



Revised Thyroplasty: The Importance of Inner Perichondrium Dissection

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Purpose: The outcome of voice surgery on unilateral vocal cord paralysis (UVCP) by medialization laryngoplasty (ML) was various although the series of reports consistently claimed that the phonation ability restored well after their reconstructive surgery. We revised several unsatisfactory subjects and proposed a correct concept to facilitate a successful surgery. **Patients and Methods:** One hundred and forty subjects suffering from UVCP and undergoing ML procedure were reviewed. Eight of the 140 subjects underwent revised thyroplasty to improve their unsatisfactory voice. The time elapse from UVCP onset to first ML procedure and between first and second ML procedure was recorded and analyzed. Maximal phonation time (MPT) was used to evaluate the improvement of phonation ability. **Result:** Inappropriate size or location of the implant material were defined in two subjects, inappropriate management of the inner perichondrium of thyroid lamina (IPTL) were defined in 5, and cricoarytenoid joint (CAJ) fixation in one. MPT was increased from 3 s to 11 s in average after revised surgery. MPT more than 10 s was obtained in 7 subjects in their followup at mean 15 months. **Conclusion:** The management of IPTL actually determined the voice surgical outcome significantly. Preoperative evaluation of the CAJ mobility was still an important factor to determine the use of corrective methods.

Keywords: Medialization laryngoplasty, thyroplasty, unilateral vocal cord paralysis, cricoarytenoid joint, maximal phonation time

INTRODUCTION

Most of unilateral vocal cord paralysis (UVCP) resulted from recurrent laryngeal nerve (RLN) injury in the past century.^{1,2} The management for UVCP following the cause had been initially proposed as laryngeal reinnervation.^{3,4} However, before the laryngeal reinnervation was well established, early in the 1974, a widespread and undying medialization laryngoplasty (ML) was invented by Isshiki *et al.*⁵ After that, a series of modifications about implant materials and implant shape were proposed to enhance the ease or efficacy of the ML.⁶ In order to facilitate the closure of the posterior glottis, arytenoids adduction (AA) procedure was proposed to increase the effect of ML and also modified with traction AA procedure by Sonoda *et al.* in 1995.⁷ In subjects with cricoarytenoid joint (CAJ) fixation, the

classical AA procedure turned to be an essential one because the classical procedure enabled a mobile CAJ while the traction AA procedure was unable to mobile a fixed joint.^{8,9}

The effective medial excursion magnitude of vocal fold produced by the three adductors physiologically is sequentially as following: Rotation effect by lateral cricoarytenoid (LCA), mass or volume effect by thyroarytenoid (TA) and then shift effect by interarytenoid (IA) muscle.¹⁰ Consequently, various combinations of ML mimicking the TA muscle effect and AA mimicking the LCA muscle effect was used to medialize the vocal fold according to the disabilities such as vocal atrophy or CAJ fixation in addition to the vocal paralysis.

To address the entity of an unsatisfactory voice surgery with previous ML with or without AA procedure, we categorized the etiologies as inappropriate size or location of the implant material, incomplete removal of the inner perichondrium of thyroid lamina (IPTL) or incomplete dissection between the IPTL and the TA muscle to allow better compliance of TA muscle, and CAJ fixation. However, with or without AA procedure, extensive scar inside the thyroid window was usually discovered after the implant from previous voice surgery was removed. Therefore, the causes of an unsatisfactory voice surgery might be ascribed to poor compliance in the paraglottic spaces, muscular process or

Received: May 8, 2014; Revised: June 18, 2014; Accepted: September 6, 2014

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even the CAJ. In this study, we proposed our experience in the revision of an unsatisfactory ML.

PATIENTS AND METHODS

Between 2001 and 2013, 262 patients with vocal cord paralysis were presented to our institution and managed by the corresponding author, the senior otolaryngologist consultant (Wan-Fu Su) at the Tri-Service General Hospital and Buddhist Tzu Chi General Hospital, Taipei Branch, Taiwan. Among them, 170 subjects suffered from UVCP, whereas the other 92 subjects suffered from bilateral vocal cord paralysis. Moreover, 140 of the 170 subjects underwent ML and 6 of them were supplemented with classical AA procedures. Eight of the 140 subjects underwent revised thyroplasty to improve their unsatisfactory voice and were enrolled in this study.

Surgical procedure

The patients were prepared under local anesthesia. Incision was made via previous voice surgery scar. The subcutaneous scar containing the subcutaneous tissue and strap muscles was opened to reveal the implant. The implant can be loosened and removed by instrument. The smooth scarring IPTL was usually adhered to the thyroid lamina and the underlying TA muscle. The existed window was trimmed appropriately to achieve a window location as 8 mm from thyroid midline and 3 mm from thyroid lower border and a window size as 3 mm × 15 mm in female and 4 mm × 19 mm in male. Then, a freer elevator was used to broadly release the IPTL away from the overlying thyroid cartilage. Along the edge of the created window, the IPTL was detached meticulously, and the area of IPTL dissection should be larger than that of the window at all edge in order to place the implant compliantly [Figure 1]. The microscope can be used to remove the scarring IPTL from the underlying TA muscle. We had to obtain the adequate size that the compliance space between the thyroid lamina and the TA muscle allowed for the redesigned implant stuffing and free vocal fold medialization. A probe or dissector was usually used to investigate the compliance in the posterior end of the window under the laryngo-videoscopy. The shape and size of the implant were appropriately trimmed based on the biofeedback of voice perception, maximal phonation time (MPT) or the glottic closure in the laryngo-videoscopy. Wound closure was done after a satisfactory voice result with MPT more than 10 s or well glottic closure in the laryngo-videoscopy was obtained.

RESULT

All eight subjects suffering from UVCP and resultant ML procedures had RLN injuries due to thyroid surgery. Various

time elapses from UVCP onset to ML procedure were noted, with 43 months in average (range: 17-81 months) [Table 1]. Six female and 2 male subjects were aged 42 in average. Various time elapses from previous ML procedure to this revised voice surgery were also noted, with average 11 months (range: 6-17 months). Inappropriate size or location of the implant material were defined in 2 subjects, inappropriate management of the IPTL were defined in 5, and CAJ fixation in one. MPT before and after surgery was 3 ± 1 and 12 ± 2.4 s, respectively. The improvement of MPT revealed statistical significance after our revised thyroplasty ($P < 0.05$). MPT more than 10 s was obtained in 7 subjects in their followup at mean 15 months.

DISCUSSION

The major features of UVCP include breathy and husky phonation. Sometimes the glottal incompetence may put the

Table 1. Characteristics of 8 patients undergoing revised thyroplasty

Sex	Age	Etiology of revision	Time (months)		MPT (seconds)	
			Elapse 1	Elapse 2	Before	After
Female	43	Incomplete dissection	60	12	3	12
Female	31	Incomplete dissection	81	8	2	11
Male	45	Inappropriate implant	17	17	4	13
Female	60	CAJ fixation	25	6	5	10
Female	54	Incomplete dissection	65	11	3	17
Female	33	Inappropriate implant	24	15	2	9
Male	41	Incomplete dissection	30	9	3	14
Female	40	Incomplete dissection	44	7	2	11

CAJ = Cricothyroid joint; MPT = Maximal phonation time

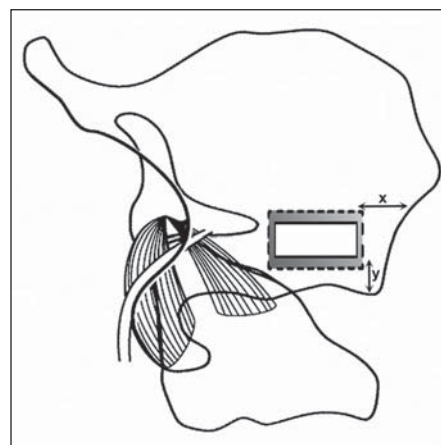


Figure 1. The area of inner perichondrium dissection (dotted line) should be larger than that of the window. Window location showed 8 mm (x) from midline and 3 mm (y) from thyroid lower border. Window size showed 3 × 15 mm and 4 × 19 mm in female and male respectively

patient at risk of life-threatening aspiration. The paralyzed vocal fold is not only significantly lateralized, but a considerable vertical gap exists between the two vocal folds. The main objective in the treatment of patients with UVCP is to provide a well closed and good vibrating glottis. Unlike the postoperative problems such as aspiration or breathy voice in patients with BVCP treated by status laryngoplasty,^{11,12} UVCP can be managed simply by a status laryngoplasty without similar morbidities.¹³ Although the laryngeal reinnervation had its inherent advantages in the voice reconstruction,⁴ the ML still had its advantage in easy performance and consequently widespread in use according to the meta-analysis study.¹⁴ However, unsatisfactory results through inappropriate practice in this surgery by new hands arose subsequently every now and then.

Based on our limited subjects, we categorized the etiologies as inappropriate size or location of the implant material in 2 subjects, CAJ fixation in 1 and then incomplete removal of the IPTL or an incomplete dissection between the thyroid lamina and IPTL to allow better compliance of TA muscle in 5 subjects. The inappropriate size or location of the implant material could be differentiated empirically, and the CAJ fixation could be discernible by instrument test after the scar tissue inside the window completely removed. The incomplete IPTL intervention included an incomplete dissection between IPTL and thyroid cartilage and incomplete removal of IPTL from underlying scarring tissue. All those can be identified by instrument test with greater resistance and poorer compliance under the direct view of laryngo-videoscopy. Also, the biofeedback of voice perception, MPT or the glottic closure in the laryngo-videoscopy offered some clues. With or without AA procedure, extensive scar inside the thyroid window was usually discovered after the implant was removed. To achieve an excellent placement of the implant in ML, meticulous shaping of the implant and adequate release of the TA muscle from the IPTL was still required even in those experienced hands. Therefore, incomplete removal of the IPTL or an incomplete dissection between the TA muscle and IPTL to allow better compliance of TA muscle occurred commonly and were displayed in this study (5/8).

Five of the 8 revised subjects obtained satisfactory outcomes after simple removal of the scar that denoted that the previous ML produced an inadequate dissection between IPTL and the TA muscle. Reviewing several literatures regarding ML procedure, we found that they focused on the window location and size description and ignored the significance of IPTL dissection so that those duplicators obtained unexpected results. Su *et al.* had performed several successful revision ML with extensive IPTL dissection.¹⁵ Although their technique mainly focused on the modified sutured AA, I believed the

adequate IPTL dissection offer the paralyzed fold and the implant more space and lead to more ideal medialization. The time elapse from UVCP onset to ML procedure and between first and revised ML procedure played no significance on the results. The TA muscle atrophy actually showed minimal change in the glottic area.

Instrument test was unable to produce entire medial movement of VC especially in the posterior one-third of vocal fold even the scar tissue in the window was fully removed until the CAJ was freed and medially rotated in one subject. This connoted that the previous unsatisfactory outcome may be due to the existed CAJ fixation even though the dissection between the IPLA and TA was adequate or that the CAJ fixation occurred after previous ML operation. AA was considered an important procedure in those patients. The aims of AA are to close a wide posterior glottal chink and correct the different vertical positions of the two vocal folds.¹⁶ To obtain maximal compliance of the paraglottic soft tissue, the scar should be dissected completely from underlying soft TA muscle in revision cases. An incision on the scar opposite the middle of TA muscle was made and then the dissection between the scar and the underlying soft TA muscle was performed rather than between the scar and the thyroid lamina bridge because the latter offered inadequate space to release the TA muscle. Then, a modified posterior ML with a larger prosthesis projected toward the vocal process was placed to medially displace the vocal fold and arytenoid cartilage simultaneously. Kojima *et al.* once performed cadaveric dissection and showed the necessity of IPTL incision to achieve sufficient medialization of the posterior glottis.¹⁷ Many other literatures also demonstrated it was not possible to correct a wide posterior glottal chink by tradition ML with preservation of the IPTL.^{18,19} All those papers connote the importance of release the TA muscle from its underlying covering. However, surgeons sometimes were unaware of the level or the adequacy of the medialization of the paralyzed fold. Endoscopic observation helps surgeons to confirm the desired vocal fold medialization. Patients sometimes cannot produce a good phonation during surgery due to the influence of sedation, atrophy of the paralyzed fold, or sulcus of the healthy vocal cord. Endoscopy allows the surgeon to confirm accurate adduction and medialization. Excessive adduction or excessive insertion of the implant will also be avoided under endoscopic observation during surgery.

CONCLUSION

The management of IPTL actually determined the voice surgical outcome significantly. Preoperative evaluation of the CAJ mobility was still an important factor to determine the use of corrective methods.

FINANCIAL DISCLOSURE

No financial disclosures.

CONFLICT OF INTEREST

None.

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