

Surgical closure of the larynx for intractable aspiration, using double hinged flaps of the vocal folds and false vocal folds

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Abstract

We report a new surgical procedure to treat intractable aspiration: closure of the larynx, using double hinged flaps of the vocal folds and false vocal folds.

The anterosuperior portion of the thyroid cartilage is ablated. A small horizontal incision is made just above the anterior commissure and is continued posteriorly along the laryngeal ventricle; these incisions are continued across the posterior wall of the glottis. Incisions are made into the bilateral vocal folds and false vocal folds in order to create the hinged flaps. The glottis and the supraglottis are closed by approximating the bilateral vocal folds and false vocal folds hinged flaps. Superiorly or inferiorly based sternohyoid muscle pedicles are then inserted into the dead space between the approximated bilateral vocal folds and false vocal folds hinged flaps. The removed lamina of the thyroid cartilage is obliterated between both sternohyoid muscle flaps to enforce the closure of the larynx.

Key words: Pneumonia, Aspiration; Larynx; Surgical Procedures, Laryngoscopic

Introduction

Many surgical procedures have been established to treat swallowing disorders with aspiration. These operations allow restoration of respiration and deglutition without aspiration. Many surgical procedures have been established to treat intractable aspiration.^{1–8} It is important to evaluate the state of the swallowing disorder; surgical procedures can then be selected according to the pathophysiology.

This paper will focus on surgical options for intractable aspiration with swallowing disorder and will present a new surgical closure technique for the larynx, using hinged flaps created from the vocal folds and false vocal folds.

Operative procedure

If a preliminary tracheotomy has not been performed, a permanent tracheostomy is first created under local anaesthesia, and general anaesthesia is then delivered through the tracheostomy cannula.

A vertical anterior cervical skin incision is made between the hyoid bone and the cricoid cartilage as an approach to the anterior aspect of the thyroid cartilage. Skin flaps are developed by subcutaneous

dissection superficial to the sternohyoid and omohyoid muscles. The fascial layer over the sternohyoid and omohyoid muscles is exposed. The sternohyoid muscles are separated in the midline and the bilateral sternohyoid muscles are retracted with a retractor, exposing the thyroid and cricoid cartilage of the larynx.

An incision is made along the superior edge of the superior thyroid notch and bilateral lamina of the thyroid cartilage. The outer and inner perichondria are removed from the thyroid cartilage. Since there is no perichondrium in the midline of the thyroid cartilage, the thyroepiglottic ligament is separated from the thyroid cartilage with scissors. The antero-superior portion of the thyroid cartilage is then ablated with scissors (Figure 1a).

The anterior commissure is located halfway between the superior thyroid notch and the inferior border of the thyroid cartilage (Figure 1a, b); this point is a key external landmark for the level of the vocal fold.

Before the laryngeal lumen is entered, a small horizontal incision is made just above the anterior commissure in order to visualize the vocal folds. This incision is continued posteriorly under direct vision of the vocal folds. Using small skin hooks,

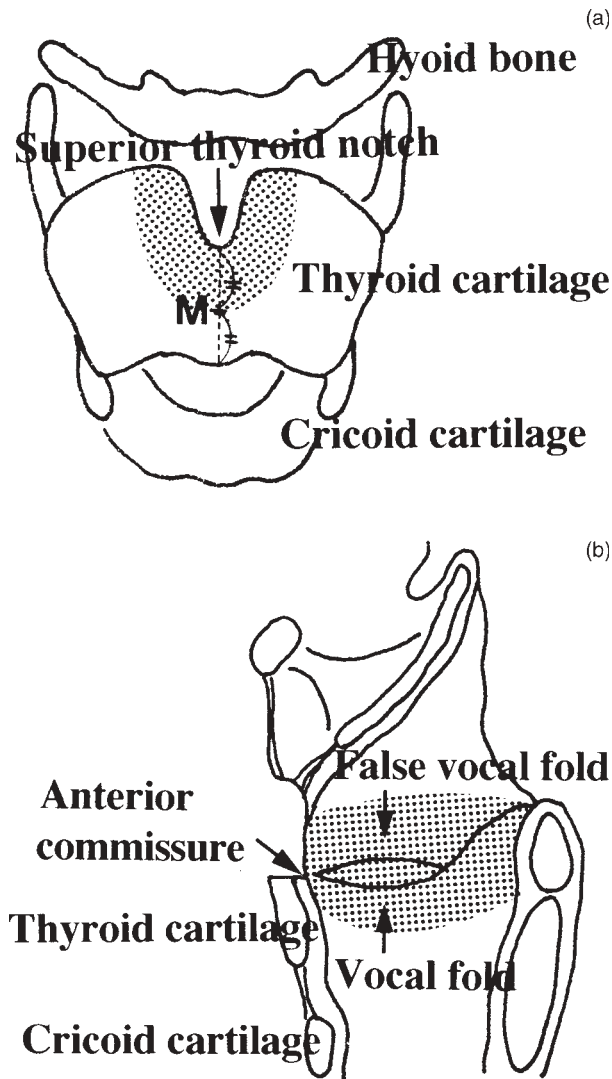


FIG. 1

(a) Removed portion of the thyroid cartilage (shaded area). M = halfway point between the superior thyroid notch and inferior border of the thyroid cartilage. (b) Sagittal view of the larynx after the anterosuperior portion of the thyroid cartilage has been removed. Shaded area = laryngeal closure area.

the stem of the epiglottis is retracted superiorly, allowing direct vision of the bilateral vocal folds and false vocal folds. An incision is made along the laryngeal ventricle, and this incision is continued across the posterior wall of the glottis, that is, the posterior commissure.

To promote haemostasis, 0.5 per cent lidocaine with adrenaline (1:200,000) is infiltrated into the bilateral vocal folds and false vocal folds. Incisions are made into the bilateral vocal folds and false vocal folds in order to create hinged flaps (Figure 2a). The glottis and the supraglottis are then closed by approximating both vocal folds and false vocal folds hinged flaps with interrupted 4-0 nylon sutures (Figure 2b).

Superiorly or inferiorly based sternohyoid muscle pedicles are then inserted into the dead space between both the approximated vocal folds and

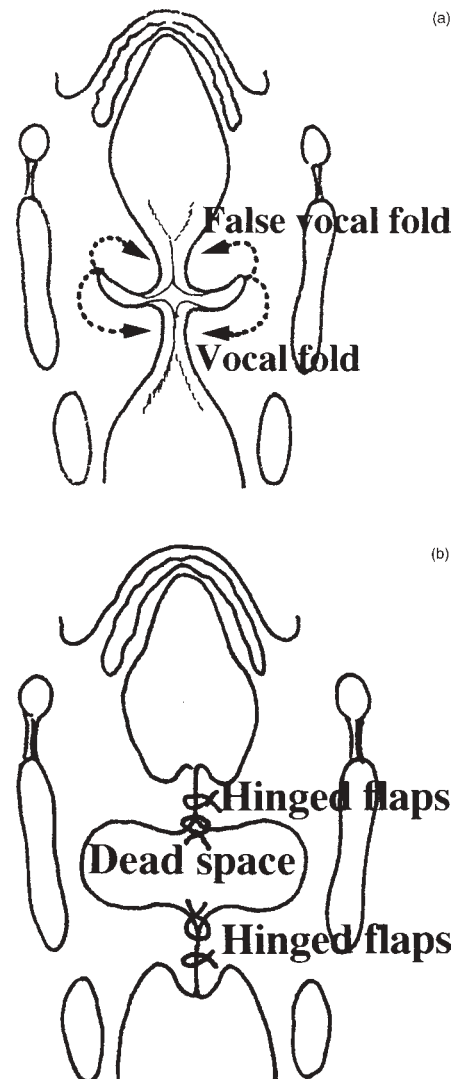


FIG. 2

(a) Coronal view of the larynx before creating hinged flaps. Dotted lines and arrows = incision lines used to create hinged flaps. (b) Coronal view of the larynx after closing vocal folds and false vocal folds hinged flaps.

false vocal folds hinged flaps (Figure 3). The leading edges of the sternohyoid muscle flaps are anchored to the interarytenoid muscle around the posterior wall of the glottis, that is, the posterior commissure. The removed lamina of the thyroid cartilage is obliterated between both sternohyoid muscle flaps to enforce the closure of the larynx (Figure 3). The wound is closed over a drain.

Case report

The case in question was that of a 55-year-old man who complained of intractable aspiration due to a swallowing disorder caused by a brain haemorrhage. He suffered repeated aspiration pneumonia. Nutrition was initially delivered through naso-gastric tube feeding and later via a percutaneous endoscopic gastrostomy.

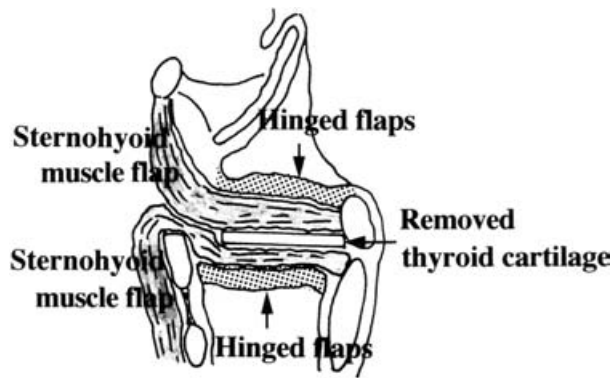


FIG. 3

Sagittal view of the larynx after completion of five-layer closure.

A pre-operative videolaryngoscopy showed copious saliva retained in the bilateral piriform sinus of the hypopharynx and entering into the trachea. A pre-operative videofluorogram demonstrated aspiration of a substantial amount of contrast medium.

Surgical closure of the larynx was performed, using hinged flaps of vocal folds and false vocal folds (Figure 4).

A post-operative videolaryngoscopy via the tracheostoma showed the larynx to be completely closed. A post-operative videofluorogram showed that aspiration had been improved. The patient was able to successfully swallow without aspiration.

Results

The advantages associated with closure of the larynx in combination with double hinged flaps of the vocal folds and false vocal folds include: (1) reliability (the method allows complete closure of the larynx and enables restoration of respiration and deglutition without aspiration), and (2) minimal surgical invasion. The disadvantage is that the patient loses phonatory function.

Discussion

Surgical procedures for swallowing disorders are performed for patients who have difficulty with pharyngeal swallowing and aspiration. The cause and pathophysiology of swallowing disorders are different for each patient. Furthermore, there is no consensus on surgical indications for swallowing disorders with aspiration.

Generally, surgery becomes one of the options for the treatment of swallowing disorders after the patient has undergone sufficient rehabilitation. Alternatively, surgery can be performed early in the rehabilitation process, when it is effective for rehabilitation of patients with swallowing disorders.

Regarding mild aspiration, surgical procedures (e.g. laryngeal suspension surgery, cricopharyngeal myotomy and infrahyoid myotomy) can be selected alone or in combination, according to the patient's type of aspiration and its timing before, during or

after swallowing. Medialization of the vocal fold can be selected for the patient with glottic closure insufficiency.

Patients who have swallowing disorders with intractable aspiration and aspiration pneumonia may undergo surgery to prevent aspiration. Many surgical techniques have been devised to separate the upper respiratory tract from the digestive tract. These operations allow restoration of respiration and deglutition without aspiration. Patients who have difficulty in pharyngeal swallowing and aspiration require such procedures.

There are two major categories of such operations. The first is divarication of the upper respiratory and digestive tracts. Lindeman's diversion procedure¹ and the total laryngectomy of Cannon and McLean² are examples of this. The second category is surgical closure of the larynx. The larynx is closed at the glottic level or at the supraglottic level. The former is achieved by Montgomery's procedure.³ The latter is achieved by the epiglottic flap operation of Habal and Murray.⁴ Biller's laryngoplasty⁵ closes the larynx at the supraglottic level. Castellanos⁶ reported petiole supraglottopexy, a transthyrotomy closure of the supraglottic larynx. Each surgical procedure is successful in preventing aspiration, in the hands of a laryngeal surgeon.

Biller's technique of tubed epiglottoplasty⁵ is useful for the management of chronic, intractable aspiration. This method of laryngoplasty effectively prevents aspiration without sacrificing phonatory function. This technique restricts the closure of the epiglottis and aryepiglottic folds over the arytenoids and into the interarytenoid area. Closure of the posterior part of the larynx occasionally becomes incomplete. We introduced a modified form of Biller's technique for supraglottic closure of the larynx for intractable aspiration.⁷ This revised technique reduced leakage from the closed, posterior part of the larynx and improved the likelihood of successful surgical closure of the larynx. We added reliability to the closure in the simple Biller's procedure, employing surgical closure of the posterior glottis.

- **This paper introduces a new surgical technique of laryngeal closure both at the glottic and the supraglottic level in combination with double hinged flaps of the vocal folds and false vocal folds, for intractable aspiration**
- **The advantages of this procedure include reliability as a method of complete closure, without aspiration, and minimal surgical invasion**
- **The disadvantage is the loss of phonatory function**

Following laryngeal closure at the glottic level by Montgomery's procedure,² closure of the posterior part of the glottis occasionally becomes dehiscient. Sasaki *et al.* introduced a variation on Montgomery's procedure for glottic closure, avoiding posterior

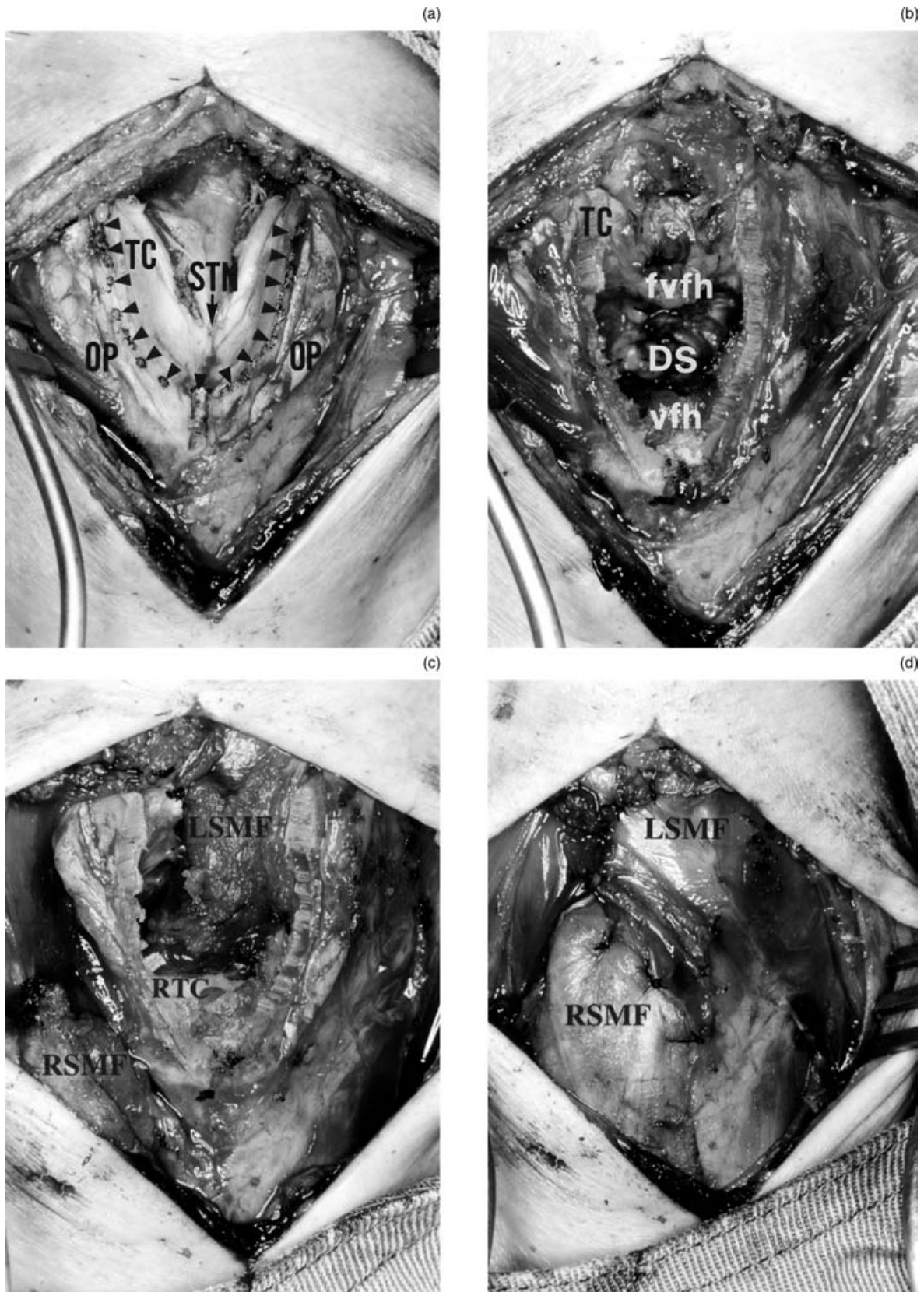


FIG. 4

(a) The outer perichondrium (OP) and inner perichondrium have been removed from the thyroid cartilage (TC). STN = superior thyroid notch; arrow heads = thyroid cartilage incision line. (b) Appearance after closure of the hinged flaps of the vocal fold (vfh) and false vocal fold (fvfh). DS = dead space; TC = thyroid cartilage. (c) Left superiorly based sternohyoid muscle flap (LSMF) and right inferiorly based sternohyoid muscle flap (RSMF) and removed thyroid cartilage (RTC) have been inserted into the dead space. (d) Appearance after closure of the larynx. LSMF = left superiorly based sternohyoid muscle flap; RSMF = right inferiorly based sternohyoid muscle flap

dehiscence by the introduction of a viable, superiorly based sternohyoid muscle flap to reinforce closure of the glottis in its posterior commissure.⁸

In this paper, we introduce a new surgical technique of laryngeal closure both at the glottic and the supraglottic levels, used for treating intractable aspiration. The advantages associated with closure of the larynx in combination with double hinged flaps of the vocal folds and false vocal folds include reliability (as a method of complete closure of the larynx for restoration of respiration and deglutition without aspiration) and minimal surgical invasion. The disadvantage is that the patient loses phonatory function.

Many surgical procedures have been established for swallowing disorders with intractable aspiration. It is important to select patients who will benefit from these surgical interventions.

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