

Clinical Notes

An Accurate Method of Teflon Injection Using Functional Phonosurgery

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● A technique for Teflon injection is described that allows the laryngologist to assess vocal fold vibration during general anesthesia. A tracheostomy tube fitted with a rostral air line allows translaryngeal airflow. During endoscopy with a bivalved laryngoscope, the cords are approximated manually. Vocal fold vibration is produced with the cords adducted. The precise site of defects in glottic closure is clearly seen and corrected with Teflon injection. In cases where standard Teflon injection has failed, utilization of this method has allowed substantial voice improvement. The ability to assess vibratory function of the vocal folds during direct suspension laryngoscopy enhances the precision of vocal fold augmentation techniques in difficult rehabilitation cases.

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The ultimate goal in vocal rehabilitation is to prevent aspiration and to achieve good phonatory function. Teflon (polytef) injection has been highly efficacious in the treatment of laryngeal paralysis.^{1,3} Although Teflon is most commonly used

for augmentation of a cord with a recurrent nerve paralysis, there are several other uses. Arnold⁴ lists the following indications: (1) some congenital laryngeal defects, (2) vocal cord defects after removal of benign lesions such as nodules or polyps, (3) excessive glottic chink after arytenoidectomy, and (4) various cases of cordectomy or partial laryngectomy.

After partial laryngeal surgery, the immobile pseudocord can be augmented with Teflon to prevent aspiration and to improve the voice. This constitutes approximately 2.2% of cases selected for injection,⁵ even though there are many patients who could potentially benefit from Teflon augmentation after partial laryngectomy. The postoperative voice was studied in a review of 30 patients who underwent vertical hemilaryngectomy: 11 (36%) had a good to excellent voice; 8 (27%) had a weak, breathy voice; and 11 (36%) had a poor, barely audible voice.⁶ Underutilization of Teflon injection in these patients may, in part, be due to difficulties with the procedure.

For unilateral recurrent paralysis, the procedure of Teflon injection is most often performed during direct laryngoscopy utilizing either topical or general anesthesia. The injection is ideally made along the lateral aspect of the thyroarytenoid muscle, and one procedure is usually sufficient to restore good phonatory function.³ Since the paralyzed cord is on the

same level as the functional cord, there is little chance of a postoperative vertical height mismatch.

With more complex laryngeal pathology, the relationships of the vocal cords in the vertical dimension are also likely to be abnormal. For example, a complete vagal paralysis will leave the cords at different levels.⁷ Further distortion occurs after partial laryngeal surgery. In the heavily scarred larynx, accuracy of injection is paramount, in that any further injection after the first may lead to extrusion of material from the injection site.⁸ Recognizing the importance of the vertical level of injection, Lewy⁵ advocated topical anesthesia and phonatory cooperation of the patient to improve control over the site of injection. Suspension laryngoscopy and general anesthesia were recommended for difficult cases where a stabilized larynx was essential.⁹ However, the latter precludes phonatory assistance by the patient. The recently described method of transcutaneous Teflon injection allows for active patient participation.¹⁰

To overcome the difficulties in the functional assessment of a complex case of glottic insufficiency, the following method of phonosurgery was developed. The procedure is primarily used for patients after surgery (partial laryngectomy) and requires a tracheostomy. Because laryngeal edema may develop after injection of the scarred neocord, a tracheostomy may

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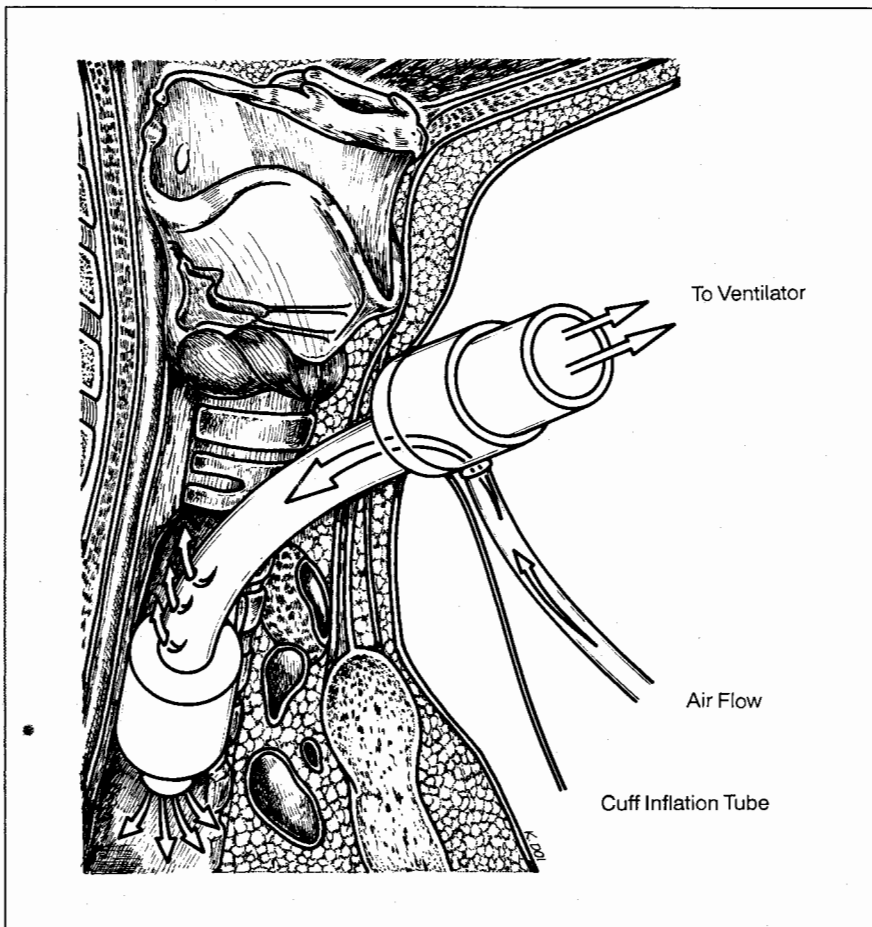


Fig 1.—Diagram of tracheostomy tube in place. Rostral airflow line passes air translaryngeally.

be a consideration with any method of Teflon injection when used on the partially resected larynx.¹⁰

MATERIALS AND METHODS

Since this procedure is reserved for difficult Teflon augmentation cases, general anesthesia is required. With the oral endotracheal tube in place, a tracheostomy is performed. A tracheostomy tube (Fig 1) with a rostral airflow port (Communitrache 1, Implant Technologies Inc, Minneapolis) is placed, and the patient is ventilated through the tracheostomy tube, allowing removal of the oral endotracheal tube. The suspension bivalved laryngoscope (Fig 2) is used to allow adequate room for instruments and affords excellent exposure of the larynx. Compressed, humidified air is then forced through the speaking airflow line, simulating normal translaryngeal airflow. The normal true vocal cord is then brought medially to contact the neocord by atraumatically pushing the affected arytenoid over with endolaryngeal forceps. The sound quality, as well as the appropriate vertical level, is assessed for Teflon injection. The injection is then carried out slowly, continuously rechecking the sound quality. Postoperatively, the patient is decannulated when the airway is secure, usually on the second postoperative day.

To assess the difference between phonation induced manually, in comparison with natural cord vibration, a canine larynx was manipulated in a similar manner. One adult mongrel male dog was anesthetized with phenobarbital. A tracheostomy was then performed, and the dog was ventilated transtracheally. A rostral airflow line was also inserted through a tracheotomy. A 0° telescope (Storz) was coupled to a strobe light source (Storz 8000) and a camera (Circon CCD). With retrograde translaryngeal airflow, the arytenoids were brought to the midline using a laryngeal forceps. This was then compared with phonation produced by stimulating the laryngeal nerves.¹² The larynx was stroboscopically analyzed, and the resultant image was recorded on a videorecorder (Sony).

REPORT OF A CASE

A 71-year-old man had near aphonia after a vertical hemilaryngectomy for radiation-failure T₁ left true vocal cord carcinoma. The left neocord was formed by imbricating remaining false vocal cord

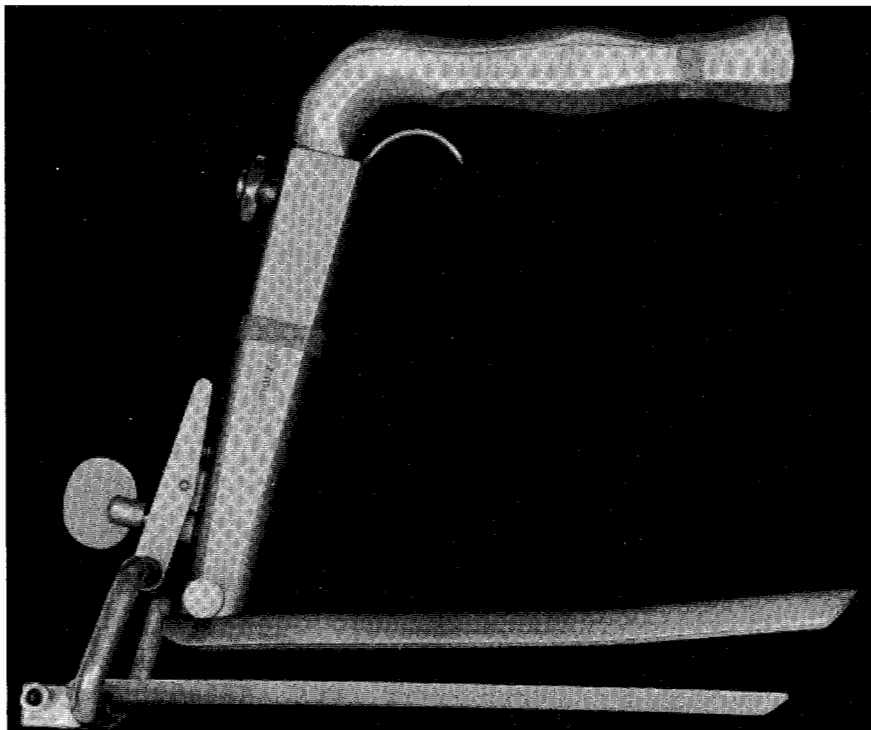


Fig 2.—Side view of bivalve laryngoscope.

mucosa, leaving the patient with poor glottic closure. One and two years postoperatively, the patient underwent direct laryngoscopy and Teflon injection of the left neocord. The second laryngoscopy was performed with the patient under local anesthesia to assess glottic incompetence under physiologic conditions. However, the patient's emphysema prevented him from cooperating fully. Because the patient had only minimal improvement in his voice and occasional aspiration, he underwent a third direct laryngoscopy. A tracheostomy was performed as a precaution against postoperative edema. Using the method of phonosurgery described above, it was obvious that the prior Teflon injections medialized the neocord superior to the functional level of the right true cord. Teflon was injected to fill the functional defects. The patient was decannulated one week after surgery. Subsequent evaluation of the patient revealed the glottic closure to be complete and the voice much improved. Eighteen months later, the voice remains adequate and the patient does not aspirate.

COMMENT

The most common complication of Teflon injection of the vocal cord is failure to improve the voice, usually caused by inadequate closure of the glottic chink.¹¹ Because this occurs in 10% to 20% of all cases, multiple operations may be required.¹⁰ With the patient awake, assessing the cord

size, position, and relationships during phonation allows for more accurate injection. Voice quality improvement during the procedure is an important and reliable guide to the amount of Teflon needed for injection. The patient described here had undergone two prior injections, both of which failed to sufficiently narrow the glottic chink. The technique of phonosurgery described above simulated phonation in the anesthetized patient, permitting precise injection.

Normal phonation is a complex phenomenon that requires a steady stream of subglottic airflow through stiffened and adducted vocal cords. The translaryngeal airflow creates a characteristic vocal cord vibratory pattern. In laboratory animals, these patterns have been documented using videostroboscopy during stimulation of both canine recurrent laryngeal nerves.¹²

In the canine experiment performed in this study, the stroboscopic patterns of the vocal folds were examined during manual adduction and compared with those seen with recurrent laryngeal nerve stimulation. Manually adducting the canine vocal cords with a constant stream of subglottic air created a stroboscopic pattern of vocal fold vibration that differed from that found with nerve stimulation.

Specifically, there was a decrease in the two-margin (upper and lower) system of vibration. However, the vocal fold vibrations were in phase from the anterior to the posterior glottis, and the resultant phonation was of normal intensity.

Similarly, in the case reported, phonation produced during the phonosurgery was not normal. The vocal fold vibrations produced by manually induced phonation would be expected to differ from those seen with normal intrinsic laryngeal muscle activation. However, the adequate voice obtained with this technique demonstrates its efficacy in defining the vertical level of injection and in guiding the amount of Teflon injected.

CONCLUSIONS

1. This case report demonstrates a new technique of functional phonosurgery.
2. The procedure described allows precise determination of the appropriate level and amount of Teflon injected.
3. The outcome may be more accurately predicted at the time of surgery.
4. Teflon injection during functional phonosurgery is useful in difficult cases, especially in the correction of postsurgical defects.

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Editorial Footnote

The technique described in this article is attractive because of the claim of precision injection and superior voice quality after partial laryngectomy. The procedure can be used for other types of laryngeal pathology as well, and the concepts that are proposed seem quite sound.

Our reviewers felt that this information should be shared with you. However, some important issues are not addressed, and

several key questions are left unanswered. Most instances of postoperative aphonia are the result of absent tissue that has been partially replaced by scarring. Injection of Teflon into these areas is usually impossible or inadequate.

This report should be considered preliminary in nature. We shall await more experience and more details, as well as clarification of the method of forceps manipula-

tion and movement of the vocal cord tissue. We hope to see more in the way of quantitative aerodynamic and acoustic documentation of vocal improvement in a control group and in patients who are treated by this method.

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Chief Editor