

Editorial Review

Laryngeal framework surgery (thyroplasty)

MEREDYDD LLOYD HARRIES, B.Sc., F.R.C.S.

Phonosurgery is defined as 'surgery specifically designed to alter the voice' (Von Leden, 1991). It can be divided into four categories: (1) Vocal fold surgery; (2) Laryngeal framework surgery; (3) Neurolaryngeal surgery; (4) Post-laryngectomy voice rehabilitation.

All the above procedures require a knowledge of the anatomy and the physiology of the vocal folds. It is important to preserve the relationship of the five layers of the vocal fold for the production of the mucosal wave and normal voice (Hirano and Kakita, 1985).

Laryngeal framework surgery can also be referred to as laryngoplasty or glottoplasty but the term thyroplasty, introduced by Isshiki (Isshiki *et al.*, 1974) remains popular in the UK. Four types of thyroplasty are described which can lengthen, shorten, tighten, relax and/or medialize the vocal folds. Thyroplasty type I which medializes the vocal fold is gaining popularity as more ENT surgeons realize the long-term problems of teflon injection (Gardener and Parnes, 1991) and many now refer to this procedure simply as thyroplasty with no subclassification. Thyroplasty types II, III and IV are rarely carried out in this country as botulinum toxin is widely available, surgery for presbylaryngeal changes is rare and transsexual surgery tends to be located in only a few centres.

The first laryngeal framework surgery on a patient with a unilateral vocal fold paralysis was described in 1915 by Payr (Payr, 1915) but Isshiki is recognized as the main surgeon to popularize this technique (Isshiki, 1989) and to introduce an alloplastic material to medialize the vocal folds. Thyroplasty type I involves cutting a window in the thyroid cartilage ala and inserting a prosthesis. This will push the paralyzed vocal fold medially allowing contact with the opposite vocal fold and the better production of voice. A full description of the procedure can be found in an excellent review by Kaufmann who has considerable expertise in this surgery and can be considered one of the world's leading authorities in laryngeal framework surgery (Kaufmann, 1986).

The procedure is carried out under local anaesthetic so that there is auditory feedback from the patient's own voice and the appropriately sized prosthesis to give the best voice is chosen. Many

also use a flexible laryngoscope to visualize the larynx so that the prosthesis that gives the best medial position of the vocal fold is used. As the primary objective is vocal rehabilitation I have stopped using the flexible laryngoscope and concentrate on the vocal result but nevertheless recommend using both auditory and visual feedback when first attempting laryngeal framework surgery. One of the complications of thyroplasty is inserting a prosthesis that is too large thus compromising the airway but if the procedure is carried out under local anaesthesia this complication is unlikely. In Isshiki's (Isshiki, 1989) original description the cartilage window is preserved but later complications such as its displacement or regeneration of the cartilage have led to most surgeons in the USA removing the cartilage window. Keeping the medial perichondrium intact holds the prosthesis lateral to the body of the vocal fold thus preserving the mucosal wave. This is a great advantage of thyroplasty over teflon injection, certainly in the long term as local migration of polytetrafluorethylene particles into the superficial layers of the vocal fold leads to loss of the mucosal wave and gives poor voice quality.

There are numerous materials that can be used as a prosthesis to medialize the vocal fold. These include autologous cartilage from the superior half of the thyroid ala, silastic and hydroxyl apatite. Hydroxyl apatite comes in a premade form in eight different sizes (four male and four female) and requires a locking plate that fits into the cartilage window and holds the prosthesis in place (Flint and Cummings, 1993). Because this material is biointegratable, osteoneogenesis has been noted in the region of the thyroid cartilage which although it may stabilize the implant is likely to make it irreversible. Carved silastic implants are used in most centres and there is variation in design: some insert the implant in halves whilst others use partial incisions so that the implant will snap into place. Silastic creates a thin capsule of fibrous tissue with minimal fibrosis. Removal of the prosthesis at a later stage is simple due to the lack of integration with surrounding tissues (Isaacson *et al.*, 1990). Thyroplasty remains the only procedure for vocal rehabilitation in a patient with a unilateral vocal fold paralysis that is theoretically truly reversible and has in rare cases

been used for severe aspiration or in professional voice users before the recommended 12 month wait between onset of symptoms and surgery. Should vocal fold mobility return then removal of the silastic prosthesis is a simple procedure and minimal fibrosis lateral to the body of the vocal fold does not disturb the mucosal wave.

Thyroplasty can be used on any patient with a unilateral vocal fold paralysis. In patients where the aetiology is due to widespread malignant disease and who have a short term life expectancy, a transcutaneous injection of collagen under a local anaesthetic is my preferred procedure (Ford *et al.*, 1992). Long-term voice quality is not a consideration in these patients and injection gives them a reasonable voice and a competent larynx for their remaining brief life.

Thyroplasty type I takes around 30 minutes to perform in an uncomplicated patient. There are two kits currently available for thyroplasty which assist in the positioning, measurement and cutting of the cartilage window. John Weiss produce one of these which has male and female instruments together with a periosteal elevator. I have heard other surgeons state that a kit is of no value but I have found that using this decreases the operating time and is particularly useful to novice surgeons. This kit requires the surgeon to fashion a silastic prosthesis to suit each individual patient whereas a similar kit from Smith and Nephew must be used with the preformed hydroxyl-apatite prosthesis. Theoretically this may decrease the adjustability of the procedure but also increases the cost.

Thyroplasty results are now appearing in journals as voice laboratories are developing equipment to analyse certain parameters of the voice. Changes in voice quality can be described subjectively by the patient, perceptually by a trained speech therapist and quantitatively which includes airflow, laryngographic and acoustic recordings (Harries and Morrison, 1995). A prospective study should try to combine all three methods for a comprehensive analysis,

Thyroplasty is a relatively straightforward surgical procedure which should be within the capabilities of most surgeons. As with most surgical procedures, the greater skill lies in the selection of patients for this procedure and this is where the voice clinics with their sophisticated equipment for better imaging of the larynx are invaluable. It is important to assess the position of the paralysed vocal fold, both horizontal and vertical, and whether the patient is using supraglottic structures to produce voice (Harries and Morrison, 1996). It is now established that the procedure of choice for a patient with a lateralized cord which may lie on a superior plane to the opposite cord is an arytenoid adduction which is usually combined with a thyroplasty type I (Netterville *et al.*, 1993). Arytenoid adduction requires greater technical skill but by rotating the muscular process of the arytenoid cartilage anteriorly the vocal fold moves both medially and inferiorly provided the cricoarytenoid joint is not distorted. Accurate assessment of the patient pre-operatively is

therefore essential to identify this vertical incongruency which may be a reason for poor results with a simple thyroplasty. The longer a patient has had a paralysed vocal fold the harder it is to get him/her to decompensate from using the supraglottic structures and to revert to the true vocal folds as the vibratory source (Kaufmann, 1993). In these cases poor results may not be due to surgical failure but rather the patient continues to use compensatory structures such as the vestibular folds (false cords) rather than the vocal folds that are in a perfect post-operative position. This can be identified pre-operatively by flexible laryngoscopy which is better than rigid laryngoscopy at demonstrating the technique of voice production and may be cured by speech therapy which 'decompensates' the larynx.

In conclusion, thyroplasty should be carried out under local anaesthesia to improve the voice in a patient with a unilateral vocal fold paralysis. Every patient undergoing this procedure should have a detailed pre-operative examination of the larynx which ideally should include both rigid and flexible laryngoscopy with stroboscopy in the presence of a speech therapist. Disappointing results can be related to surgical technique which may be improved with one of the thyroplasty kits currently available or may be related to poor patient selection and inadequate pre-operative laryngeal assessment. Quantitative results of patients who have undergone thyroplasty suggest that it improves the voice in both the short and long term and is a better procedure than teflon injection for the vocal rehabilitation of a patient with a unilateral vocal fold paralysis.

References

- Flint, P., Cummings, C. (1993) Phonosurgical procedures. In: *Otolaryngology, Head and Neck Surgery*. 2nd Edition. vol. 3, ch. 112. (Cummings, C., ed.). CV Mosby Co., St Louis, pp 2072–2109.
- Ford, C., Bless, D., Loftus, J. (1992) Role of collagen in the treatment of glottic insufficiency: a study of 119 patients. *Annals of Otolaryngology, Rhinology and Laryngology* **101**: 237–247.
- Gardener, G., Parnes, S. (1991) Status of the mucosal wave post vocal cord injection versus thyroplasty. *Journal of Voice* **5**: 64–73.
- Harries, M., Morrison, M. (1995) Short term results of laryngeal framework surgery – Thyroplasty type 1: A pilot study. *The Journal of Otolaryngology* **24**: 281–287.
- Harries, M., Morrison, M. (1996) Management of the patient with a unilateral vocal cord paralysis: preoperative assessment. *Australian Journal of Otolaryngology* **2(3)**: 252–259.
- Hirano, M., Kakita, Y. (1985) Cover-body theory of vocal fold vibration. In: *Speech science* (Daniloff, R., ed.) College-Hill Press, pp 1–46.
- Isaacson, G., Kim, J., Kirchner, J., Kirchner, J. (1990) Histology of Isshiki Thyroplasty Type 1. *Annals of Otolaryngology and Laryngology* **99**: 42–45.
- Isshiki, N. (1989) *Phonosurgery: theory and practice*. Ch. 3, Springer-Verlag, Tokyo, pp 23–33.
- Isshiki, N., Morita, H., Okamura, H., Hiramoto, M. (1974) Thyroplasty as a new phonosurgical technique. *Acta Otolaryngologica* **78**: 451–457.
- Kaufman, J. (1986) Laryngoplasty for vocal cord medialisation: an alternative to Teflon. *Laryngoscope* **96**: 726–731.
- Kaufman, J. (1993) Management of vocal fold paralysis. The Centre for voice disorders of Wake University, Winston, Salem. *The Visible Voice* **2(3)**: 50–71.

- Netterville, J., Stone, R., Civantos, F., Luken, E., Ossoff, R. (1993) Silastic medialisation and arytenoid adduction: The Vanderbilt experience. *Annals of Otolaryngology and Laryngology* **102**: 413–424.
- Payr, E. (1915) Plastik am Schildknorpel zur Behebung der Folgen einsteinger Stimmbandlahmung. *Deutsche medizinische Wochenschrift* **43**: 1265–1270.
- Von Leden, H. (1991) The history of phonosurgery. In: *Phonosurgery: assessment and surgical management of voice disorders*. ch. 2. (Ford, C., Bless, D., eds.) Raven Press Ltd., New York, pp 3–23.

Address for correspondence:
Meredydd Lloyd Harries,
The Voice Clinic,
Ear, Nose and Throat Department,
The Royal Sussex County Hospital,
Eastern Road,
Brighton BN2 5BE.

Fax: 01273 602730