

HEMICRICOIDECTOMY FOR VOICE REHABILITATION FOLLOWING HEMILARYNGECTOMY WITH IPSILATERAL ARYTENOID REMOVAL

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The purpose of this article is to describe an approach to reconstruction of the larynx after vertical partial laryngectomy with removal of the ipsilateral arytenoid cartilage. This method addresses the problem of postoperative posterior glottal incompetence (aphonia with or without aspiration). The technique involves resection of the ipsilateral half of the cricoid cartilage, use of an inferiorly based strap muscle flap for vocal fold reconstruction, and placement of a customized stent. This technique may be used at the time of the primary cancer extirpation or as a secondary rehabilitative procedure. Generally, patients who have undergone this procedure have had minimal postoperative breathiness with good phonatory and airway function. We recommend this reconstructive technique for patients with large posterior defects following hemilaryngectomy.

KEY WORDS — cricoid cartilage, hemicricoidectomy, hemilaryngectomy, laryngeal cancer, laryngeal carcinoma, laryngeal reconstruction, vocal cord cancer, vocal fold cancer, voice rehabilitation.

INTRODUCTION

This report presents the authors' approach to laryngeal reconstruction following vertical hemilaryngectomy with removal of the ipsilateral arytenoid cartilage. It specifically targets the problem of postoperative posterior glottal incompetence. The typical vertical hemilaryngectomy reconstruction involves the use of a pedicled muscle flap to fill the resection defect. However, when the ipsilateral arytenoid cartilage is removed, severe breathy dysphonia or aphonia usually results from posterior glottal incompetence. This outcome is due to profound air wasting due to the contralateral (healthy) vocal fold's inability to achieve posterior closure. We have employed ipsilateral hemicricoidectomy as a secondary rehabil-

itative procedure in such patients, and as a primary procedure at the time of hemilaryngectomy in patients who require arytenoid cartilage removal.

SURGICAL TECHNIQUE

A horizontal incision is made in a skin crease overlying the thyroid ala. The underlying tissue is dissected to expose the cricoid cartilage in the midline. Next, the soft tissue overlying the ipsilateral portion of the cricoid cartilage is dissected free, exposing the cartilage from the anterior midline to the posterior midline. Preserving the inner perichondrium and subglottic mucosa, the hemicricoidectomy is then carried out bluntly with a Freer or Herd elevator (Fig 1). An oscillating saw may also be used for this por-

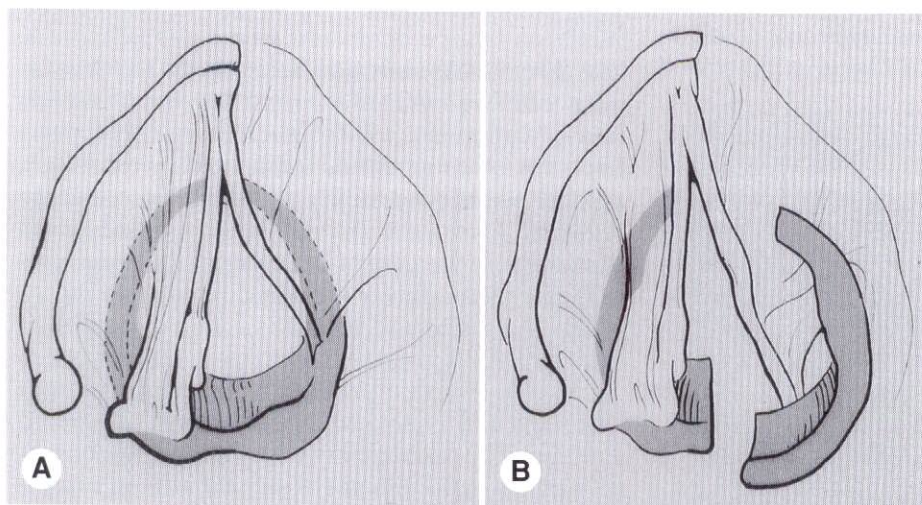


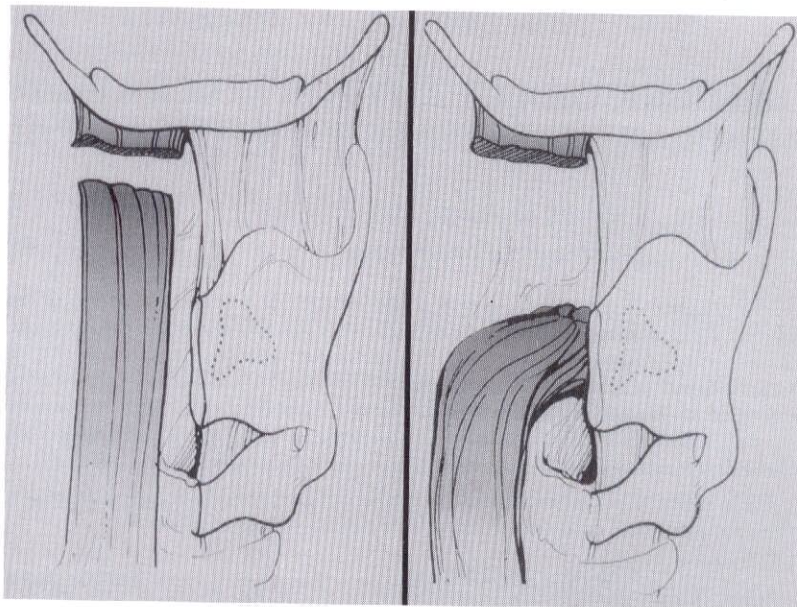
Fig 1. A) Problem: widely lateralized posterior neoglottis. B) Removal of ipsilateral half of cricoid cartilage.

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Fig 2. Reconstruction with strap muscle sutured to midline, filling gap left by removed arytenoid cartilage.



tion of the procedure. Care is taken not to cross the midline anteriorly or posteriorly. Excessive resection will lead to significant airway narrowing. Conversely, inadequate resection of the posterior portion of the cricoid cartilage leads to a poor postoperative outcome (due to a persistent glottal gap). The anterior cut is made at the midline, and the posterior cut is made 2 to 3 mm from the midline.

The vocal fold reconstruction is accomplished by the use of an inferiorly based portion of medial strap muscle, approximately 2 to 3 cm in thickness. The superior muscle detachment should be made just below the hyoid bone; care should be taken not to devitalize the neurovascular bundle below. The cut end of the strap muscle flap is sutured to the site of the previously removed arytenoid cartilage (Fig 2). Pyriform sinus mucosa is then mobilized and used to cover the muscle flap. The mucosal closure should be complete, particularly inferiorly. A Montgomery stent is then custom-tailored as a hemilaryngectomy mold (Fig 3A). Once the stent is placed into the larynx, the mucosa is closed in a standard fashion. The remaining strap muscles are closed in the midline. Finally, braided pacemaker wire is placed through the skin flap and the larynx, securing the stent. The wound is drained and closed in layers. Figure 3B shows the completed procedure. The stent is left in place 1 to 2 weeks and then removed endoscopically.

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CASE REPORTS

CASE 1

A 30-year-old man with a history of T1N0 squamous cell carcinoma of the right true vocal fold had been initially treated with radiotherapy. Three years later, the tumor recurred, and he underwent a right vertical hemilaryngectomy with arytenoid cartilage removal. Afterward, the patient was aphonic. On examination, the patient demonstrated a wide-open posterior glottis during attempted phonation (Figure 4A,B). An attempt at improving the voice by augmenting the left vocal fold with lipoinjection was unsuccessful. The patient desired further voice rehabilitation and underwent hemicricoidectomy and reconstruction. The tracheotomy was removed 3 weeks after surgery. After the operation, the patient's voice was rated as class 2.0 (see Table). Figure 4C shows the appearance of the larynx during inspiration 1 year after reconstruction.

Comment. With the hemicricoidectomy procedure, the time to decannulation may vary from patient to patient, since the airway is significantly reconfigured

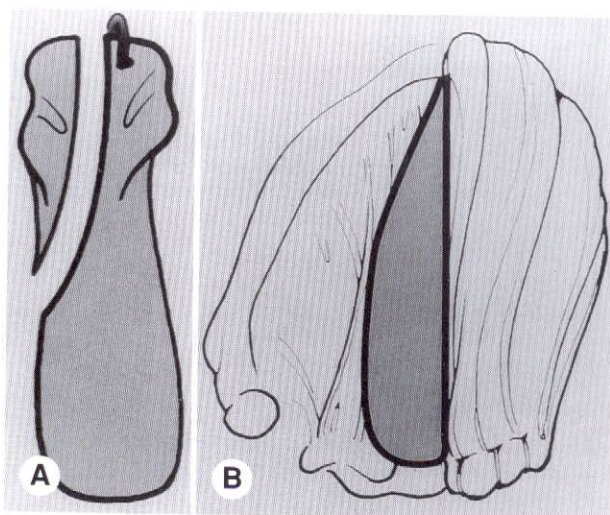


Fig 3. Modified Montgomery stent. A) Anterior view. B) Superior view of stent in place, against strap muscle reconstruction.

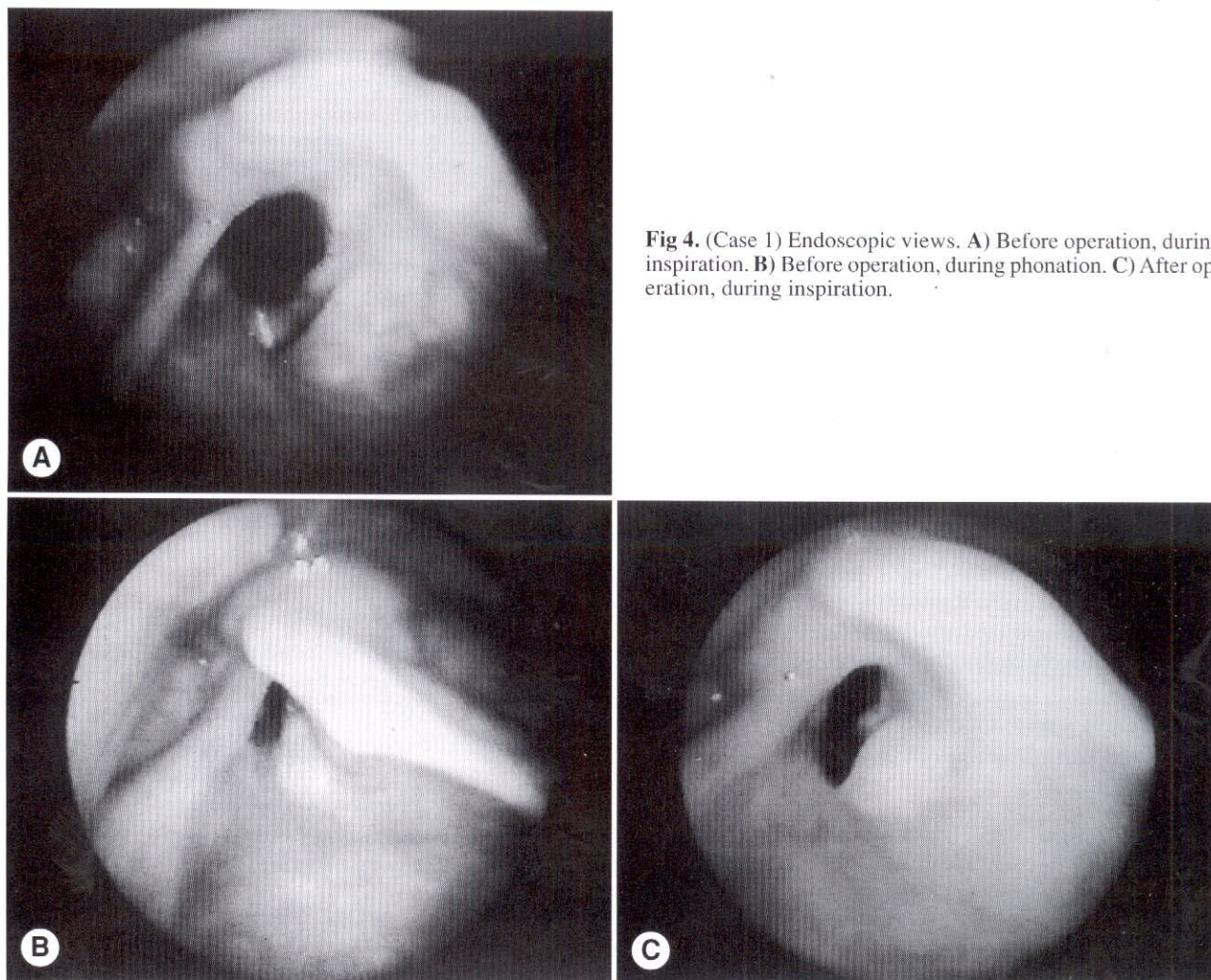


Fig 4. (Case 1) Endoscopic views. **A)** Before operation, during inspiration. **B)** Before operation, during phonation. **C)** After operation, during inspiration.

and reduced in size. In this patient, although Fig 4C shows that the airway was obviously narrowed, the patient was athletic and experienced no airway-related symptoms. Five years later, the patient's voice and airway were unchanged. In performing this procedure, the surgeon must avoid removing too much of the cricoid cartilage.

CASE 2

A 34-year-old woman was found to have a T2N0 squamous cell carcinoma of the left true vocal fold. The lesion was bulky and involved a portion of the ipsilateral arytenoid cartilage. The patient elected surgical therapy and underwent an extended left hemilaryngectomy with removal of the ipsilateral aryte-

noid cartilage. During the operation, the patient was left with a relatively large posterior defect. Therefore, she underwent hemicricoidectomy, followed by strap muscle reconstruction. She was decannulated 3 weeks after surgery. At the 2-year follow-up, the patient had no evidence of new or recurrent cancer, and her voice was rated as class 3.0; the patient was satisfied with the result.

Comment. Hemicricoidectomy as part of the primary oncological procedure may be indicated when the surgeon anticipates difficulty closing the posterior larynx with a traditional method of reconstruction.

DISCUSSION

Vertical partial laryngectomy has long been accepted as a form of conservation laryngeal surgery for the treatment of selected glottic tumors.¹⁻³ The procedure was initially designed to treat unilateral glottic malignancies, but has since been extended to include tumors involving the anterior commissure and/or the ipsilateral arytenoid mucosa.⁴

Although there has been little change in terms of

VOICE RATING SYSTEM

Voice Rating	Definition
1.0	Normal voice
2.0	Near-normal voice (normal to layperson)
3.0	Moderate dysphonia
4.0	Severe dysphonia
5.0	Aphonia

the resection over the years, there have been many articles proposing different reconstructive techniques.⁵⁻⁹ The goal of reconstructive techniques is mainly to provide better postoperative voice and deglutition by reconstructing the resected vocal fold. In his article on glottic reconstruction, Hirano⁵ proposes three requirements for good phonatory function following this procedure: adequate glottic closure, proper alignment of the reconstructed fold at the glottic level, and a smooth lining for the reconstructed side. With standard hemilaryngectomies (not involving the resection of the arytenoid cartilage), the above criteria are achievable with the use of muscle flaps or other reconstructive techniques in most cases, since the surgical defect is relatively small. However, when the resection is extended to involve the arytenoid cartilage, a larger defect is created posteriorly. This posterior defect is usually difficult to fill with a pedicled muscle flap because of the height and bulk of the cricoid cartilage in this region. As a result, the patient undergoing reconstruction with a standard muscle flap often experiences profound air wasting due to a persistently open posterior glottis. The patient is also placed at an increased risk of aspiration, as he or she cannot occlude the glottis when swallowing.

Biller and Urken¹⁰ recognized this problem and proposed hemicricoid collapse. This technique allowed the remaining arytenoid cartilage to better approximate the reconstructed side, resulting in elimination of aspiration in 3 of the 4 patients on whom they performed the procedure. Their procedure involved removing multiple small vertical segments of cricoid cartilage on the ipsilateral side and collapsing the cricoid ring. The segments were secured in the collapsed position with a suture.¹⁰

In addition to providing a novel reconstructive technique, Biller and Urken¹⁰ demonstrated the relative safety of removing portions of the cricoid cartilage, which previously was thought to be injudicious. Unfortunately, the cricoid collapse procedure is quite technically complicated, as it entails making up to 9 cuts in the cricoid cartilage with a saw while avoiding injury to the inner perichondrium. We performed this procedure in 1 patient and found that it did not allow adequate medialization of the posterior portion of the glottis.

As an alternative, we propose removal of the ipsilateral half of the cricoid cartilage. This procedure has been used as an adjunct in reconstruction following hemilaryngectomy with resection of the ipsilateral arytenoid cartilage. The removal of half of the cricoid cartilage allows the muscle flap reconstruction to better approximate the midline, since it does not have to bend around the cricoid cartilage. Additionally, with removal of the bulky posterior portion of the cricoid cartilage, the muscle flap can more easily fill the posterior defect left by the removal of the arytenoid cartilage.

Because of the partial airway collapse, molds must be placed until the reconstructed side heals. A tracheotomy is therefore needed as part of the procedure. As mentioned, a modified endolaryngeal stent is placed; this is typically removed 1 to 3 weeks after the operation. After a period of observation, the patient is decannulated.

Hemicricoidectomy is infrequently indicated; we have performed this procedure in 6 patients. Unfortunately, follow-up in this group has been poor. Nevertheless, 5 of the patients were decannulated within 6 weeks. The other patient, who had long-standing suppurative chondritis before the operation, required prolonged tracheotomy. The average length of time to decannulation was 5 weeks. Long-term voice follow-up was possible for 3 patients: 1 had an excellent voice and 2 had fair voices. No patient in the series had significant postoperative aspiration.

One potential disadvantage of this procedure is the risk of causing airway narrowing. We did not encounter problems in decannulating these 6 patients. However, we recognize that we present only a small series of cases, and that these results may not hold up with continued use of this procedure.

CONCLUSIONS

Hemicricoidectomy with strap muscle reconstruction may be used to close the posterior larynx in patients requiring vertical hemilaryngectomy with removal of the ipsilateral arytenoid cartilage. We believe that this technique offers a viable method of vocal rehabilitation to patients who otherwise have no feasible alternatives. Although experience with this technique is limited, the procedure may provide excellent results in carefully selected cases.

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