

Medialization laryngoplasty

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Medialization laryngoplasty was performed in 25 patients between 1993 and 1997. The underlying pathology resulting in glottal incompetence was vocal cord paralysis in 22 patients and vocal cord bowing in 3 patients. Two types of implants were used: self-carved Proplast in 19 patients and pre-fabricated hydroxyapatite prostheses in 6 patients. Preoperative and postoperative results were compared in terms of dysphagia, vocal quality as graded by three experienced voice specialists, and computer measurements of the glottal gap. All patients showed improvement both subjectively and on the objective measurements used. Swallowing returned to normal in all patients who had isolated recurrent laryngeal nerve paralysis. The voice improved in all patients but was rarely judged as entirely normal. (*Otolaryngol Head Neck Surg* 1999;120:275-8.)

Treatment of unilateral vocal cord paralysis (UVCP) depends on the position of the paralyzed cord, the cause of the paralysis, and the chances of spontaneous functional recovery.^{1,2} Laryngeal dysfunction resulting from UVCP depends mainly on the position of the paralyzed vocal cord. A cord in a paramedian position is associated with few swallowing problems and a more or less satisfactory voice, but in a lateral position the difficulties in swallowing and voice are much more important. According to the Wagner-Grossman theory,^{3,4} the vocal fold is in the paramedian position when the recurrent nerve is involved and in the lateral position in high vagal lesions, where both the superior and recurrent laryngeal nerves are compromised. This thinking has

been questioned in recent reports,^{5,6} which essentially state that the location of the lesion along the vagus nerve cannot be predicted by the position assumed by the paralyzed cord.

Only a few epidemiologic studies have investigated the cause of UVCP,^{7,8} and even less is known about the potential and time frame for recovery in the various possible causes. Even in patients in whom the nerve is known to have been sectioned, the paralyzed larynx is not completely immobile because of the bilateral innervation of the interarytenoid muscle, the passive movements caused by aerodynamic forces, and the transmission of extralaryngeal movement to the larynx.¹ Therefore the treatment choice between speech therapy, temporary injection laryngoplasty, and laryngeal framework surgery is based mainly on clinical expertise and, possibly, laryngeal electromyography.

Despite a long history of speech therapy exercises for UVCP,⁹ no consensus is available on the role,^{2,10} type,^{1,9,10} and duration of speech therapy for UVCP. Usually surgery is indicated if speech therapy does not resolve the swallowing problems or if the voice remains unsatisfactory. The goal of all surgical procedures for UVCP is to medialize the vocal cord. For a long time, this surgery was based on laryngeal injections, mainly of Teflon.¹¹ Since the beginning of the century, several authors have described surgical procedures to medialize the vocal cord,¹²⁻¹⁵ but the popularization of medialization laryngoplasty (ML) is largely the result of the work of Isshiki et al.¹⁶

PATIENTS AND METHODS

Between 1993 and 1997, 25 patients underwent ML. There were 18 men and 7 women. The average age was 61 ± 16 years. Most of the patients (22) presented with UVCP, except 3 patients who had important vocal cord bowing without paralysis. The cause of UVCP included central vagus lesion in 3 patients, high vagal paralysis in 5, thoracic involvement of the left recurrent nerve in 9, thyroidectomy in 5, and laryngeal trauma in 3. The 3 patients with laryngeal trauma had large glottic bowing after longstanding intubation in 1 and previous laryngeal surgery in 2 cases. The delay between the beginning of symptoms and ML varied between 1 week and 5 years, with an average of 9 months. The majority of patients had preoperative speech therapy.

The surgical technique of ML is similar to the original technique described by Isshiki et al.¹⁶ The only modifications

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Fig. 1. Preoperative videolaryngoscopic image of a patient with a left UVCP. The picture frame where the glottic closure is optimal has been chosen every time. *Stippled line* is the length of the normal vocal cord. *Thick line* is the maximal glottic gap width, and *closed continuous line* represents the surface of the glottic gap.

were the removal of the cartilage from the thyroid window and the use of synthetic implants. In 19 patients the implant used was a custom-carved piece of Proplast, and in the remaining 6 cases, a commercially available hydroxyapatite preformed prosthesis (Vocom, Smith & Nephew Richards, Memphis, Tenn.)¹⁷ was implanted. The inner perichondrium of the thyroid cartilage was preserved initially to minimize local edema and then deliberately sectioned before the introduction of the implant. The procedure was usually performed with the patient under local anesthesia, except in three patients who required general anesthesia for concomitant procedures: a cricopharyngeal myotomy, an extended radical neck dissection with vagus nerve sacrifice, and placement of an esophageal prosthesis. The position of the vocal cord was adjusted through vocal and fibroscopic feedback when local anesthesia was used. For procedures in which patients were under general anesthesia, the vocal cord position was monitored by use of classic suspension laryngoscopy equipment with the microscope image transmitted on a television screen. Although monitoring during general anesthesia is less optimal because of the lack of dynamic vocal feedback, the endotracheal tube did not appear too problematic. In one case jet ventilation anesthesia was used, and in the remaining two, small endotracheal tubes (5.0 mm) were used. In addition, the presence of a stable and clear picture provided by the microscope was believed to be a definitive advantage.

Swallowing difficulties were scored by the patients using a performance status scale used to determine the quality of life of head and neck cancer patients.¹⁸ One of the scales assesses the capacity to eat in public, and the other assesses the normalcy of the diet. The lowest score for each scale is 0 and the highest 100. The results obtained on each scale were averaged for every patient and are presented as a mean for the patient population.

Vocal quality was evaluated independently by two speech pathologists (F. E. and I. C.) and an otolaryngologist (V. S.) using the GRBAS scale introduced by Hirano.¹⁹ The five parameters are scored between 0 and 3. The results represent an average of the individual patient scores.

Preoperative and postoperative videostroboscopic images were reexamined, and the frame in which the glottis is the most closed was digitized with a video analog-to-digital converter board (Miro DC 20; Miro Computer Products, Palo Alto, Calif.) with a resolution of 300 dots/inch. The distance of the maximum vocal cord gap and the surface of the gap were measured with a public-domain image-analysis software (Osiris; Department of Medical Computing, University Hospital of Geneva, Switzerland). To compensate for variations caused by the different optics used, the focal distance of the camera, and the variations in distance between the optic and glottal planes, we used the length of a normal vocal cord (*VCnorm*) as a reference to which the other measures were normalized (Fig. 1):

Table 1. Preoperative and postoperative results regarding the severity of dysphagia, the vocal quality, and the measure of the glottic gap

	Preoperative	Postoperative	p Value
Dysphagia score	58 ± 39	84 ± 24	<0.001
Vocal assessment			
Grade of dysphonia	2.7 ± 0.6	1.2 ± 0.6	<0.001
Roughness of voice	2.0 ± 0.7	0.9 ± 0.6	0.01
Breathiness of voice	2.8 ± 0.4	1.5 ± 0.6	<0.001
Asthenia	2.5 ± 0.8	1.4 ± 0.9	0.04
Strain	1.6 ± 0.7	0.7 ± 0.7	0.05
Length of normal vocal cord (pixels)	230 ± 53	251 ± 34	NS
Width of glottic gap (pixels)	0.15 ± 0.07	0.03 ± 0.02	0.002
Surface of glottic gap (pixels)	9.9 ± 5.8	0.9 ± 1	0.006

NS, Not significant.

Width of glottal gap = Measured maximal gap/Length VC_{norm}

Surface of glottal gap = Measured surface/(Length VC_{norm})²

The unit of these measurements is pixels. The average follow-up was 12 ± 6 months. Statistical analysis used Student's *t* test.

RESULTS

Most patients had important swallowing difficulties, with an average preoperative score of 58 ± 39 (Table 1). In the “eating in public” scale used by List et al.,¹⁸ this score corresponds to patients restricting their meals to certain places and only in the presence of selected people. For the “normalcy of diet” scale this score corresponds to a soft diet. Postoperative swallowing was significantly improved, with an average score of 84 ± 24 (*p* < 0.001). Sixteen patients had normal swallowing after surgery, with a score of 100. The remaining patients had associated pathologic conditions such as total vagal paralysis, other cranial nerve deficits, or esophageal cancers.

All vocal criteria as assessed by the speech pathologists according to the GRBAS scale were improved (*p* < 0.05). The most significant improvements were in the grade and breathiness scales. In addition, the computerized measurements of the vocal cord gap were significantly smaller after surgery (*p* < 0.05).

We encountered three complications (12%) that required a second surgical procedure for correction. In one case the laryngeal mucosa was violated, and the procedure was aborted, to be performed successfully 2 weeks later. In another patient, the Proplast implant eroded the laryngeal mucosa 6 months after surgery and required surgical removal. In this patient with large postintubation glottal bowing without paralysis, the

voice remained satisfactory, and the patient did not request further surgery. In a third patient the shim of the Vocom hydroxyapatite set broke during the procedure and resulted in a postoperative displacement of the entire implant. During the second procedure, the implant was removed, and another one was placed with good results. We did not have any postoperative hemorrhage, wound infections, or laryngeal obstruction requiring a tracheotomy.

DISCUSSION

The goal of all procedures for UVCP is to achieve a closure of the glottis on phonation, which is supposed to permit a better voice and resolve swallowing problems. The type of phonosurgery used is based mainly on the preferences and individual expertise of the surgeon because few comparative,^{20,21} and no randomized, studies are available. In a recent review,¹ the choice of surgical technique was based on two parameters: the permanence of the lesion and the presence of a posterior glottic opening. For UVCP that is believed to be temporary, a Gelfoam injection laryngoplasty is proposed. If a definitive treatment is judged necessary, ML or autologous fat injection laryngoplasty is advised, both of which can be combined with an arytenoid adduction in case of posterior glottic incompetence.

Difficulty in closing posterior glottic openings with the ML were already noted by Isshiki et al.,²² and they proposed arytenoid adduction as the procedure of choice for posterior glottic openings. Although this opinion is repeated in the literature,^{1,2} several recent studies do not show an obvious difference between these two techniques.^{20,23} Although in these retrospective and nonrandomized studies, a bias could have been introduced by patient selection, the role of arytenoid

adduction remains to be defined on the basis of precise preoperative criteria.

Comparison between surgical techniques is plagued by the lack of standardized evaluation criteria for vocal quality. Of the numerous acoustical analysis measurements available, it has been stated that jitter, shimmer, signal-to-noise ratio, and measurements of breathiness can be useful in evaluating UVCP treatment results.¹ Acoustical analysis data in our patients (data not shown) did not seem to correlate with the perceptual evaluation by speech therapists and the subjective satisfaction of the patients. This is in agreement with the findings of Rabinov et al.²⁴ that acoustical measures discriminate best among normal voices, whereas perceptual evaluation reliability increases with the severity of vocal pathology. Similar conclusions have been drawn for UVCP patients undergoing ML by Plant et al.²⁵ We therefore used another objective measurement of medialization, the digitized images of the larynx during phonation, as suggested by Omori et al.²⁶

In conclusion, ML is a valuable technique in the surgical treatment of UVCP, giving excellent swallowing results and satisfactory vocal results.

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