone, with the possibility of preserving, or not, the epiglottis and, at least one arytenoid cartilage<sup>(5)</sup>. Its reconstruction is described with two variations: 1 - tracheohioidopexy (THP), in which there is maintenance of both or only one cricoarytenoid unit; 2 - tracheohioidoepiglotopexy (THEP), in which resection provides for the preservation of the epiglottis, maintaining the entire cricoarytenoid unit or only one cricoarytenoid unit<sup>(5,6)</sup>.

The most recurrent functional complications of horizontal open partial laryngectomies (SCL and STL) are related to respiratory and swallowing functions<sup>(1,3)</sup>. In cases whose resection is broader than that predicted by the surgical technique, as in already described cases of STL that remove part of the base of the tongue, adjacent tissue or arytenoid, the procedure of extended, enlarged or modified STL is named<sup>(2,6-9)</sup>.

In transglottic tumors extended to the base of the tongue, the indication for resection of the hyoid bone rules out the possibility of performing a classic partial laryngectomy, due to the complexity of fixing the cricoid cartilage and reconstructing the remaining structures. This neolarynx can generate a great risk of pulmonary complications, due to severe dysphagia<sup>(7)</sup>. Therefore, tumors with these characteristics are traditionally indicated for total laryngectomy, which contributes to serious functional and quality of life impairments.

In order to reduce the indications for total laryngectomy and expand the application of partial laryngectomies in the treatment of laryngeal cancer, an expansion of the technique was performed to meet the functional and psychosocial demands of a patient. Therefore, the objective of this case report was to describe the functional aspects of swallowing and voice of a patient who underwent enlarged supratracheal laryngectomy with cricoglossohioidopexy, a successful technique and unprecedented in the world.

## PRESENTATION OF THE CLINICAL CASE

The study was approved by the institution's Research and Ethics Committee under number 89042418.7.0000.5274. The patient agreed to participate in the study and signed the Informed Consent Form.

Male patient, 69 years old, with incomplete elementary education, with no history of cancer in the family, smoker and alcoholic for approximately 35 years, with a previous history of right vocal fold tumor, being treated with laser microsurgery and modulated intensity radiotherapy (IMRT with 66 Gy in 33 fractions). After treatment, the patient maintained his smoking habit (Figure 1). He remained disease-free for approximately ten years.

During the medical follow-up of hospital cancer control, exams identified recurrence with transglottic tumor in the larynx. By videolaryngoscopy, an infiltrative lesion was observed in the right aryepiglottic fold, laryngeal face of the epiglottis with invasion in the right piriform sinus, extending superiorly to the base of the tongue (Figure 2). Preserved mobility of both vocal folds and left arytenoid was also observed.

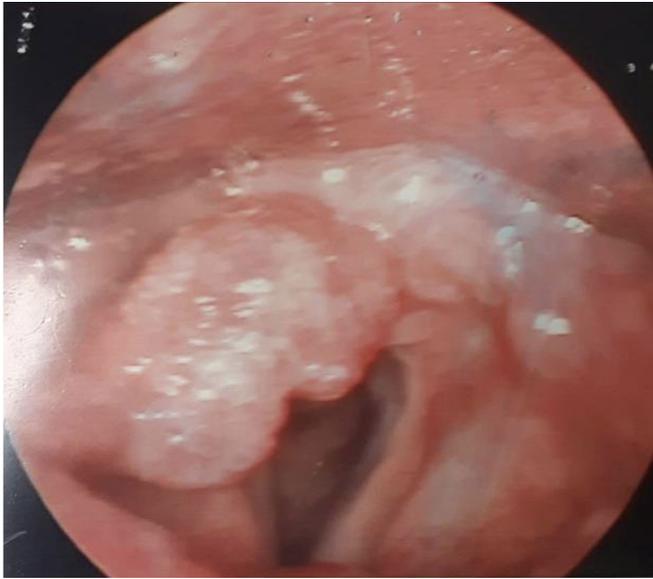
During the therapeutic planning, the patient showed dissatisfaction in carrying out the recommended treatment - total laryngectomy - due to the permanence of the tracheostomy and loss of voice. In this case, there was a suggestion to carry out an extended STL as a more conservative proposal, considering that re-irradiation was not a viable option.

After multiprofessional clinical deliberation and clarification of the risks and benefits, the patient was submitted to a modified STL, extended to the tongue base. The structures were removed: thyroid cartilage, epiglottis, aryepiglottic folds, pyriform sinuses, vocal folds and right arytenoid. Surgical neck dissection was not performed. The extent of the surgery was approximately 50% of the cricoid cartilage and hyoid bone on the right side. The remaining laryngeal structures on the left side were fixed at the base of the tongue. There were no complications in the postoperative period (Figure 3).

The patient was released from the hospital 22 days after the surgical procedure and the tracheostomy was maintained for 75 days. Nutritional support in the first two months after surgery was through the exclusive nasogastric tube (NG tube) and, after that period, he remained for three months with NG tube and oral feeding, in a pasty consistency and a thickened



**Figure 1.** Videolaryngoscopy of a patient undergoing cancer control. Edema is observed in the laryngeal and pharyngeal regions, due to smoking



**Figure 2.** Videolaryngoscopy in the preoperative period for cancer control. View of the structures affected by the neoplasia: infiltrative lesion in the right aryepiglottic fold, laryngeal face of the epiglottis with invasion in the right piriform sinus, extending superiorly to the base of the tongue



**Figure 3.** Postoperative computed tomography: resection of the cricoid cartilage and hyoid bone



**Figure 4.** Postoperative video laryngoscopy in cancer control. Preservation of left arytenoid and saliva stasis is observed in pharyngeal recesses on the left side

liquid in the consistency of honey. The NG tube remained for 92 days and, after that, the patient continued with an exclusive oral route, progressively evolving consistencies until feeding with soft solids and thickened liquid in the nectar consistency. The patient remained functionally stable and comfortable using a food thickener.

Exactly after surgery and until the time of the study, the patient was under the care of the Speech Therapy team, being exposed to swallowing and voice rehabilitation, mainly due to an incomplete laryngeal closure, resulting from surgical treatment.

In the clinical examination of the immediate postoperative period, a severe alteration in the mobility of the tongue was observed, being subsequently tractioned by the pexy at the base of the tongue. Some strategies become relevant, such as exercises for mobility and tongue strength, as well as the supraglottic and super-supraglottic maneuvers, which allow a greater range of motion and duration of closure of the laryngeal vestibule<sup>(1,3)</sup>.

To evaluate the functional results six months after the surgery, videofluoroscopy of swallowing and videolaryngoscopy were performed.

The patient underwent an image exam with exclusive oral feeding, after six months of surgery. The Siemens Axion Iconos MD Remote Control X-ray Machine (Serial Number 13020) was used. All video segments were recorded in side view, with an image capture rate of 30 frames (frames) per second. The Penetration and Aspiration Scale developed by Rosenbek, in 1996, was used as a safety parameter for swallowing<sup>(10)</sup>. The material accumulated in different regions of the pharynx after the end of swallowing was considered food residue<sup>(11)</sup>. The contrast was offered in a glass, using 100% barium sulfate (BS) dilutions, Bariogel®, drinking water and Resource® Thicken Up Clear thickener. The evaluation consisted of offering three consistencies, namely: thin liquid, in 5 ml (2.5 ml of water + 2.5 ml of BS), 10 ml (5 ml of water + 5 ml of BS) and 20 ml (10 ml of water + 10 ml of BS); semi-liquid, in 5 ml of BS, 10 ml of BS and 20 ml of BS; pasty, in 5 ml (5 ml of BS + 1.2 g of thickener), 10 ml (10 ml of BS + 2.4 g of thickener) and 20 ml (20 ml of BS + 3.6 g of thickener). The individual was positioned seated in lateral view, as close as possible to the table top and the intensifier, thus avoiding image distortions.

In the objective examination, silent aspiration in thin liquid was observed during swallowing and residue on the basis of tongue, vallecula, arytenoid, upper esophageal sphincter and pyriform recesses in all consistencies and volumes, especially with semi-liquid and pasty. Despite the functional results described, the patient reported complaints related to swallowing only with thin liquid.

In relation to videolaryngoscopy, represented in Figure 4, it was observed the preservation of the voice from the vibration of the left cricoarytenoid unit, associated with the remaining structures (base of the tongue and constrictors of the pharynx). In the auditory-perceptual analysis, through the Consensus Auditory-Perceptual Evaluation of Voice (CAPE V) 6, roughness and breathiness vocal quality was noted. The patient had good speech intelligibility and *pitch* and *loudness* deviation (low voice and reduced intensity).

Up to the time of writing this report, the patient remained in clinical oncologic control, without cancer for two years and without pulmonary complications.

## DISCUSSION

The functional and oncological outcomes of SCL and STL are favorable in supraglottic and glottic tumors<sup>(3-6,12)</sup>. Transglottic tumors that affect the pre-epiglottic space, the hyoid bone, immobilize at least one cricoarytenoid joint, affect the thyroid cartilage and invade the subglottic space, involving the cricoid cartilage, usually require a total laryngectomy<sup>(7)</sup>.

It is possible to understand that an unfavorable outcome and deficit in the functionality of the larynx still characterize a restricted prognosis of patients with the disease in its advanced stage, due to the loss or alteration of the voice and the presence of dysphagia that significantly compromises the quality of life<sup>(1,6)</sup>.

In order to solve these losses, the expanded STL technique has been used as an alternative to total laryngectomies<sup>(6,7)</sup>. However, invasion of the base of the tongue and hyoid bone maintains the contraindication, due to factors such as difficulties / complications of neolaryngeal reconstruction and massive intractable aspiration<sup>(7)</sup>.

Anteroposterior suspension of the neolarynx is a protective measure of the lower airways and, therefore, its fixation at the base of the tongue does not securely guarantee this positioning, requiring fixation on a bone base<sup>(4,5,7)</sup>. The methodology described in this study was adapted based on Laccourreye's description of 1994<sup>(5)</sup>. The cricoid cartilage was approached in the portion of the remaining hyoid bone on the left side and fixed at the base of the tongue on the right side, in an attempt to ensure the elevation and anteriorization of the laryngeal remnant.

A similar technique was approached in the literature by Hafiz et al.<sup>(7)</sup>, with a reconstruction called cricoglossomandibulopexy. In this study, complete resection of the hyoid bone and fixation of the neolarynx in the mandible (bone base) and at the base of the tongue were performed. However, the structures from the apex were disrupted after surgery.

In laryngeal cancer, surgery must prove acceptable functional results in terms of voice and swallowing, to maintain and justify partial surgery<sup>(1,3,6)</sup>. Thus, a reconstruction that includes resection of the cricoid ring and hyoid bone in STL in minimally invasive transglottic tumors in the subglottis is, perhaps, a challenge for the rehabilitation team<sup>(1,6,7)</sup>.

There are critical factors in the recovery of swallowing after partial laryngectomies: the closing of the airway at the entrance of the neolarynx (the space between the arytenoid cartilage and the base of the tongue) and the contact of the base of the tongue with the posterior wall of the pharynx<sup>(1,6)</sup>. Due to the anatomical changes resulting from the reconstruction, the sphincter action is provided by the approximation of the mobile arytenoid cartilage (rotating forward and inward), the epiglottis (tilting backwards) and the remaining structures<sup>(2,3)</sup>.

The literature dealing with partial laryngectomies states that patients with functional swallowing had longer total pharyngeal transit time, narrower lateral opening of the upper esophageal sphincter and weaker contact between the base of the tongue and the posterior pharyngeal wall. Pharyngeal pressures depend on the action of the velopharyngeal valve, the protrusion of the tongue base and the contraction of the pharyngeal constrictors. Therefore, it can be speculated that the incomplete retraction of the base of the tongue resulted in lower pharyngeal pressure, prolonging the duration of the total transit time, reducing the lateral opening of the upper esophageal sphincter and the elevation of the hyoid bone<sup>(3,6)</sup>. This new physiology probably

provided the large amount of post-swallowing residues in the evaluated individual.

The most frequent functional complications in STL are generally related to breathing, voice and swallowing. Thus, the presence of residue and aspiration in the swallowing analysis of the patient in the present study was already partially predicted, as reported by some authors<sup>(6)</sup>. There are reports in the literature that approximately 40% of patients undergoing SCL and STL have chronic aspiration, mainly with thin liquids, a finding that is justified by the incomplete closure of the larynx, due to the total removal of vocal and vestibular folds<sup>(6,7,12)</sup>.

The voice of patients submitted to STL is produced through the passage of air through the neolarynx during expiration, promoting the vibration of the mucosa and remaining structures, such as arytenoids and pharynx<sup>(2,6)</sup>. There is a consensus in the literature of the presence of some degree of roughness and breathiness in the voice emission of these patients, due to the removal of approximately 70% of the larynx<sup>(6)</sup>. Therefore, there is a maintenance of a functional and laryngeal voice, considered a success in STL.

It is important to note that the presence of aspiration and residue did not affect the general health conditions of the patient, until the moment of the evaluation. Therapeutic success (exclusive nutrition and hydration by mouth and functional laryngeal voice) was possible through constant speech therapy at all times of treatment in order to compensate for functional damage. Such therapeutic strategies need to overcome the losses of aspiration and guidelines, such as maintaining an active life, healthy eating, strict oral hygiene and medical, speech therapy, physiotherapy and nutritional monitoring are essential.

The decision to perform an expanded STL, in this case, was mainly based on the intention to preserve the laryngeal functions, due to the patient's demand, and mobility of both vocal folds and left arytenoid was observed in the pre-surgical video laryngoscopy. For transglottic tumors with invasion of the base of the tongue, hyoid and pre-epiglottic space, the modified STL with reconstruction by means of cricoglossohioidopexy had favorable oncological and functional repercussions in the case described.

The patient remained in oncological control with multiprofessional monitoring for functional maintenance until the moment of this study.

## FINAL CONSIDERATIONS

The functional and oncological outcomes of supratracheal laryngectomy with reconstruction using cricoglossohioidopexy were favorable for a transglottic tumor with invasion on the basis of the tongue. The patient had partial preservation of laryngeal functions, moderate degree of dysphonia and dysphagia and exclusive oral feeding and hydration. The specialized multiprofessional team, including Speech Therapy, is essential, due to the complex rehabilitation process.

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