Chapter 38 – Bilateral Vocal Fold Immobility

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Bilateral vocal fold immobility (BVFI) is not a common condition. Patients usually have symptoms of airway insufficiency, such as stridor and dyspnea, with a normal or nearly normal voice. This is in contrast to patients with unilateral vocal fold immobility, who usually complain of a breathy voice and aspiration. BVFI includes immobility from both neurogenic causes and mechanical fixation of the cricoarytenoid (CA) joints.

Bilateral vocal fold paralysis (BVFP) may be due to (1) iatrogenic injury to the recurrent laryngeal nerve (e.g., thyroidectomy, anterior cervical disc surgery, carotid endarterectomy, esophageal surgery), (2) progressive neurologic disorders (e.g., amyotrophic lateral sclerosis, Shy-Drager syndrome, syringomyelia, Guillain-Barré syndrome), and (3) idiopathic causes. Mechanical fixation of the CA joints causing BVFI may be due to (1) fixation of the CA joint secondary to radiation therapy, rheumatoid arthritis and other connective tissue disorders, and benign infiltrative disorders such as amyloidosis, granulomatous diseases, and trauma and (2) posterior glottic stenosis (PGS).

Correctly identifying the cause of BVFI and BVFP is critical in guiding treatment and shaping the expectations of both the patient and surgeon. The aim of treatment is to improve the airway while minimizing adverse effects on the voice.

PATIENT SELECTION

Patients with BVFI usually demonstrate symptomatic airway obstruction and often already have a tracheostomy and want to be decannulated. Contraindications to treating BVFI, other than performing a tracheostomy, are the presence of aspiration or a rapidly progressive neurologic disorder. Relative contraindications to treating PGS are compromised pulmonary status, uncontrolled diabetes, and previous radiation therapy. Unrealistic expectations on the part of the patient are a relative contraindication to treating all types of BVFI. Patients must understand and accept that to improve their airway, the quality of their voice may be adversely affected. Patients should also expect to have worse vocal quality at the expense of an improved airway. Such counseling needs to be frank and well documented. A patient who is unwilling to accept any decrease in vocal function should be considered for tracheostomy and not glottic enlargement surgery. In addition, the patient should understand that multiple procedures might be necessary to optimize the airway with the least potential impact on the voice. This allows the surgeon to enlarge the glottic airway in a staged, conservative fashion, which hopefully will minimize the negative impact on the voice.

PREOPERATIVE EVALUATION

It is difficult to distinguish between BVFP and BVFI by physical examination alone. A detailed history aids in narrowing the differential diagnosis, but additional studies are usually necessary.

Laryngeal electromyography of both the right and left thyroarytenoid–lateral cricoarytenoid (TA-LCA) muscle complexes is useful to determine the cause of BVFI. If BVFP is present, there will be evidence of significant neurologic injury, with or without partial recovery. If the neurologic pattern shows a new injury with a chance of recovery, delaying destructive surgery is prudent.[1] The authors advocate that in an attempt to preserve the voice, surgery should involve the vocal fold with the worse neurologic status. This may improve voice outcomes by not altering the vocal fold that has best neurologic status and thus better muscle tone. Patients with BVFI and PGS, in contrast to those with BVFP, will have normal neurologic activity of the TA-LCA muscle complexes.

Manual palpation of both CA joints, either in the office[2] or in the operating room, can further help detect the cause of BVFI and assist in guiding surgical planning. When both joints are impaired, palpation can determine the CA joint with the least range of motion. This is the optimal side for static, glottic enlargement surgery.

PREOPERATIVE PLANNING

Imaging studies are important in evaluating a patient with idiopathic vocal fold immobility. Enhanced computed tomography (CT) or magnetic resonance imaging (MRI) of the skull base, neck, and upper part of the chest can help identify the site of a lesion (brain stem, vagus nerve, or recurrent laryngeal nerves). Enhanced CT with fine

cuts through the larynx is used to evaluate the CA joint for abnormalities or, in the case of PGS, the extent of stenosis, which may change the type of surgical intervention. Arytenoid subluxation or dislocation may also be identified. MRI of the brain is needed when brain or brain stem causes are suspected, such as stroke or Arnold-Chiari malformation.

Swallowing studies are crucial in patients who complain of dysphagia. Because the incidence of aspiration is high after many types of surgery to improve the airway, more conservative surgery or tracheostomy may be most appropriate for patients with dysphagia or tenuous swallowing ability.

SURGICAL APPROACHES

Bilateral Vocal Fold Immobility

Surgical treatment of BVFI involves static enlargement of the glottic airway. A stepwise approach to create an adequate airway may be prudent. The surgeon must integrate the patient's comorbid problems into the surgical decision-making process. In general, patients with rapidly progressive neurologic disorders or other serious comorbid conditions tend to be best treated with a tracheostomy. Most other causes of BVFI can be treated with conservative endoscopic techniques. Transverse cordotomy and medial arytenoidectomy procedures are ideal conservative options because the airway is enlarged with fewer detrimental effects on vocal quality[3] than occur with external and total arytenoidectomy procedures. Total arytenoidectomy creates a larger posterior airway but is more likely to lead to aspiration and a substantive decrease in vocal quality. Endoscopic suture lateralization is useful as a temporary measure when there is no loss of mucosa in the posterior glottis. External (open) arytenoidectomy is reserved for patients in whom endoscopic procedures have failed or are impossible because of anatomic limitations. Treatment of PGS may be achieved by endoscopic or open techniques and consists of lysis of the interarytenoid synechiae, creation of a microtrapdoor flap, or the techniques mentioned earlier. If the patient already has a tracheostomy before arytenoid surgery, it should remain in place until a proper capping trial for decannulation can be conducted, approximately 6 weeks after surgery.

Palpation of the Cricoarytenoid Joint

Palpation of the CA joint is performed by placing a sturdy instrument adjacent to the vocal process and pushing laterally. An instrument such as an Abrams cannula can be used if the patient is awake. A blunt laryngeal elevator or large cup forceps can be used to palpate the joint while the patient is under general anesthesia. Both CA joints are evaluated to compare the degree of effort required to displace the vocal process and the speed of medial tissue recoil. If one CA joint displays better movement, surgery is initially performed on the contralateral (worse) side. If the interarytenoid region moves during this maneuver, PGS is probably present.

Securing the Airway

The patient's airway is secured by intubation with a laser-safe endotracheal tube (ETT) if appropriate, placement of a tracheostomy, or jet ventilation. The method of airway maintenance is determined by the severity of the patient's airway restriction, comorbid conditions, and the surgery to be performed.

Tracheostomy

Tracheostomy is a reasonable option for patients with BVFI, especially those with dysphagia or rapidly progressive neurologic disease, as well as for patients who do not want decreased vocal function (see Chapter 68).

Transverse Cordotomy

Transverse cordotomy (posterior cordectomy) was described by Dennis and Kashima in 1989[4] as a more conservative surgery than total arytenoidectomy. The patient is intubated with a 5.0 or 5.5 laser-safe ETT if a preexisting tracheostomy is not present. The laryngoscope is suspended and angled toward the operative side. Usually, the ETT can be placed in the posterior glottis to allow exposure of the vocal process on the side to be operated. Alternatively, the ETT can be placed anterior to the laryngoscope or jet ventilation can be used. CO_2 laser precautions are implemented, including placement of a saline-soaked pledget in the subglottis to prevent disruption of the ETT cuff. A typical CO_2 laser setting of 4 watts, superpulse, with a small (0.25 to 0.4 mm) spot size minimizes collateral thermal damage. After confirming the location of the vocal process, an incision is made just anterior to it. Care is taken to not expose the arytenoid cartilage to avoid the formation of a granuloma. The cordotomy extends across the entire width of the true vocal fold and completely separates the vocal fold from the vocal process. The incision may also include the medial 3 to 4 mm of the false vocal fold (Fig. 38-1). Hemostasis is achieved with the laser, suction cautery, or bipolar cautery. Endoscopic evaluation with a 30-degree telescope should confirm that the cordotomy is flush with the wall of the subglottis laterally. The application of topical mitomycin C (0.5 mg/mL) to the wound for 5 minutes is an optional adjunctive treatment in an attempt to decrease fibroblast formation and scar tissue at the operative site. Four percent lidocaine spray is used at the end of the

procedure to minimize postoperative laryngospasm.

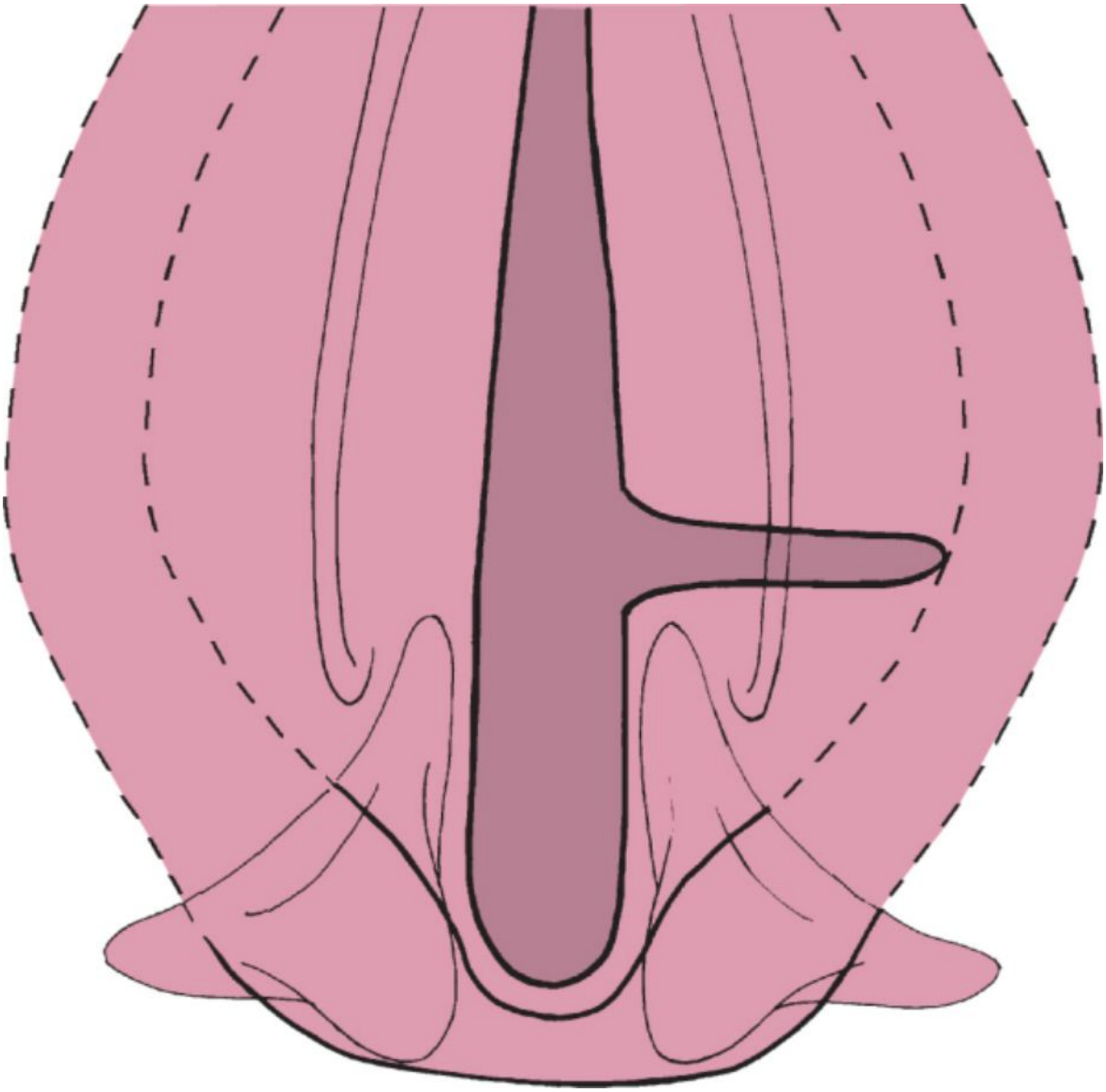

Figure 38-1 CO_2 laser incision extending laterally to the cricoid ring for transverse cordotomy.

Medial Arytenoidectomy

In 1993, Crumley and colleagues described a more conservative version of total arytenoidectomy.[5] The patient is intubated with a laser-safe 5 or 5.5 endotracheal tube. Laser safety precautions are implemented. CO_2 laser ablation of the most medial 2 to 3 mm of the body of the arytenoid cartilage results in enlargement of the posterior glottic airway. The vocal process and intra-arytenoid mucosa should not be disturbed (Fig. 38-2). The amount of arytenoid cartilage obliterated is guided by the degree of airway compromise and tissue reaction. Initially, it is prudent to be conservative in resection in case the patient might require a contralateral medial arytenoidectomy or airway enlargement surgery in the future. This must be discussed before surgery. Hemostasis is achieved with the laser or epinephrine-soaked (1 : 10,000 concentration) pledgets. Application of mitomycin C is optional. Laryngotracheal anesthesia with 4% lidocaine is used to minimize postoperative laryngospasm.

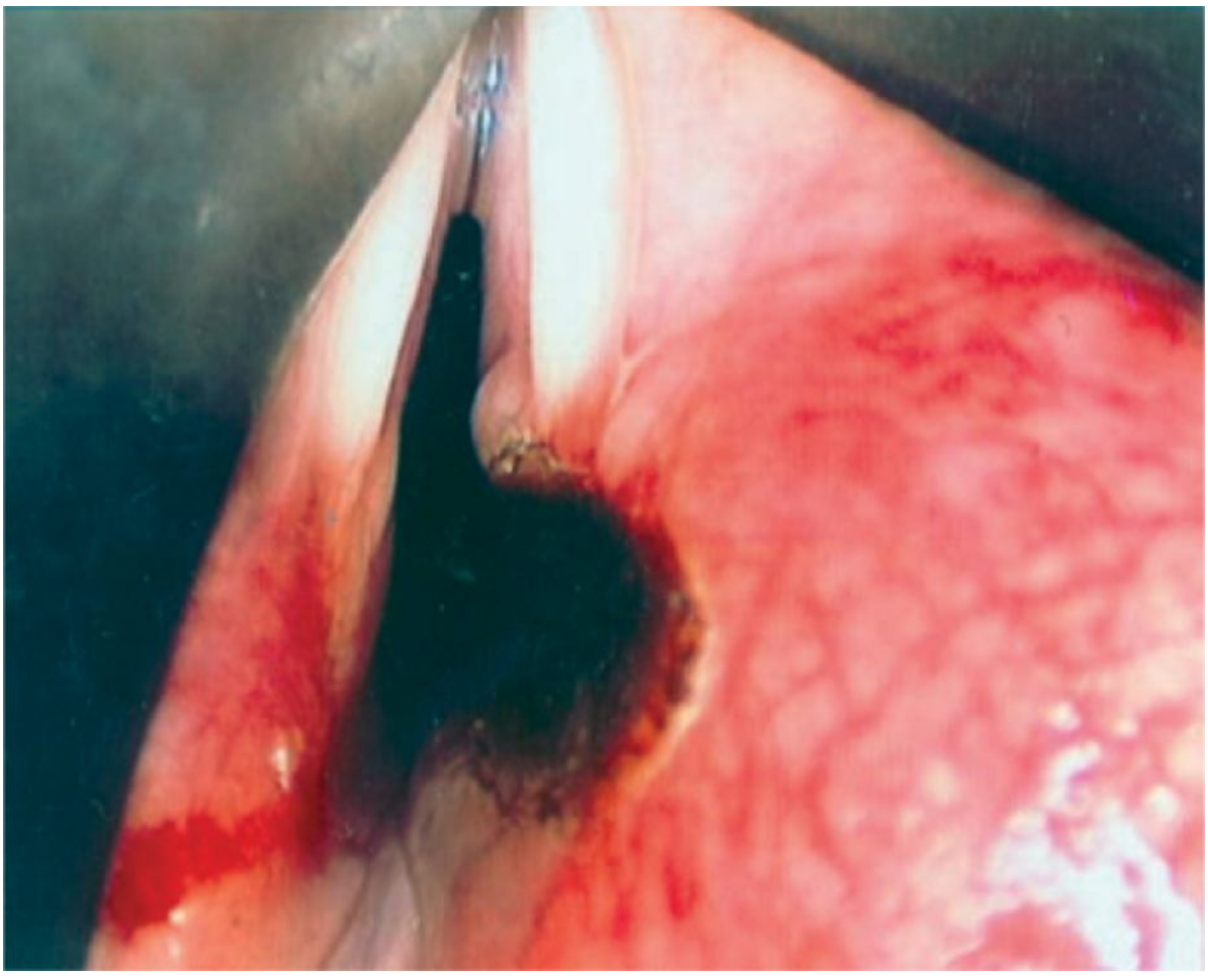

Figure 38-2 Defect after medial laser arytenoidectomy.

Total Arytenoidectomy

The classic total arytenoidectomy procedure was described by Ossoff and associates in 1983.[6] The same initial steps are taken as with the medial arytenoidectomy procedure. Continuous CO_2 laser ablation of the entire body of the arytenoid is achieved by removing cartilage until the defect is flush with the wall of the cricoid ring (posteriorly and laterally) (Fig. 38-3). This can be verified with a 70-degree telescope. There is no reason from an airway standpoint to remove more of the arytenoid than what is within the cricoid ring. The laser and epinephrine-soaked pledgets (1:10,000 concentration) are used to achieve hemostasis, and application of mitomycin C is optional. Laryngotracheal anesthesia with 4% lidocaine is used to minimize postoperative laryngospasm.

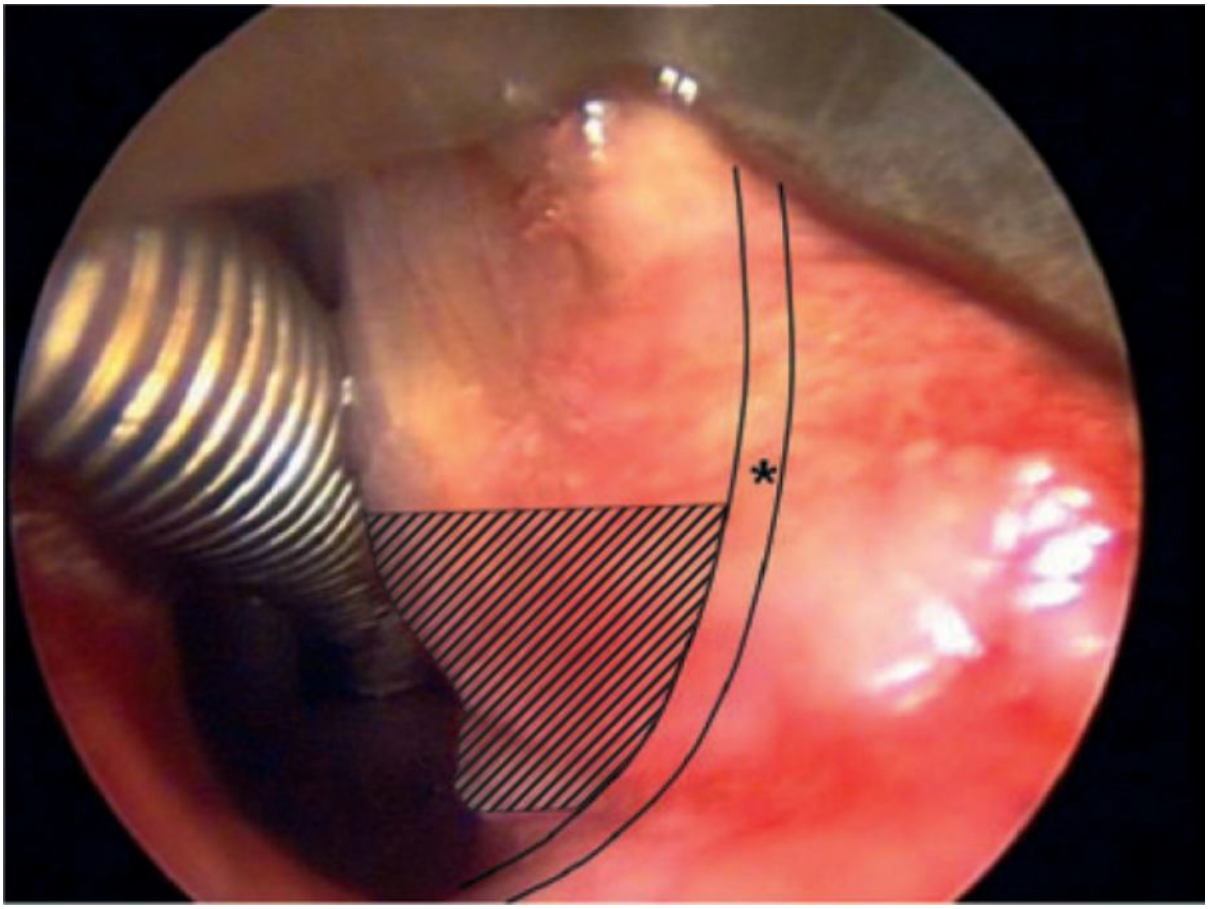

Figure 38-3 Total arytenoidectomy results in the removal of arytenoid cartilage *(shaded region)* within the cricoid ring *(asterisk)*.

Endoscopic Suture Lateralization

This procedure is based on the technique of Lichtenberger and Toohill.[7] It is used as a temporizing measure in patients with early symptomatic BVFP who have an uncertain prognosis for recovery. Endoscopic suture lateralization should not be carried out if the patient has suffered recent trauma to the posterior glottis from an ETT or is currently intubated. Under microscopic or telescopic visualization, an endoextralaryngeal needle carrier device is loaded with 2-0 Prolene suture. The needle is pushed through the skin and larynx, just anterior and below the vocal process of the most medialized vocal fold. The suture is secured outside the neck. The proximal end of the same suture is fed through the free needle designed to be used with the needle carrier. This needle is then pushed through the larynx slightly superior to the vocal fold. Traction is placed on these two sutures to lateralize the vocal fold. The sutures are tied over a silicone button on the skin. This step is repeated, with placement of another lateralization suture 1 to 2 mm anterior to the first suture (Fig. 38-4). This procedure can be performed in conjunction with partial arytenoidectomy as part of a permanent procedure.

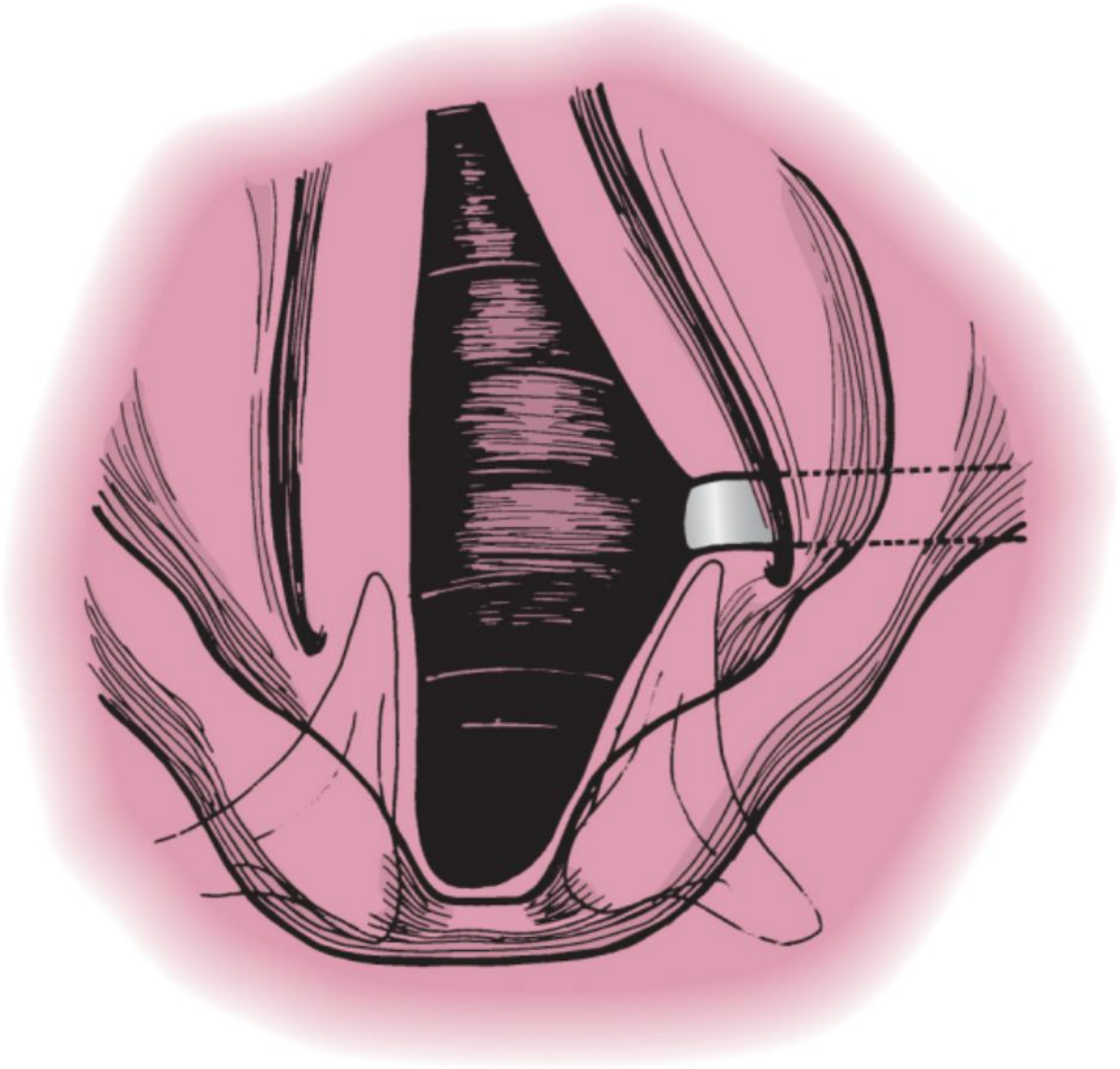

Figure 38-4 Sutures are placed around the vocal fold and sutured over a button on the skin, thereby lateralizing the vocal fold.

Open Arytenoidectomy

An anterior laryngofissure (see Chapter 42) or a lateral approach with resection of the posterior rim of thyroid cartilage and elevation of the piriform sinus mucosa may be used to expose and remove the arytenoid cartilage. However, with the advances in endoscopic techniques, these approaches are rarely necessary.

Posterior Glottic Stenosis

PGS can cause BVFI. It is typically associated with intubation and extraesophageal reflux disease. PGS is manifested as progressive airway obstruction, usually 4 to 8 weeks after extubation. Granulation tissue can cover the arytenoid cartilage and interarytenoid cleft. If this is observed, prompt débridement is associated with less scar tissue formation and consequently less airway stenosis.

Bogdasarian and Olsen developed a classification system for PGS that is useful for determining the surgery necessary to adequately address the stenosis.[8] The least severe group of patients are those with interarytenoid synechiae and a posterior sinus tract. The next group includes those with a posterior glottic web that limits movement of the arytenoids, without fixation of the CA joints and no posterior sinus tract. The third group appears similar to the second; however, one CA joint is fixed. The most severe group and the most difficult to treat consists of patients with fixation of both CA joints (Fig. 38-5).

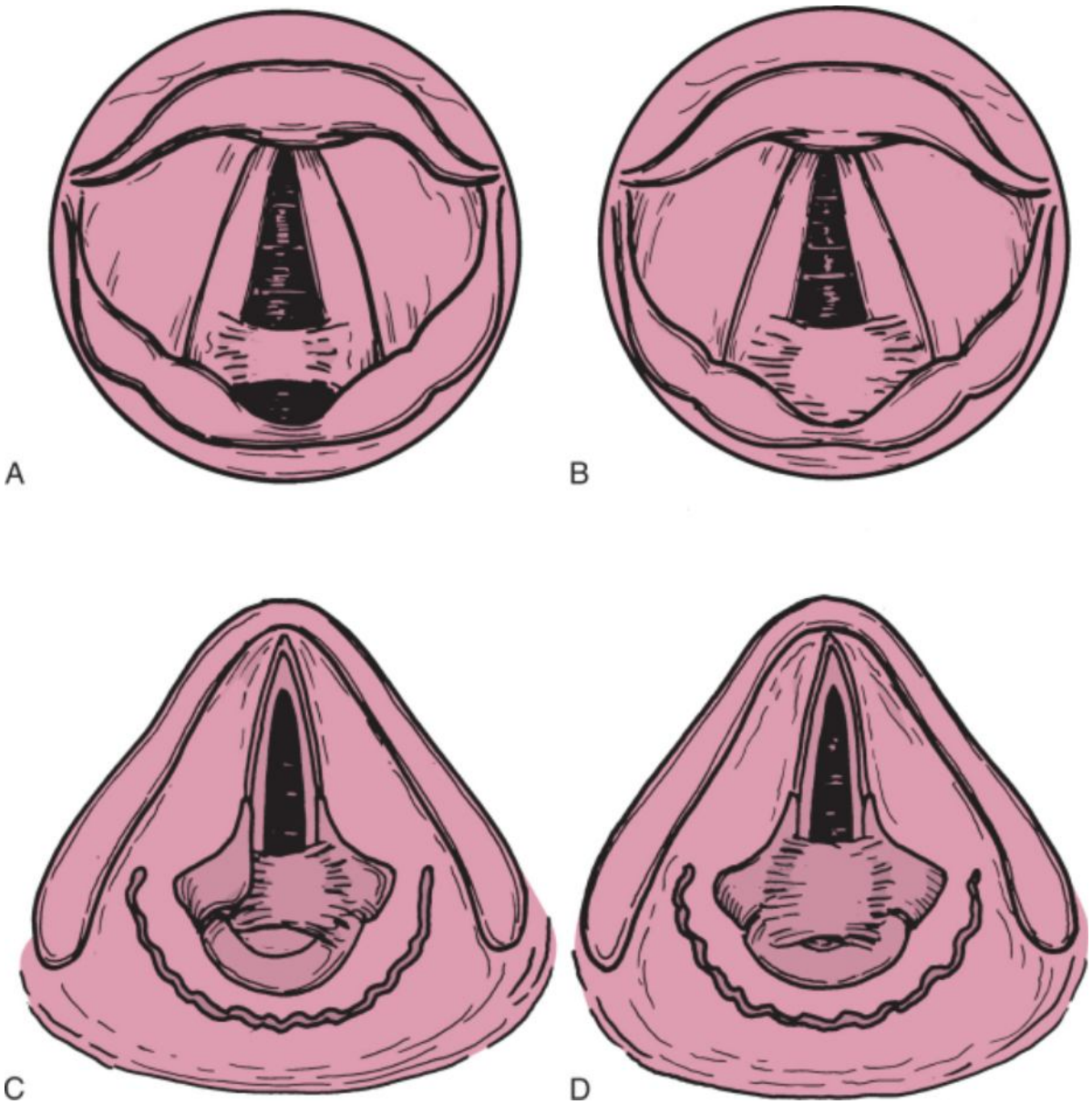

Figure 38-5 Grading of posterior glottic stenosis. **A,** Interarytenoid synechia with a posterior sinus tract. **B,** Posterior glottic web with mobile arytenoid cartilage. **C,** Posterior glottic web with fixation of one arytenoid cartilage. **D,** Posterior glottic web with fixation of both arytenoid cartilages.
(Adapted from Cotton RT, Manoukian JJ: Glottic and subglottic stenosis. In Cummings CW [ed]: Otolaryngology–Head & Neck Surgery. St Louis, CV Mosby, 1986, p 2168.)

Palpation of the Cricoarytenoid Joint

Palpation of the CA joint is performed as described earlier. If the interarytenoid region moves during this maneuver, PGS is probably present.

Interarytenoid Synechiae

Suspension laryngoscopy with exposure of the posterior glottis is carried out after the airway is secured. The mucosal integrity of the posterior glottis is assessed with the aid of 0-, 30-, and 70-degree angled telescopes. If an interarytenoid bridge of mucosa is observed, it is excised. Mitomycin C can be applied to the defect in the mucosa to reduce the risk of reformation of synechiae. Release of the bridge should restore passive mobility of the arytenoid. If patients do not achieve long-term improvement with this procedure, injury to the CA joint (fixation) is probable. A static glottic enlargement procedure as described earlier is then necessary.

Posterior Scar—Microtrapdoor Flap

Dedo and Sooy[9] and Goldberg[10] described an endoscopic flap technique to treat PGS. A CO_2 laser or knife is used to make an incision over the less mobile arytenoid, from the vocal process into the interarytenoid cleft and

extending up to the contralateral CA joint and for 4 to 5 mm below the vocal folds in the interarytenoid cleft. A mucosal and submucosal flap is elevated from the underlying scar. The scar tissue is excised or vaporized until mobility is restored or the limits of dissection are met. The flap is repositioned, and sutures or fibrin glue may be required to secure the flap in proper position. If joint mobility is not regained, additional glottic enlargement procedures are necessary as described earlier. Placement of an endolaryngeal stent may be necessary in patients who require revision surgery. Epinephrine-soaked pledgets (1:10,000 concentration) provide hemostasis, and mitomycin C may be applied to the exposed CA joint.

POSTOPERATIVE MANAGEMENT

Patients are usually observed for 24 hours postoperatively for airway difficulties. However, patients with an established tracheostomy are candidates for outpatient surgery. Voice rest is not necessary. Patients should receive perioperative reflux medications, such as a proton pump inhibitor, to decrease exposure of the healing surgical site to reflux contents. Treatment of reflux continues until healing is complete. Pain medications are also prescribed, and antibiotics are used when deemed necessary by the surgeon.

Patients will experience significant worsening of their voice in the immediate postoperative period because of the large posterior glottic defect and possible edema of the vocal fold. Voice should improve over the next 2 to 3 months, at which point it stabilizes. Frequent follow-up examinations will not only warn the surgeon of granulation tissue formation, which requires surgical removal, but also serve to reassure the patient. A small posterior glottic notch is expected when healing is complete. Decannulation is deferred until healing is complete and the airway is adequate, usually 6 to 8 weeks after surgery.

PEARLS

- Patients with BVFI secondary to mechanical fixation of the cricoarytenoid joints typically have more severe airway restriction and require more aggressive surgical enlargement of the posterior glottis than do patients with BVFP.
- Laryngeal electromyography is crucial in determining the presence of neurologic injury and may guide the surgeon in determining the operative side.
- Palpation of the arytenoid, either in the office or in the operating room, to confirm passive motion or immobility is critical information that helps guide treatment.
- Endoscopic techniques have replaced larger, more destructive surgery and have resulted in decreased patient morbidity.
- Granulation tissue formation is minimized by the use of perioperative reflux medications and the application of mitomycin C to any mucosal defects.

PITFALLS

- Only patients with realistic expectations of the balance between voice and airway improvement should undergo surgery to enlarge the glottic airway.
- Overly aggressive primary surgery will probably leave the patient with more severe breathy dysphonia and dysphagia than was necessary for airway improvement or decannulation.
- Posterior glottic airway surgery may worsen glottic protection during swallowing, thereby increasing the risk of aspiration.
- Bilateral vocal fold paralysis and immobility must be differentiated from posterior glottic stenosis because the initial surgical options may be different.
- Exposure of arytenoid cartilage during transverse cordotomy may lead to the formation of granulation tissue and the need for surgical débridement.