Chapter 41 – Medialization Laryngoplasty and Arytenoid Adduction

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Medialization laryngoplasty (type I thyroplasty) and arytenoid adduction are excellent surgical options for rehabilitation of the voice in patients suffering from glottic insufficiency. These represent the current standard of care for surgical therapy to augment and reposition the vocal folds to improve vocal fold closure and thereby improve vocal function.[1,2] Glottic insufficiency may be caused by any combination of the following: vocal fold atrophy (presbylarynges), vocal fold paresis, or vocal fold paralysis. These procedures can also be used to address soft tissue deficits of the vocal folds following surgery or trauma.[3]

A variety of different implant materials have been used to medialize the vocal folds in a medialization laryngoplasty approach, including silastic, hydroxylapatite, and Gore-Tex. This chapter discusses the general approach to medialization laryngoplasty and does not discuss the different implants or the design of the shape of the implant, given that these are very personal choices and that medialization laryngoplasty can be done successfully with any of the above-mentioned implant materials.

PATIENT SELECTION

The majority of patients with glottic insufficiency do not require (or desire) operative intervention. Surgical therapy is indicated for patients with symptoms that interfere with their quality of life (voice-related) or whose glottic insufficiency leads to pulmonary compromise due to aspiration.[1] The decision to perform surgery is multifactorial with the patient's vocal requirements and overall upper aerodigestive hygiene being key variables. Once a decision is made that surgery for glottic insufficiency is warranted and the patient understands the risks and benefits, a decision must then be made regarding an open procedure involving a medialization laryngoplasty and/or arytenoid adduction or an endoscopic, minimally invasive approach, such as vocal fold augmentation/injection. This decision is typically made based on a combination of factors, including where the procedure will take place (office versus operating room), the patient's general medical condition, and the nature and position of the weakened or paralyzed vocal folds. If the patient's dysphonia and/or dysphagia is related to a severe posterior glottic insufficiency, arytenoid adduction should be strongly considered because it is the only operation that consistently corrects glottic insufficiency in the posterior aspect of the glottis.[4–6] Neither vocal fold augmentation nor medialization laryngoplasty can address clinical issues related to posterior glottic insufficiency.

Indications for medialization laryngoplasty and/or arytenoid adduction include symptomatic glottic insufficiency (dysphonia, aspiration), especially if there is little or no chance of return of vocal fold motion when vocal fold paralysis or paresis is present. Relative contraindications include a previous history of radiation therapy of the larynx and marginal airway status due to poor abduction of one (contralateral to an immobile vocal fold) or both of the vocal folds.

PREOPERATIVE PLANNING

Equipment

There is a limited need for specialized equipment to perform medialization laryngoplasty and arytenoid adduction. Standard head and neck soft tissue instruments are required (similar to those for neck dissection). A flexible laryngoscope, preferably with a C-mount camera and video monitor, must be available. The surgeon's preferred implant material must also be available, be it silastic block, Gore-Tex ribbon, or one of the preformed implants made of silastic or hydroxylapatite. Often a small drill with a 2- to 3-mm cutting burr is required when the thyroid cartilage is ossified. It is also helpful to have a small measuring caliper to measure precisely the location of the thyroplasty window and the size and dimensions of a silastic block if it is used.

Preoperative Planning

It is helpful to review the patient's laryngeal examination before the surgical procedure is undertaken. Features of the glottal insufficiency, mobility of the contralateral vocal fold, and overall airway status should be reviewed. The patient should be counseled to stop taking all anticoagulation agents, such as nonsteroidal anti-inflammatory medications, Coumadin, and Plavix. It is important to have a discussion with the patient regarding the environment in the operating room, given that the patient will be awake and only slightly sedated. It is best to prepare patients psychologically for having surgery on their neck while they are awake.

Consent for medialization laryngoplasty and/or arytenoid adduction should include a discussion regarding the scar on the neck, complications of bleeding and infection, and the possible need for revision of the procedure in the future. The patient should be told that there may be a need for a bilateral procedure and the addition of an arytenoid adduction procedure pending the intraoperative results of the medialization laryngoplasty. Often, with experience, surgeons can determine preoperatively, based on the laryngeal examination and the patient's voice quality, whether they will require a unilateral or bilateral medialization laryngoplasty. However, certain situations do occur intraoperatively in which voice quality is only marginally improved with a medialization laryngoplasty and it is determined that the patient would benefit significantly from a simultaneous arytenoid adduction. Thus, these different possibilities must be discussed with the patient preoperatively and should be included on the consent form.

SURGICAL TECHNIQUE

Medialization Laryngoplasty (Type I Thyroplasty)

Before the patient comes into the operating room, nebulization of a lidocaine/Pontocaine mixture is often done to provide topical anesthesia to the upper aerodigestive tract, which facilitates the patient tolerating the flexible laryngoscopy during the procedure. In addition, Robinol should be administered, unless medically contraindicated, to minimize laryngeal secretions during the procedure. Once in the operating room, the patient is placed in a supine position with a conservative shoulder roll to provide extension of the neck. Care should be taken to ensure that the patient is comfortable. After intravenous sedation, 1% lidocaine with 1:100,000 epinephrine can be injected both superficially and deep in the area of the thyroid ala of the proposed side or sides of surgery. Topical anesthesia to the nasal cavity can be achieved with placement of a cotton pledget with a combination of a decongestant and anesthetic on the pledgets.

Incision for the medialization laryngoplasty is done in a curvilinear fashion in an adjacent deep normal skin crease near the inferior border of the thyroid ala. The platysma muscle is then incised and subplatysmal flaps are elevated superiorly and inferiorly to approximately the level of the hyoid bone and the cricoid cartilage, respectively. Once the strap muscles are identified, they can be released from superior to inferior in the midline, and retracted on the side of the proposed surgery. Subperichondrial infusion of lidocaine with epinephrine is used before incising the perichondrium of the thyroid cartilage in the midline. Subperichondrial elevation should then be done widely to expose the thyroid ala approximately 5 mm posterior to the muscular tubercle of the thyroid ala. The posterior aspect of the muscular tubercle of the thyroid ala will identify the true inferior border of the thyroid cartilage, which determines the plane of the vocal fold and location of the thyroplasty implant (Fig. 41-1). A caliper can then be used to measure approximately 5 to 7 mm posterior to the midline of the thyroid cartilage and 3 mm above the inferior border of the thyroid cartilage. This is the area where the proposed thyroplasty window will be made. Once this area has been identified, a 25-gauge needle can be placed through the thyroid cartilage in this area, confirming with simultaneous flexible laryngoscopy, that the proposed thyroplasty window is appropriately positioned immediately lateral to the vocal fold and is not too posterior, anterior, or superior.

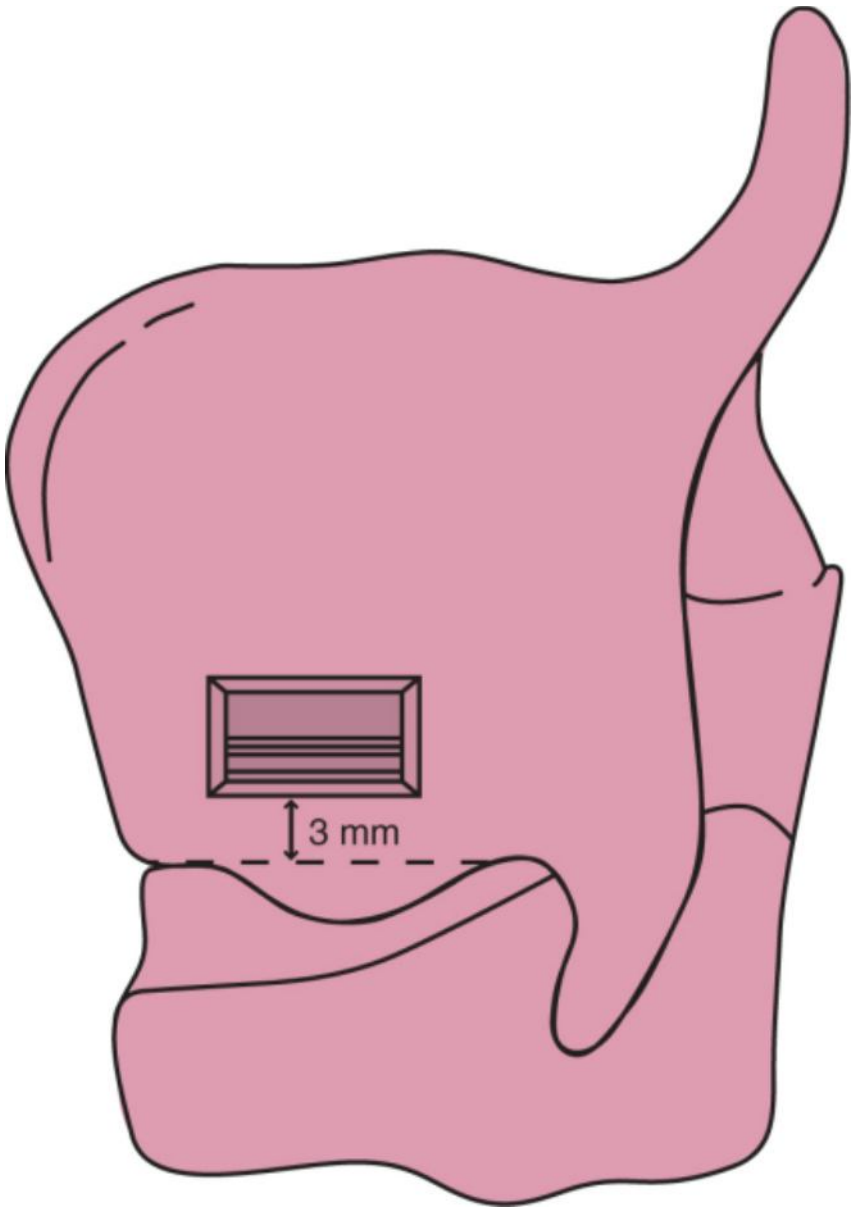

Figure 41-1 Location of medialization laryngoplasty window.

If a Gore-Tex medialization laryngoplasty is planned, then a 3- × 3-mm window at the previously determined optimal site can be made with a drill (if the thyroid cartilage is ossified) or with a no. 15 scalpel blade.[7] For a silastic medialization laryngoplasty, the thyroplasty window is typically 6 × 13 mm in dimension and can be created with either the drill or a scalpel. Once the thyroid cartilage has been removed from the window, it is wise to incise the perichondrium superiorly, posteriorly, and inferiorly, creating an anteriorly based inner perichondrium flap. The paraglottic space can then be elevated posteriorly and inferiorly in preparation for placement of the medialization laryngoplasty implant. Simultaneous flexible laryngoscopy and evaluation of the voice during the elevation of this pocket will determine the size, location, and nature of the implant and is extremely important to the success of the operation. Surgeons should take great care to avoid overmedialization of the vocal fold anteriorly as well as superiorly. These are the two most common mistakes made by inexperienced surgeons doing medialization laryngoplasty. The implant is then inserted through the thyroplasty window with simultaneous flexible laryngoscopy monitoring and assessment of the patient's voice quality (Fig. 41-2). Adjustments can then be made to the implant based on the findings of the voice quality, vocal fold augmentation, and vocal fold closure pattern seen using the flexible laryngoscope.

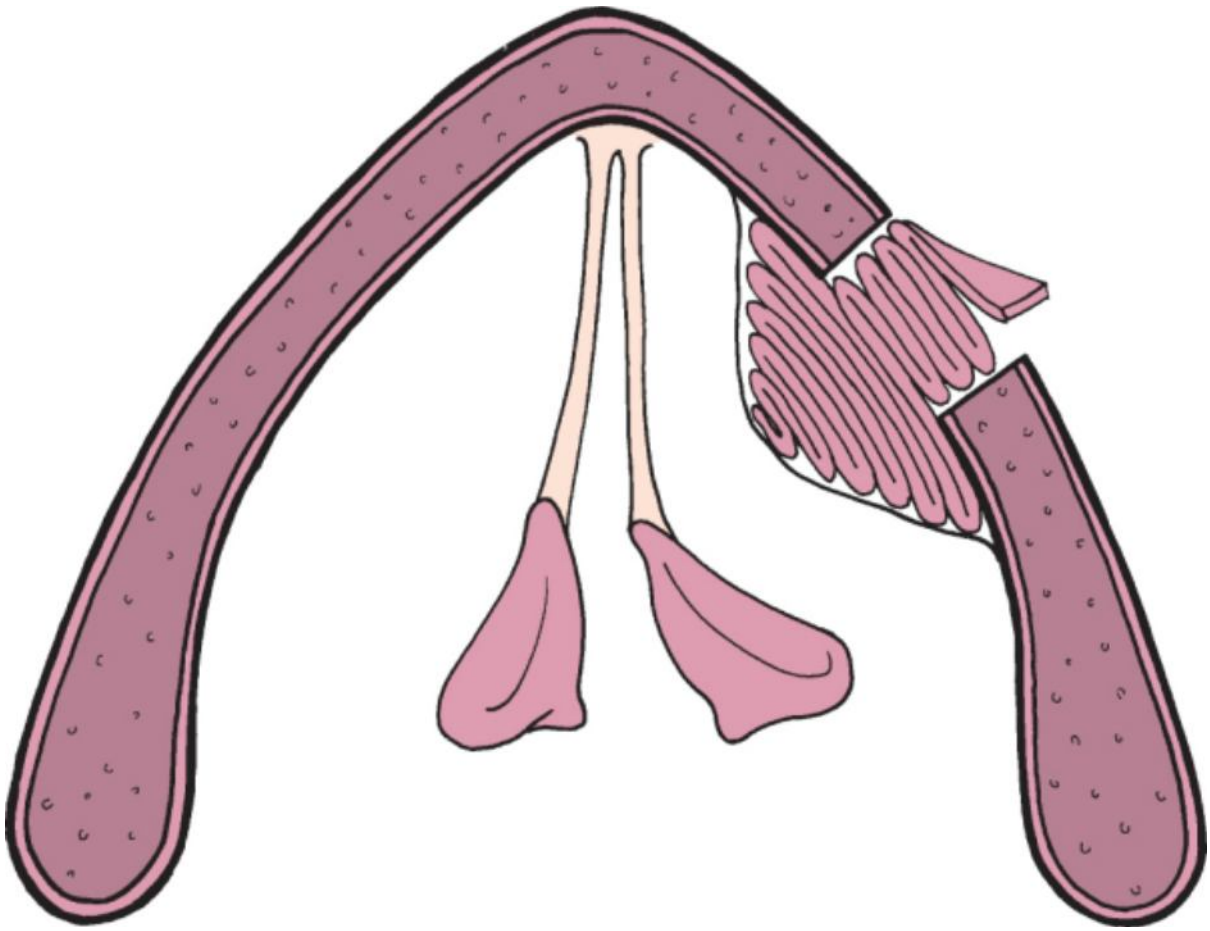

Figure 41-2 Placement of Gore-Tex into paraglottic space to medialize the vocal fold.

Once the voice quality and vocal fold position are optimized, the implant can be secured to the adjacent thyroid cartilage with a permanent 4.0 Prolene suture. Hemostasis should be obtained and a small drain placed in the dependent portion of the wound. The perichondrium should be laid back over the thyroplasty window and the strap muscles should be reapproximated in the midline. Finally, skin closure should include both dermal and epidermal closures to maximize the cosmetic results of the operative site.

Arytenoid Adduction

Arytenoid adduction is almost always done in combination with medialization laryngoplasty.[4–6] The surgicalapproach to arytenoid adduction is the same as described earlier for medialization laryngoplasty. If during preoperative planning the surgeon is very confident that the patient will require arytenoid adduction, it is often wise to perform the approach to arytenoid adduction (described next) before making the medialization laryngoplasty window. After elevating the perichondrium off of the anterior two thirds of the thyroid ala as described for medialization laryngoplasty, this elevation should be continued back to the posterior border, specifically skeletonizing the inferior cornu of the thyroid cartilage. Careful dissection around the posterior border of the thyroid ala from the inferior cornu superiorly up toward the greater cornu is then done, taking great care to adhere to the thyroid cartilage to avoid entering the piriform sinus. For the further exposure and rotation of the larynx, a hook can be placed on the greater cornu to rotate the larynx and expose its posterior aspect. Bipolar cautery can then be used to release the upper portion of the cricopharyngeus muscle as it attaches to the inferior cornu. This allows exposure of the piriform sinus. The piriform sinus lies directly over the posterior lamina of the cricoid cartilage, which is the location of the posterior cricoarytenoid muscle and is the main anatomic landmark for the surgical dissection. To fully evaluate the location of the piriform sinus throughout this portion of the dissection, it is wise to have the patient intermittently “puff out” their cheeks or hold their breath, which will inflate the piriform sinus and outline its boundaries. Dissection of the piriform sinus off the cricoid cartilage should then be done in an inferior-lateral to superior-medial direction until the posterior cricoarytenoid (PCA) muscle is identified. The PCA muscle can be identified by the direction of the muscle fibers running from a medial-inferior to lateral-superior direction and ending at the muscular process of the arytenoid cartilage. Following retraction of the inferior portion of the piriform sinus, the PCA muscle is usually clearly identified and can be traced up to identify the ridge on the arytenoid cartilage, which is the muscular process of the arytenoid cartilage (Fig. 41-3). A small portion of the posterior border of the thyroid cartilage can be removed with a rongeur to assist in finding and suturing the muscular

process of the arytenoid cartilage (Fig. 41-4). Once the muscular process of the arytenoid cartilage is identified, a figure-of-eight suture of 4.0 monofilament is placed through the arytenoid cartilage. Confirmation of proper placement of this suture is done with simultaneous flexible laryngoscopy to confirm that control and manipulation of the arytenoid is now possible via the suture placed through the muscular process of the arytenoid cartilage.

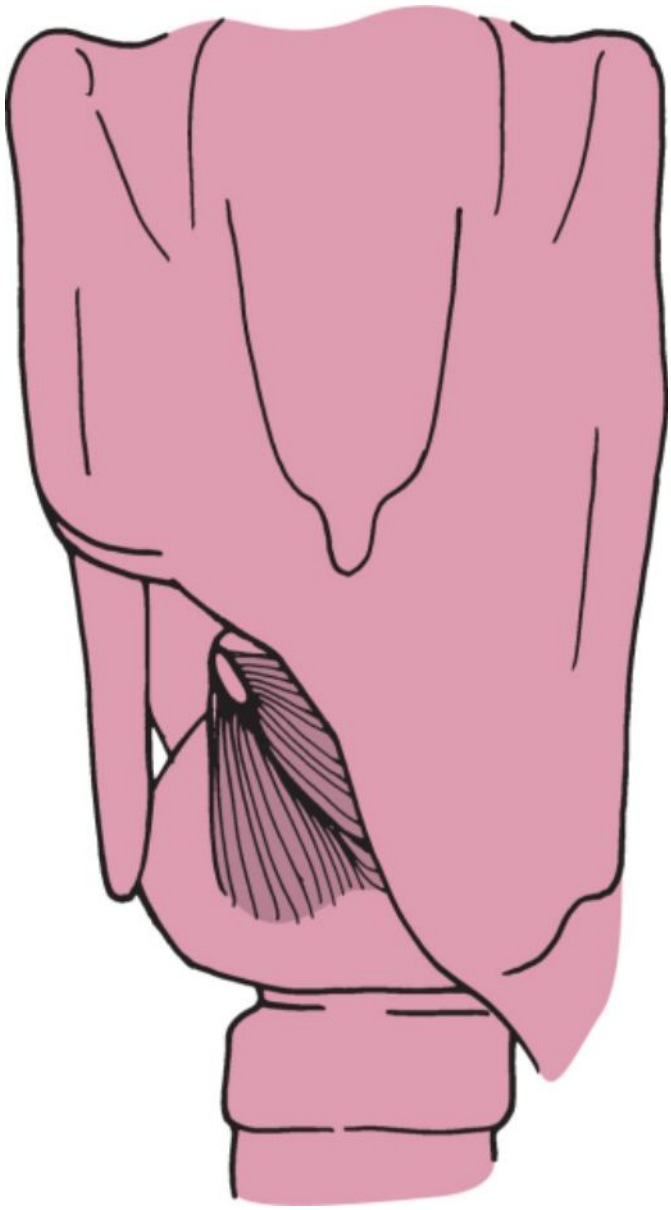

Figure 41-3 Identification of the muscular process of the arytenoid cartilage.

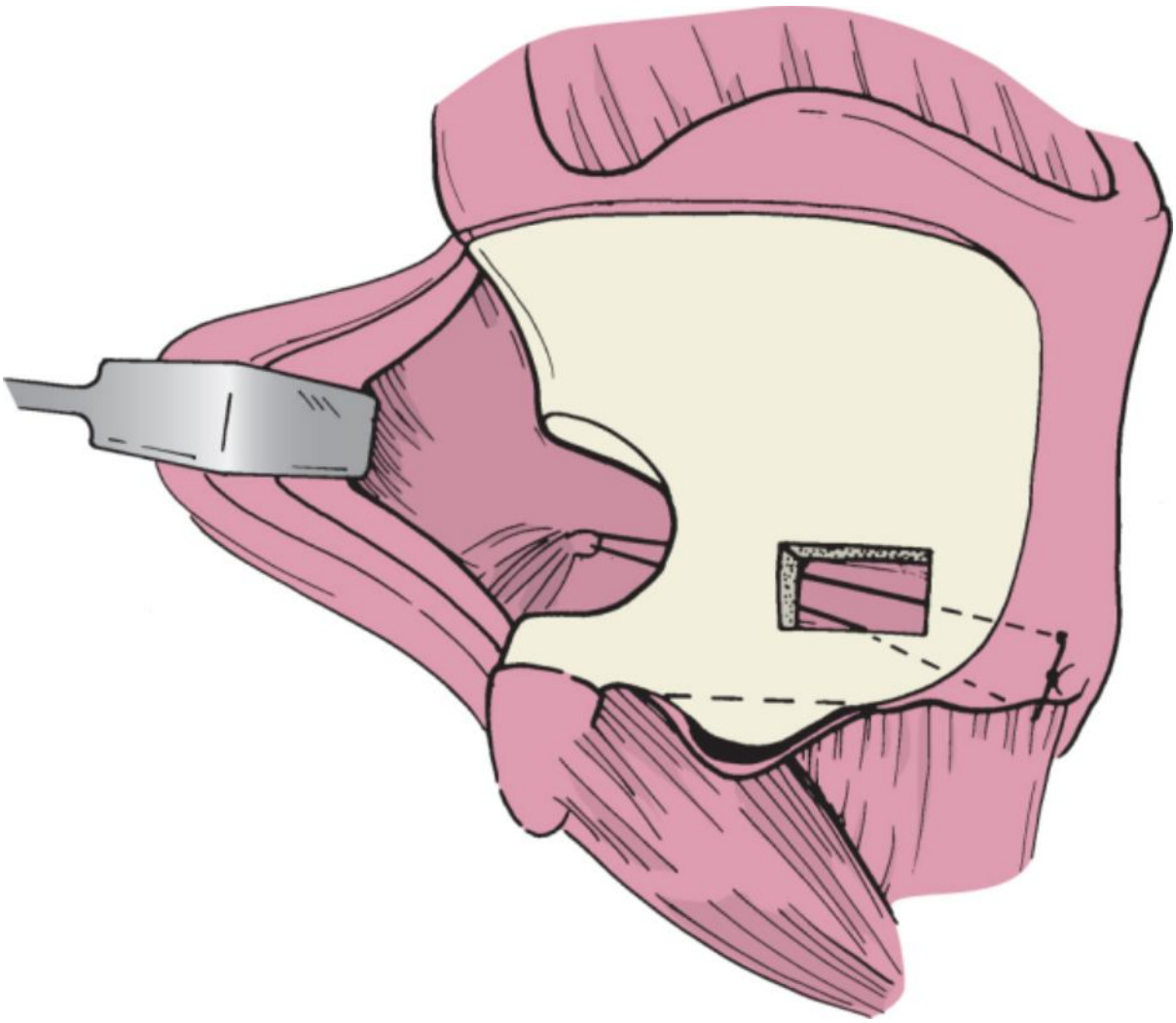

Figure 41-4 A small portion of the posterior border of the thyroid cartilage can be removed with a rongeur to assist in finding and suturing the muscular process of the arytenoid cartilage.

If the medialization laryngoplasty window has not yet been made, the two arms of the suture placed through the muscular process of the arytenoid cartilage can be clamped and the larynx can be placed back into its anatomic location for creation of the medialization laryngoplasty window as described earlier. Once the medialization laryngoplasty window is created, lateral paraglottic dissection posterior to the window can be done with a Cottle elevator to develop a tract that extends from the muscular process of the arytenoid cartilage to the medialization laryngoplasty window. Once this path has been created, a middle ear alligator can be passed from the window posteriorly to the posterior aspect of the larynx and bring both arms of the arytenoid adduction suture forward through the window. Once the sutures have been drawn forward, one suture can be placed anterior and inferior to the window through the cricothyroid membrane, and the second suture can be placed immediately anterior through the medialization laryngoplasty window through the thyroid cartilage. Gentle tension on this suture will rotate the arytenoid into an adducted position and significantly improve the vocal fold length and position of the paralyzed vocal fold. With gentle tension on the arytenoid adduction sutures, and simulated medialization through the medialization laryngoplasty window, voice quality and vocal fold position can be evaluated to determine optimal suture tension and amount of medialization required (see Fig. 41-4). When medialization laryngoplasty is done in conjunction with arytenoid adduction, typically less medialization is required, and it is very rare that a significant amount of tension needs to be applied to the arytenoid adduction suture for optimal phonatory function. After the arytenoid adduction suture has been placed, the medialization laryngoplasty can be completed and the wound can be closed as described earlier for the medialization laryngoplasty procedure.

POSTOPERATIVE CARE

Following both medialization laryngoplasty alone or medialization laryngoplasty in conjunction with arytenoid adduction, patients are observed in the hospital overnight. During this time period, pain management is done on an as-needed basis, intravenous steroids are administered, and the drain is typically kept in place overnight. The morning following surgery, the drain can usually be removed and the patient can be discharged home. It is wise to

have the patient keep the head of the bed elevated in the immediate postoperative time period. There is no need for strict voice rest following either of these laryngeal framework procedures. One dose of prophylactic antibiotics should be administered in the operating room but no further treatment is required. Follow-up in the office is approximately 1 month, given that it takes approximately 3 to 4 weeks for the vocal fold and the surrounding tissues to resolve before needing a repeat laryngeal examination in the office.

COMPLICATIONS

The most common complication of medialization laryngoplasty is malposition of the implant.[8] The implant can be inappropriately located in a variety of dimensions, although the most common implant malpositions include (1) too much medialization of the vocal fold by the implant and (2) too superior positioning of the implant.[5,9] The latter problem causes a ventricular prolapse and medialization of the false vocal fold, which impairs normal voice production. In addition, as mentioned earlier, excessive medialization of the vocal fold anteriorly can cause a pressed or strained voice quality. Lastly, undermedialization of the vocal fold due to inadequate implant size will result in significant improvement of voice quality intraoperatively as well as for a week or two following surgery; however, this voice improvement diminishes rapidly around 3 to 4 weeks following surgery. On follow-up examination in the office, undermedialization is seen. This is often due to the surgeon's not accounting for the intraoperative edema that occurs within the vocal fold throughout the surgical procedure. For this reason, the implant should be designed to induce a very slight amount of stress within the voice at the end of the procedure, knowing that a small amount of the strain in the voice is due to vocal fold edema, and as that edema resolves in the 2 to 3 weeks following surgery, the voice quality will be excellent.

A rare complication of medialization laryngoplasty is implant extrusion. Implants can extrude medially into the airway or laterally out into the skin. The former complication is severe and can become an airway emergency. This is believed to occur due to an unrecognized violation of the mucosa, usually of the ventricle, during placement of the implant.

Specific complications associated with arytenoid adduction include a pharyngeal cutaneous fistula and/or over-rotation of the arytenoid cartilage. Both of these complications are extremely rare. The former can occur from violation of the piriform sinus during the dissection to identify the posterior cricoarytenoid muscle. If violation is identified intraoperatively, careful oversewing of the piriform sinus is warranted. Over-rotation of the arytenoid cartilage during the arytenoid adduction procedure can come from excessive tension placed on the arytenoid adduction suture. This is usually identified during the procedure and thus rarely occurs. It is important to note that excessive tension is rarely required for the arytenoid adduction procedure. The suture placed on the arytenoid cartilage is only to guide the arytenoid into a more favorable position for phonation and to keep it there; thus, excessive tension on the suture is usually not required.

PEARLS

- Medialization laryngoplasty is an excellent permanent treatment option for dysphonia due to glottal insufficiency.
- Patient selection and preoperative counseling for medialization laryngoplasty and arytenoid adduction must include the unique nature of surgery in the neck with the patient only lightly sedated.
- Implant selection is based on the material with which the surgeon feels most comfortable.
- Arytenoid adduction is the only surgery that can lengthen a foreshortened vocal fold and address posterior glottal incompetence.
- Slight overmedialization should be done during medialization laryngoplasty to correct for intraoperative edema of the vocal fold and prevent undermedialization of the vocal fold postoperatively.

PITFALLS

- Medialization laryngoplasty and arytenoid adduction should not be done when the preoperative airway is compromised with poor contralateral vocal fold abduction.
- Implant position is the key to successful medialization laryngoplasty and great care should be taken to ensure that the implant is not placed too superior or too anterior.
- Great care should be taken not to violate the airway during implant placement (medialization laryngoplasty) and during elevation of the piriform sinus (arytenoid adduction).
- A clear path must be created for the arytenoid adduction suture from the muscular process of the arytenoid to the medialization laryngoplasty window to ensure proper rotation of the arytenoid.
- Excessive tension on the arytenoid adduction suture can cause over-rotation of the arytenoid and poor voice outcome.