

# Type I Thyroplasty for Voice Improvement

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ince the early 1900s, doctors have researched possible treatments to correct dysphonia (impairment of voice)

caused by unilateral vocal cord paralysis. In 1912, Brunings used paraffin to inject the vocal cord, which had successful results, but was not well received by other physicians, due to the formation of a paraffinoma. In 1915, Payr used a transverse U-shaped incision on the thyroid cartilage to make an anteriorly-based pedicle flap, which was depressed in an inward direction to displace the vocal cord medially. The effect was limited; in most patients, the flap did not survive. Therefore, most surgeons did not accept this procedure. Many other surgeons varied Payr's surgery, using different cartilage grafts and placing them usually between the thyroid cartilage and the inner perichondrium of the vocal cord. These procedures had varying degrees of success, but no one treatment was widely used. In the 1960s, Arnold popularized the use of polytetrafluoroethylene (PTFE) injected into the paralyzed vocal cord. PTFE injection was the treatment of choice until the development of type I thyroplasty in recent years.<sup>1</sup>

In 1974, Isshiki developed a series of thyroplasties, which are surgeries to correct the vocal cords through an external approach by way of the thyroid cartilage.<sup>12</sup> There are four types of thyroplasties:

Type I: Medialization of the vocal cord.

Type II: Lateralization of the vocal cord.

Type III: Relaxation (shortening) of the vocal cord.

Type IV: Tensing (lengthening) of the vocal cord.<sup>1</sup>

Type I thyroplasty has several distinct advantages over PTFE injection making it the treatment of choice for unilateral vocal cord paralysis since the mid-1980s.

**Disadvantages of PTFE Approach**  
Although PTFE injection was successful in many patients, it has

**Type I thyroplasty is indicated for patients with dysphonia caused by unilateral vocal cord paralysis, vocal cord atrophy, or vocal cord sulcus.**

many disadvantages and limitations. PTFE is not highly predictable when injected; in some cases, it spreads uniformly while in other cases it may not spread at all. PTFE can not be removed easily without significant damage to the vocal cord, which may result in airway obstruction. Macrophages may engulf the PTFE within the cord, producing a hard granuloma. Once injected, the position and quantity of the PTFE is difficult to revise or reverse. In addition, the PTFE has migrated in many patients. PTFE injection is usually performed on an awake patient, often making it difficult to position the rigid laryngo-

scope and lewey arm without causing patient discomfort. In these circumstances, the inadequate surgical exposure is a contraindication for PTFE injection. If there is a possibility that the motor function will return to the vocal cord, PTFE injection is not indicated as part of the therapy. PTFE injection will partially medialize the vocal cord, but will never provide complete relief from the aspiration common in patients with vocal cord paralysis. Type I thyroplasty overcomes these issues with better patient outcomes in most cases.

## Type I Thyroplasty

Type I thyroplasty medially displaces the paralyzed vocal cord by depressing a rectangle of thyroid cartilage and creating a window, which is secured by a piece of autologous cartilage or by a polymeric silicone wedge or block. By adjusting the thickness and position of the block, vocal cord position can be fine-tuned intraoperatively by having the patient speak while the surgeon watches the movement of the vocal cord with a flexible laryngoscope.

## Preoperative Considerations

Type I thyroplasty is indicated for patients with dysphonia caused by unilateral vocal cord paralysis, vocal cord atrophy, or vocal cord sulcus (groove). Patients undergo many preoperative tests to determine if type I thyroplasty is indicated. The manual compression test is important in determining if the surgery will be successful. This test is done by placing fingers on the affected side, pushing the thyroid ala medi-

ally, and having the patient speak. If the patient's voice sound has improved, type I thyroplasty is usually successful. During the preoperative evaluation, the patient's voice is recorded and his or her vocal cord movement is videotaped with a flexible laryngoscope. This test determines if the cord moves at all and the size of the opening between the cords. Some doctors may also use computed tomography, but this evaluation is optional.

The surgeon must consider the duration and cause of paralysis in determining whether there may be a return of function. If a nerve has been cut, the surgeon will also need to ascertain at what level the neural interruption occurred. During thoracic surgery, the vagus nerve may be cut, whereas during neck surgery, the recurrent laryngeal nerve or the vagus nerve may be cut. By looking at the videotape of the vocal cords, the surgeon can determine the position of the vocal cord and whether there is any atrophy of the affected cord, which helps determine the size and shape of the implant. The normal vocal cord position and function is also documented to help determine the placement of the implant. Patients with a large larynx and large gaps between their vocal cords to be closed may have results as good as those patients with a small larynx and small gaps.<sup>3</sup> If the patient has had previous radiation therapy to the area or has had neck surgery, trauma, or high vagal lesions, the chance of returning the voice to normal is diminished.

Finally, and most importantly, the patient's wishes are considered. All patients receive a complete head, neck, and chest examination. Patients who undergo type I thyroplasty are often asked not to be intubated for elective cases within 3 months postoperatively. Therefore, a patient may be asked to have the elective surgery done before type I thyroplasty if the surgery can not wait 3 months or if the patient desires to have the elective surgery done before the thyroplasty. The 3 months allows for better results in the healing process of the vocal cord. The patient will also undergo the

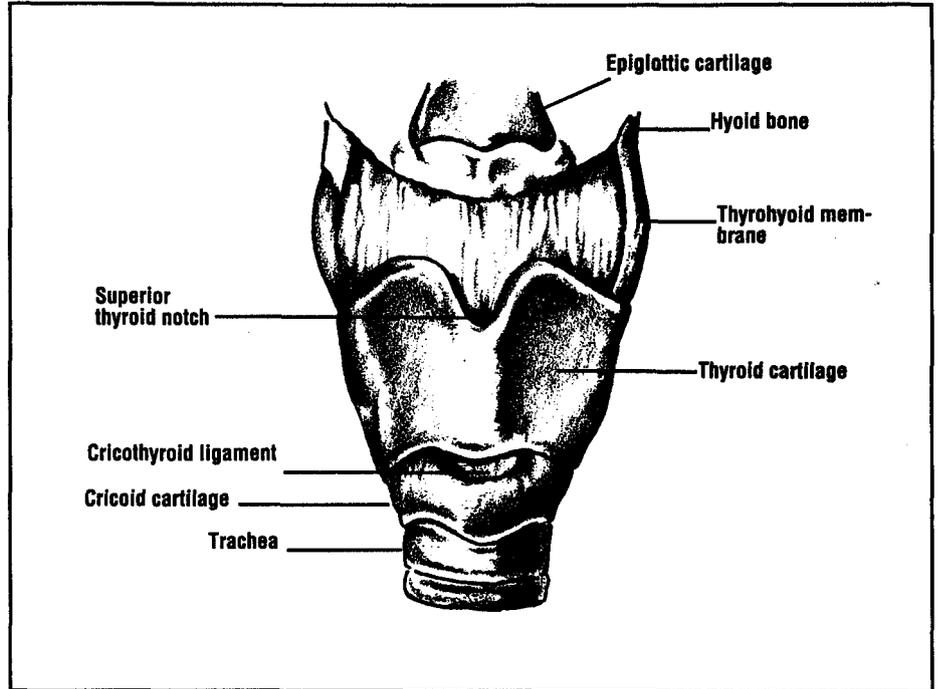


Figure 1. Anterior view of the larynx.

standard preoperative tests required by the hospital and anesthesia department for a local intravenous sedation case.

#### Patient Preparation

The patient is placed on the operat-

ing table in a supine position with the neck extended, usually with a shoulder roll placed behind the neck. If the flexible laryngoscope is used, topical nasal anesthetic will be used. Intraoperative video laryngoscopy is not necessary for

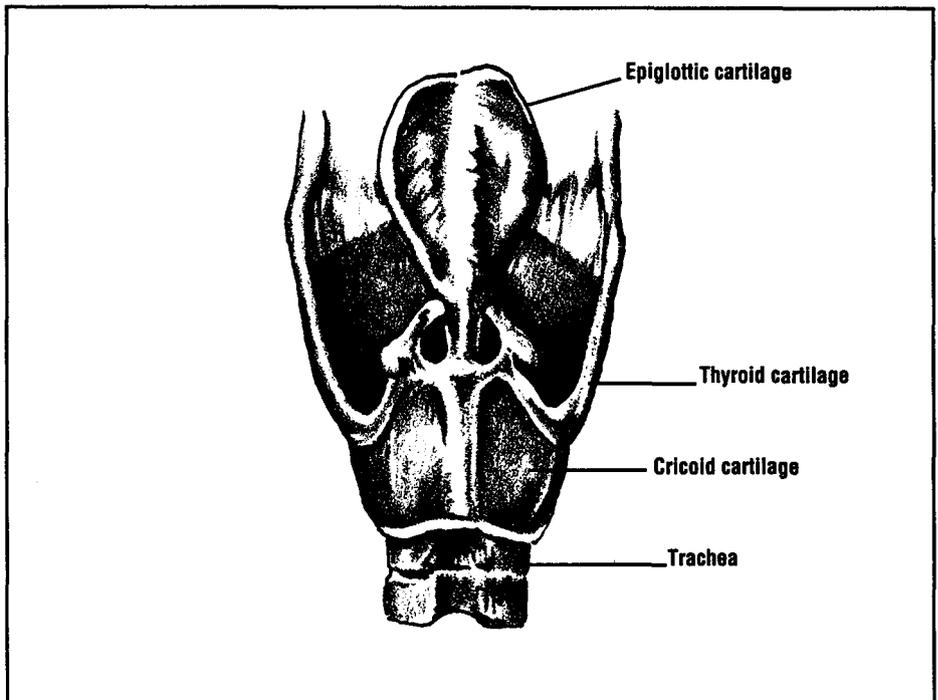


Figure 2. Posterior view of the larynx.

the success of the procedure, but most surgeons choose to use it.<sup>4</sup> Lidocaine with epinephrine is usually used for local injection. The patient is mildly sedated so that he or she is alert enough to speak.

#### Operative Procedure

A small incision is made over the thyroid cartilage and the strap muscles are dissected and retracted

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away. The thyroid notch and lower margin of the thyroid cartilage are identified and the midpoint is marked as the supposed location of the anterior commissure (Figures 1, 2, and 3). A line is drawn horizontally to indicate the upper surface of the vocal cord. The vocal cord line is the upper line of the rectangular window made in the thyroid carti-

lage. The anterior vertical line should be 5 to 7 mm from the median line of the thyroid cartilage. The window should be 4 to 6 mm high and 8 to 14 mm wide; the larger the thyroid ala, the larger the window used (Figure 4). The average windows are 6 x 12 mm for men and 4 x 10 mm for women. If the cartilage is not calcified or too hard, a knife may be used to create the window. If there is calcification present, a small cutting or diamond burr on an ototome may be used. If the window is too high, there will be bulging of the false cord. If there is too much extension of the window, the cricoid cartilage will block medial displacement.

After opening the window, the flexible laryngoscope is inserted through the patient's nose. An ear periosteal elevator is used to dissect the mucosa from the cartilage. The elevator is also used to probe through the window to determine vocal cord changes to better position the implant. Many shapes of implants are used, but the most common are the wedge and the T-shaped block. The implant must have a projection that fits in the window for better stabilization. The block is placed as the patient phonates to achieve the maximum

effect. For better precision, the inner perichondrium should be sufficiently elevated from the cartilage around the window.<sup>1</sup> Once a better voice is attained and improved closing of the vocal cords occurs, the block may be sutured to the thyroid cartilage for greater stabilization. At that time the neck incision is closed and dressed appropriately with antibiotic ointment and sterile tape strips.

#### Complications

Among the possible complications of type I thyroplasty is the perforation of the vocal cord. If a perforation occurs, antibiotics are recommended for 48 to 72 hours. Perforation creates a greater chance of infection with extrusion of the implant. However, infection may still occur without perforation. Two rare complications are airway obstruction and laryngocutaneous fistula. Laryngocutaneous fistula normally occurs if the perichondrium over the thyroid cartilage is not closed properly, but may also occur with an infection. The most common complication is undercorrection.

There are several options for a patient with poor results. A larger implant could be placed, a different shaped implant may be indicated, the contralateral vocal cord can be implanted, anterior laryngoplasty or laryngopexy can be performed, or PTFE or collagen injection may be indicated.<sup>3</sup> Many patients receive ranitidine (a histamine inhibitor that reduces acid secretion) for 2 weeks postoperatively to prevent reflux, which may cause poor results. Most complications usually occur at 1 week postoperatively and are almost always revealed by the first month postoperatively. The patient's voice is checked 1 day, 1 week, 1 month, and 3 months postoperatively. Some surgeons may prefer to have the voice checked at 6 months and 1 year postoperatively as well. While the patient is not placed on voice rest, voice conservation and vocal hygiene are essential. Studies have shown that it takes 1 month for the implant to fibrose within the vocal cord; therefore, the patient is excluded from heavy lift-

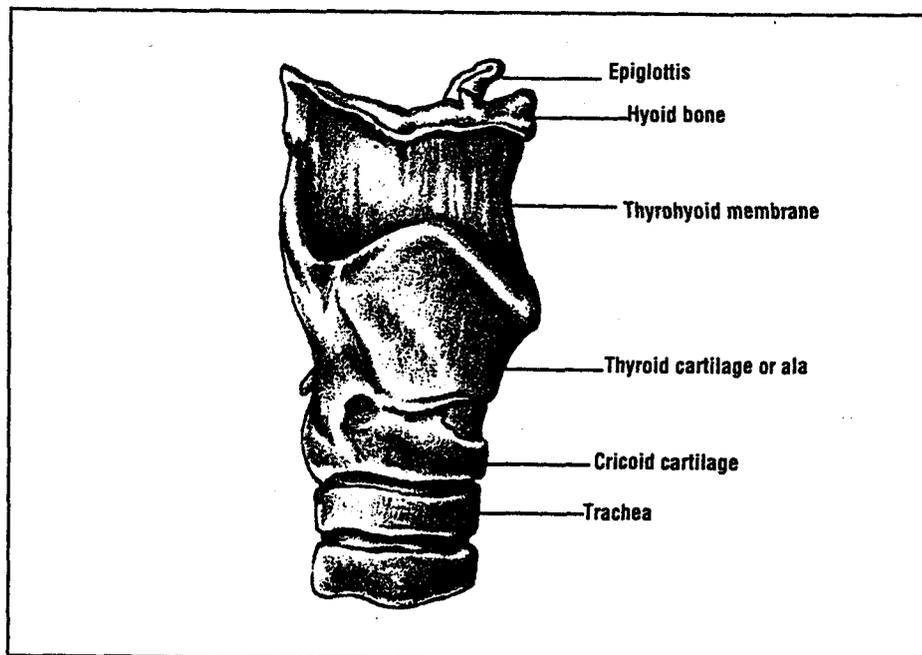


Figure 3. Side view of the larynx.

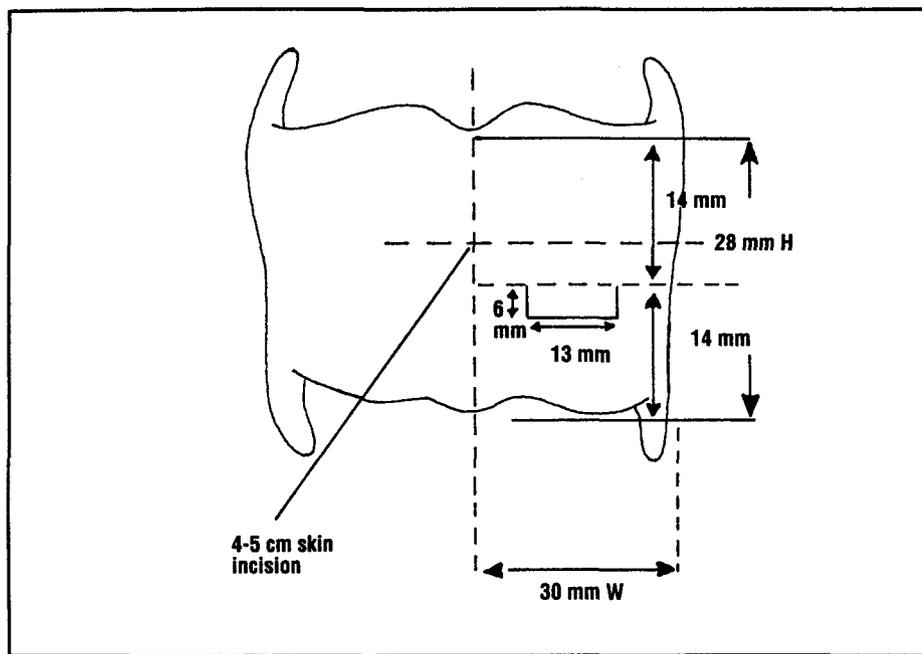


Figure 4. Placement of skin incision as compared to the calculation of the window on the thyroid cartilage.<sup>3</sup>

ing, yelling, aerobics, trumpet playing, singing, or anything that could strain the vocal cords excessively for that month.

There has been no evidence of granuloma formation in any patient receiving type I thyroplasty thus far. The major disadvantage of type I thyroplasty is the neck incision.

#### Advantages of Type I Thyroplasty

The most important advantage of type I thyroplasty is its reversibility, which is dependent on the configuration and position of the implant, the occurrence of infection, and the extent of fibrosis around the implant.<sup>3</sup> This procedure can be used in the treatment of longstanding vocal cord paralysis due to atrophy or can fill in defects in a mobile cord. Another distinct advantage is that the surgeon can adjust the degree of lateral compression in accordance with the patient's vocalization intraoperatively.<sup>3</sup> The patient can better tolerate the procedure under local anesthesia as only a flexible laryngoscope is used.

#### Conclusion

Studies have shown that type I thyroplasty successfully normalizes voice quality impaired by unilateral

vocal cord paralysis. Postoperatively, breathlessness and hoarseness are decreased due to better approximation of the vocal cords. Patients continue to have long-term improvement. Due to the relative success of type I thyroplasty, surgeons have started to do primary

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thyroplasty after nerves have been cut in skull base, neck, or chest surgery without hearing the postoperative voice changes, if any. Type I thyroplasty is beginning to be used for patients with abductor spasmodic dysphonia, bowed vocal cord, and unilateral cordectomy. Due to its reversibility, there are a variety of areas in which type I thyroplasty may be indicated in the future. Δ

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