The Journal of Laryngology and Otology
July 1999, Vol. **113**, pp. 637–641

CO_2 and KTP-532 laser cordectomy for bilateral vocal fold paralysis

L. MANOLOPOULOS, M.D.*, P. STAVROULAKI, M.D.†, J. YIOTAKIS, M.D.*, J. SEGAS, M.D.*, G. ADAMOPOULOS, M.D.*

Abstract

Laryngeal obstruction due to bilateral vocal fold paralysis has been treated in many different ways. The CO_2 laser or KTP-532 laser endoscopic cordectomy described in this report is a slight modification of the posterior partial cordectomy proposed by Dennis and Kashima. This technique was used in 18 patients (14 with the CO_2 and four with the KTP-532 laser). Prophylactic tracheostomy was performed pre-operatively. Post-operative results were excellent in nine cases, good in seven cases and poor in two cases who had to remain with a permanent tracheostomy tube with a speaking valve. The main complications noted were the formation of a granuloma (seven cases) and arytenoid oedema (six cases). Revision surgery was performed in the seven cases with granuloma formation and in the two with persistent oedema. The results and the post-operative findings from the use of the two lasers were similar.

Key words: Vocal fold; Paralysis; Laser surgery; Complications

Introduction

Laryngeal obstruction due to bilateral abductor vocal fold paralysis has been treated in many different ways. A variety of surgical procedures, including extralaryngeal and endoscopic approaches, have been used for bilateral vocal fold paralysis in an attempt to improve the patient's airway insufficiency without leaving him or her with a breathy, weak voice or an incompetent larynx. From a phoniatric point of view, surgical management should aim at a compromise between respiratory and phonatory performance (Ossoff *et al.*, 1990). The decision as to which of the several procedures for airway rehabilitation should be undertaken is determined by the patient's individual needs and the surgeon's preference.

Tracheostomy still remains a highly effective management of bilateral vocal fold paralysis (Dennis and Kashima, 1989), particularly in emergencies, but it is not usually accepted by the patient as a long-term solution. In 1922 Jackson proposed excision of the entire vocal fold and ventricle. This procedure created an excellent airway but the patient acquired an extremely breathy voice. The attempts of Hoover in 1932 (submucous resection of the vocal fold) and King in 1939 (laterofixation of the fold by an extralaryngeal approach) had also poor results regarding severe post-operative dyspnoea.

In 1946 Woodman proposed his well-known technique, which remains the procedure of choice among many ENT surgeons. He described arytenoidectomy using a posterolateral extralaryngeal approach and suturing the vocal process to the inferior cornu of the thyroid cartilage. However, in 20 to 40 per cent of cases, this technique has also failed to provide patients with an adequate airway. In 1948 Thornell described endoscopic arytenoidectomy by electrocautery for lateralization of one or both vocal folds and in 1976 Tucker reported the successful re-innervation of the posterior cricoarytenoid muscle by the ansa hypoglossi nerve-muscle pedicle. However, his results have not been reproduced by the majority of ENT surgeons and the restoration of vocal fold abduction by selective re-innervation of the paralysed posterior cricoarytenoid muscle still remains controversial. In fact, even Tucker, after performing his operation in 200 cases, mentioned a failure rate of 14 per cent. He has also emphasized the limitations of this technique in those cases in which there is fixation of the arytenoid before surgery.

In 1983 Ossoff *et al.*, described endoscopic CO_2 laser arytenoidectomy. In 1989 Dennis and Kashima introduced the technique of endoscopic laser posterior cordectomy for the management of patients with bilateral vocal fold paralysis. It is an effective technique for relieving airway obstruction and

From the Ear, Nose and Throat Department*, Faculty of Medicine, University of Athens, Greece, and the Department of Otolaryngology†, University of Bristol, Southmead Hospital, UK.
Presented in: 8th Panhellenic Congress in Otolaryngology Head and Neck Surgery, Lemesos Cyprus. November 2–5, 1995.
Accepted for publication: 1 April 1999.

https://doi.org/10.1017/S002221510014472X Published online by Cambridge University Press

maintaining subjectively good voice quality. The cordal defect which is created by the CO_2 laser remains open because both ends of the thyroarytenoid muscles contract to prevent closure. The quality of voice is generally good since the anterior three quarters of the fold are preserved in position. In 1990 Rontal and Rontal introduced an endoscopic laryngoplasty that incorporates removal of arytenoid cartilage or scar tissue by a carbon dioxide (CO_2) laser ablation through an inferiorly based micro-trapdoor mucosal flap and an endoscopic suturing technique to guarantee that the micro-trapdoor flap will remain in place and effect permanent coverage. In 1992, Linder and Lindholm described a modified endoscopic method of lateralization, employing a CO_2 laser to reduce the bulk of the fold and fibrin glue to maintain the lateral position, and in 1993 Crumley reported endoscopic laser medial arytenoidectomy for airway management in bilateral laryngeal paralysis. Most of these procedures require tracheostomy, and airway obstruction is relieved at the expense of voice quality, which is breathy.

The senior author (AG) has introduced a slight modification of the Dennis and Kashima (1989) endoscopic posterior partial cordectomy, which is currently used in our department for patients with bilateral vocal fold paralysis. This modification consists of resection of the ipsilateral false vocal fold which is preserved in the original technique. In addition, in a small, as yet, number of cases we used the KTP-532 laser which has not been used before for such procedures. We, herein, report our initial experience with this method.

Materials and methods

From 1990 to 1996 partial posterior cordectomy by CO_2 laser or KTP-532 laser was performed in 18 patients with bilateral vocal fold paralysis in our department. The CO_2 laser was used in 14 cases and the KTP-532 laser in the last four cases. There were 14 women and four men, aged from 20 to 75 years, and the duration of their symptoms ranged from three months to three years. The major presenting complaint was severe dyspnoea, especially on exertion. None of the patients reported subjective dysphagia. Thirteen patients presented with a tracheostomy and the remaining five had a tracheostomy performed pre-operatively. The aetiology of bilateral fold paralysis is presented in Table I.

All patients were subjected to detailed ENT, neurological, systemic and radiological examination. Swallowing ability was studied routinely in all patients pre-operatively and post-operatively by barium contrast radiography, while voice function was judged by a vocal therapist. However, a considerable number of patients did not have the voice test and for this reason definite conclusions about voice quality could not be drawn.

Vocal results were evaluated by high-resolution frequency analysis with a Bruel and Kjaer 2033 analyser (Naerum, Denmark) according to criteria already defined (Remacle *et al.*, 1989). Analysis of the vocal frequency was recorded in the form of a histogram of intensity as a function of frequency. The traces obtained were classed qualitatively in one of the following five cagetories: type 0: practically flat trace (absence of sound), type 1: absence of the peaks corresponding to the fundamental frequency and harmonics, type 2: presence of noise (presence of the fundamental frequency with the peaks corresponding to the harmonics absent or rudimentary), type 3: persistence of noise (the peaks corresponding to the fundamental frequency and to the harmonics remain widened and notched) and type 4: normal trace (absence of noise, presence of the peaks corresponding to the fundamental frequency and harmonics). Other vocal measurements included intensity (dB HL), maximum phnation time for /a/(sec) and phonation quotient (ml/sec). All these parameters were expressed as means ±SD and medians.

The follow-up period ranged from nine months to six years.

TABLE I
PATIENT DETAILS AND RESULTS OF SURGERY

Patients	Age	Sex	Duration of BVFP*	Previous tracheostomy	Aetiology	Exercise tolerance pre-operatively†	Post-operative complications	Revision operation	Decannulation	Exercise tolerance post-operatively†
1	75	Female	20 months	−	Unknown	Poor	Granuloma	+	+	Good
2	24	Female	14 months	−	Thyroidectomy	Poor	−	−	+	Good
3	35	Female	8 months	+	Thyroidectomy	Good	Granuloma	+	+	Excellent
4	47	Female	15 months	+	Thyroidectomy	Poor	Arytenoid oedema	−	+	Good
5	28	Female	18 months	+	Thyroidectomy	Good	−	−	+	Excellent
6	40	Male	10 months	+	Thyroidectomy	Good	Granuloma	+	+	Excellent
7	26	Female	5 months	+	Thyroidectomy	Poor	Arytenoid oedema	+	−	Poor
8	20	Female	3 months	+	Thyroidectomy	Poor	Arytenoid oedema	−	+	Good
9	50	Male	14 months	−	Unknown	Poor	−	−	+	Good
10	45	Female	10 months	+	Thyroidectomy	Good	Granuloma	+	+	Excellent
11	60	Female	15 months	−	Unknown	Poor	Granuloma	+	+	Good
12	62	Female	17 months	+	Unknown	Good	Arytenoid oedema	−	+	Excellent
13	41	Female	16 months	+	Thyroidectomy	Good	Arytenoid oedema	−	+	Excellent
14	30	Female	15 months	+	Thyroidectomy	Good	−	−	+	Excellent
15	27	Male	24 months	+	Thyroidectomy	Good	Granuloma	+	+	Excellent
16	25	Female	36 months	−	Thyroidectomy	Poor	−	−	+	Excellent
17	54	Male	10 months	+	Thyroidectomy	Poor	Arytenoid oedema	+	−	Poor
18	57	Female	11 months	+	Thyroidectomy	Poor	Granuloma	+	+	Good

*BVFP – bilateral vocal fold paralysis.
†Exercise tolerance: excellent – 5 or 4 flights of stairs, good – 3 or 2 flights of stairs, poor – 1 flight of stairs or dyspnoea at rest.

https://doi.org/10.1017/S002221510014472X Published online by Cambridge University Press

Surgical technique

The operation was performed by suspension microlaryngoscopy under general anaesthesia. A Zeiss opmi surgical microscope using a 400 mm objective lens was used. The CO_2 laser setting was 10 W for 0.1 second in repeat mode and the KTP-532 laser was 8 W for 0.1 second in continuous mode. In the subglottic space we placed neurosurgical pledgets to protect the trachea.

After the exposure of the larynx, the margins of the excision are first marked by solitary laser bursts. This facilitates the assessment of the appropriate positioning of the excision line and also allows adjustment to the 'feel' of both micromanipulator and tissue. We begin the resection by removing the ipsilateral false vocal fold. This step greatly facilitates the visualization of the true vocal fold and represents our modification of the original technique of Dennis and Kashima (1989). The margins of true vocal fold excision are also marked with the laser, starting posteriorly, anterior to the vocal process of the arytenoid cartilage, which is identified by palpation using a small-bore laryngeal suction tip. The excision is carried out through the entire vocalis and thyroarytenoid muscle and a wedge-shaped portion, approximately one quarter of the true vocal fold, is removed creating an opening of 5-6 mm (Figure 1).

The lased area is cleansed with moistened cottonoids to ameliorate the cicatrisation and to remove the charred tissue. Even though the excision could be bilateral it is performed in one vocal fold at the first setting. After six to eight weeks if the airway is not adequate the excision can be repeated in the same vocal fold or a minor cordectomy can be added on the opposite side, depending on the anatomy in each case.

All patients had had a temporary tracheostomy and the first attempt to close the tracheostomy was made on the third post-operative day. All patients received prednisolone, intra-operatively and for 48 hours afterwards, 25 mg every eight hours. A broad spectrum oral antibiotic was prescribed for seven days. If persistent swelling of the glottis occurred a second course of antibiotics and steroids was given for another week.

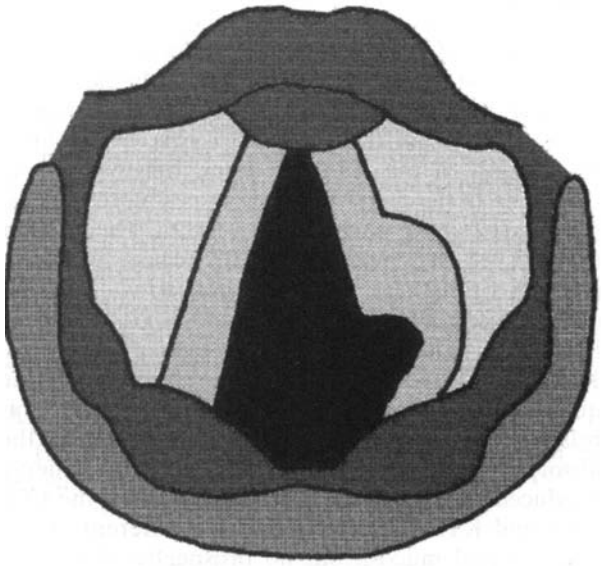

FIG. 1

Unilateral endoscopic laser cordectomy (the resected segment of the true and the false vocal fold are outlined).

Results

The results and the post-operative findings from the use of the CO_2 laser and KTP-532 laser were similar, although no statistically valid statement can be made about such small groups. Table I shows the results for each patient.

The clinical appearance of the larynx showed a roughly triangular defect in the posterior portion of the vocal fold, which remained coated with a white exudate for several days until final wound healing occurred by four to eight weeks.

Post-operative results were excellent in nine cases (50 per cent) and good in seven cases (39 per cent) after the procedure. The remaining two patients (11 per cent) had a less than satisfactory airway and had to remain with a permanent tracheostomy tube with a speaking valve.

The main complication we noted was the formation of a granuloma in seven cases (39 per cent). Arytenoid oedema was observed in six cases (33.3 per cent). Two of these patients developed airway compromise, secondary to the excessive arytenoid oedema, requiring a revision operation. The final post-operative results of these two patients were poor and decannulation was not possible. Revision surgery was also necessitated by the formation of granuloma in seven cases with satisfactory post-operative results. No web formation was observed or any complications related to the use of the laser itself (i.e. explosion burn). There were no reports of swallowing impairment or aspiration, probably due to preservation of the arytenoid cartilage, and the post-operative evaluation by barium contrast radiography reconfirmed the good pre-operative clearance through the upper oesophageal sphincter in all patients.

The outcome in terms of voice quality was subjectively assessed from the patient's accounts in 13 patients, while objective evaluation was obtained only in five of the nine cases with excellent results (Table II). Regarding the frequency analysis, according to the type of trace there was the following distribution: type 2 trace: 2/5, type 3: 2/5 and type 4: 1/5. Mean vocal intensity was 61 ± 4 dB HL (median 63), maximum phonation time for /a/ was 7.6 ± 3 sec (median 8.6) and phonation quotient was 318 ± 150 ml/sec (median 373). Although vocal parameters were perturbed as compared to a normal voice, patients were satisfied with their final voice quality, which allowed normal social interaction.

TABLE II
QUANTITATIVE VOCAL EVALUATION

Parameters	Mean ± SD	Median
Vocal intensity (dB HL)	61 ± 4	63
Phonation time (sec) for /a/	7.6 ± 3	8.6
Phonation quotient (ml/sec)	318 ± 150	373

https://doi.org/10.1017/S002221510014472X Published online by Cambridge University Press

Discussion

The treatment of patients with bilateral vocal fold paralysis presents a challenge to the otolaryngologist – head and neck surgeon. This condition most commonly results from injury to both recurrent laryngeal nerves during thyroid surgery and less frequently is caused by some other external injury to the larynx or neck, or may be due to a tumour, or a central nervous system dysfunction (bulbar disorders). Bilateral vocal fold paralysis has also been associated with inflammation (influenza, diphtheria, typhoid fever), toxic (lead and arsenic ingestion), idiopathic and metabolic causes.

With the introduction of the CO_2 laser for microsurgery, new horizons were opened up for the treatment of this condition endoscopically. The CO_2 laser posterior partial cordectomy evolved from the observation that patients having CO_2 laser endoscopic excision of vocal process granuloma rarely experience voice change (Dennis and Kashima, 1989). The quality of voice is generally good, because the anterior three quarters of the fold are presented in position, and the airway obstruction is successfully relieved, since the cordal defect, created by the CO_2 laser, remains open as both ends of the thyroarytenoid muscles contract to prevent closure.

When compared to traditional techniques, i.e. cordopexy of King (1939), arytenoidectomy and cordopexy of Woodman (1946), the advantages offered by the procedure are evident: rapidity and simplicity in concept, immediate assessment of airway size, reliability of outcome, short hospitalization, low risk of complications and suitability for revision operation when necessary. Additional advantages associated with the use of the CO_2 laser have included increased haemostasis and decreased intra-operative and post-operative oedema. The wound becomes covered by a coagulum of denatured protein and elicits a minimal inflammatory response, causing less oedema. Similarly, because there is a minimal inflammatory response, epithelial regeneration is delayed, causing longer healing times (Hendrick and Meyers, 1995). Some believe that this longer healing time may be a small advantage because it may decrease wound contraction and scarring (Rathfoot and Coleman, 1996). Lately some authors (Dennis and Kashima, 1989; Crumley, 1993; Szmeja and Wojtowicz, 1995; Bigenzahn and Hoefler, 1996) have advocated performing endoscopic partial posterior cordectomy by CO_2 laser without a previous tracheostomy, believing that the minimal post-operative oedema does not compromise respiration. In our experience, tracheostomy is not only indicated for post-operative oedema, but also for prevention of blood aspiration due to haemorrhage (cuffed tracheostomy tube). The use of the CO_2 laser, attached to the operating microscope, affords the opportunity to perform precise, hands-off, endoscopic operations, however, through the relatively narrow operative field of the microlaryngoscope. Resection of the ipsilateral false vocal fold prior to glottic resection enlarges the surgical field and facilitates the excision at the glottic level. It is well known that the greater extent of the laser resection the higher the incidence of delayed complications (Wetmore *et al.*, 1985) and the less reliable functional outcome to be expected. However, our experence with our own modification of the original procedure proposed by Dennis and Kashima (1989), although limited, allows certain optimism. Our decannulation rate (88.8 per cent) correlates well with the 80 to 100 per cent range that has been described by Rontal and Rontal (1990) and Dennis and Kashima (1989) respectively. Dennis and Kashima reported a quite high rate (66.6 per cent) of one or more revision operations in their patients following insufficient airway restoration after the initial procedure. In our series, revision surgery was necessitated in nine patients (50 per cent) due to granuloma formation or arytenoid oedema. Although this percentage remains high we do not feel that it diminishes the advantages of laser partial posterior cordectomy. In comparison, total arytenoidectomy may create a sufficient airway but can often be followed by posterior glottic stenosis, a grave potential complication (Montgomery, 1989). In addition the endoscopic laryngoplasty proposed by Rontal and Rontal (1990) is quite complex, requiring a long learning curve and can be complicated by aspiration. In contrast, aspiration was not encountered in our series nor has it been previously reported by other authors after partial posterior cordectomy.

Lasers of different wavelengths produce energy that is absorbed by different substances within tissue. The carbon dioxide (CO_2) laser has a wavelength in the infrared region (1000 nm) and is absorbed primarily by water. The potassium titanyl phosphate (KTP) laser, in contrast, has a wavelength in the visible region (532 nm/blue-green) and is absorbed by pigments containing its complementary colours such as haemoglobin and melanin (Ossoff *et al.*, 1994). Differences in laser properties also have practical considerations. The KTP-532 laser is more effective for haemostasis because its wave-length is nearer the maximum absorption of haemoglobin. Although it does not vaporize as precisely as the CO_2 laser, it has the advantage of combining a very small spot size (200 mm) with delivery through a fibre-optic system (Ossoff *et al.*, 1994). The shorter wavelength of the KTP-532 laser, however, penetrates the tissue deeper and produces more thermal scatter (Lesinski and Palmer, 1989). The greater thermal effect could potentially cause excessive scarring or damage to underlying structures. The differences between the CO_2 and KTP-532 lasers have been studied using skin as their model (Hall, 1971; Kyzer *et al.*, 1993). The difference in the quantity and distribution of melanin in the epidermis relative to the laryngeal mucosa may affect the absorption and penetration of the thermal energy produced by the KTP-532 laser. Therefore the CO_2 laser and KTP-532 laser may have different effects on laryngeal mucosa but no prospective long-term study has been reported in the literature that specifically address this possibility. In our experience, a comparison of the CO_2 and KTP-532 lasers

https://doi.org/10.1017/S002221510014472X Published online by Cambridge University Press

showed that the results and the post-operative findings did not differ significantly. However, our results are preliminary and further research is necessary before definite conclusions can be drawn.

The only inherent disadvantages of the two lasers are the added skill of the surgeon, which must be gained in applying any new technique, and the cost of the laser itself. Patients with ischaemic cardiovascular disease may not withstand the prolonged laryngoscopic suspension that stimulates the vagus nerve and may produce subsequent cardiac arrhythmia as well as silent myocardial infractions, but in out patients no such complications were observed. In addition persistent vocal fold oedema, chronic inflammation and wound-healing disorders are limitations for the application of this technique (Dennis and Kashima, 1989).

Potential complications include post-operative oedema, granuloma and scar formation, breathy voice quality, infection, arytenoid perichondritis and the known complications that accompany the use of the CO_2 laser (Dennis and Kashima, 1989). From our experience, arytenoid oedema, although a common complication, usually resolves with simple conservative measures and does not create significant problems. However, in two occasions revision surgery was required, with poor results.

Revision surgery, as already mentioned above, was also necessitated by the formation of granuloma in seven cases. Granulation tissue is thought to arise from disruption of mucosa or exposure of cartilage and secondary infection at multiple levels in the airway. Gastric acid reflux can also play an important role in the formation of granulation tissue (Courey and Ossoff, 1996). In our study, post-operative granuloma formation can probably be attributed to accidental exposure of the underlying cartilage in one case, while in two more patients continued smoking in the post-operative period may have been a predisposing factor. Repetitive trauma to the raw non-epithelialized edge of the vocal fold induced by vocalizing during the prolonged healing phase is another possible irritating factor.

Conclusion

From the results of this retrospective study it can be concluded that endoscopic laser cordectomy is a reliable option for the management of patients with bilateral vocal fold paralysis. It results in a roughly triangular defect in the posterior portion of the vocal fold, improving post-operative airway resistance and maintaining good voice quality. It is a simple and effective technique with satisfactory results that can replace more invasive surgical interventions.

Acknowledgements

The authors wish to thank Dr I. Vossinakis for his art work.

References

Bigenzahn, W., Hoefler, H. (1996) Minimally invasive laser surgery for the treatment of bilateral vocal cord paralysis. *Laryngoscope* **106:** 791–793.

Courey, M. S., Ossoff, R. H. (1996) Laser applications in adult laryngeal surgery. *Otolaryngologic Clinics of North America* **29(6):** 973–986.

Crumley, R. (1993) Endoscopic laser medial arytenoidectomy for airway management in bilateral laryngeal paralysis. *Annals of Otology, Rhinology and Laryngology* **102:** 81–84.

Dennis, D. P., Kashima, H. (1989) Carbon dioxide laser posterior cordectomy for treatment of bilateral vocal cord paralysis. *Annals of Otology, Rhinology and Laryngology* **98:** 930–934.

Hall, R. R. (1971) The healing of tissues incised by a carbon dioxide laser. *British Journal of Surgery* **58:** 222–225.

Hendrick, D. A., Meyers, A. (1995) Wound healing after laser surgery. *Otolaryngologic Clinics of North America* **28(5):** 969–986.

Hoover, W. B. (1932) Bilateral abductor paralysis, operative treatment of submucus resection of the vocal cord. *Archives of Otolaryngology* **15:** 337–355.

Jackson, C. (1922) Ventriculocordectomy, a new operation for the cure of goitrous glottic stenosis. *Archives of Surgery* **4:** 257–274.

King, B. T. (1939) A new and function restoring operation for bilateral abductor fold paralysis. *Journal of the American Medical Association* **112:** 814–823.

Kyzer, M. D., Aly, A. . Davidson, J. M., Reinisch, L., Ossoff, R. H. (1993) Subablation effects of the KTP laser on wound healing. *Lasers Surgical Medicine* **13:** 62–71.

Lesinski, S. G., Palmer, A. (1989) Lasers in otosclerosis: CO_2 vs argon and KTP-532. *Laryngoscope* **99:** 1–8.

Linder, A., Lindholm, C. E. (1992) Vocal fold lateralization using carbon dioxide laser and fibrin glue. *Journal of Laryngology and Otology* **106:** 226–230.

Montgomery, W. W. (1989) *Surgery of the Upper Respiratory System.* 2nd Edition. Vol. 2, Lea and Febiger, Philadelphia, PA, p. 651.

Ossoff, R. H., Coleman, J. A., Courey, M. S., Duncave, J. A., Werkhaven, J. A., Reinisch, L. (1994) Clinical applications of lasers in otolaryngology – head and neck surgery. *Lasers Surgical Medicine* **15:** 217–248.

Ossoff, R. H., Duncavage, J. A., Shapshay, S. M., Krespi, Y. P., Sisson, G. A. (1990) Endoscopic laser arytenoidectomy revisited. *Annals of Otology, Rhinology and Laryngology* **99:** 764–771.

Ossoff, R. H., Karlan, M. S., Sisson, G. A. (1983) Endoscopic laser arytenoidectomy. *Lasers in Surgery and Medicine* **2:** 293–299.

Rathfoot, C. J., Coleman, J. A. (1996) Laser utilization in the oral pharynx. *Otolaryngologic Clinics of North America* **29:** 963–972.

Remacle, M., Millet, B., Van Heule, P., Du Vivier, P. (1989) Clinical application of the high resolution frequency analyser. *Folia Phoniatrica (Basel)* **4:** 259–269.

Rontal, M., Rontal, E. (1990) Endoscopic laryngeal surgery for bilateral midline vocal fold obstruction. *Annals of Otology, Rhinology and Laryngology* **99:** 605–610.

Szmeja, Z., Wojtowicz, J. G. (1995) Laser arytenoidectomy in the treatment of bilateral vocal cord paralysis. *Advances in Otorhinolaryngology* **49:** 182–184.

Thornell, W. C. (1948) Intralaryngeal approach for arytenoidectomy in bilateral ahductor vocal cord paralysis. *Archives of Otolaryngology* **47:** 505–508.

Tucker, H. M. (1976) Human laryngeal reinnervation. *Laryngoscope* **86:** 769–799.

Wetmore, S. J., Key, J. M., Suen, J. V. (1985) Complications of laser surgery for laryngeal papillomatosis. *Laryngoscope* **95:** 798–801.

Woodman, D. (1946) A modification of the extralaryngeal approach to arytenoidectomy for bilateral abductor paralysis. *Archives of Otolaryngology* **43:** 63–65.

Address for correspondence:
J. Yiotakis, M.D.,
98 Vas. Sophias Ave.,
GR-115 28 Athens,
Greece.

Fax: 0030 1 6250611

https://doi.org/10.1017/S002221510014472X Published online by Cambridge University Press