

Endoscopic treatment of anterior glottic webs according to Lichtenberger technique and results on 18 patients

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Abstract Anterior glottic webs are most frequently acquired and result in a major vocal handicap. Many treatment modalities have been reported in the literature. None of them achieves perfect morphological or functional results. We present our series treated by an endoscopic technique based on CO₂ laser section of the web, mitomycin application and placement of a temporary silastic stent. We retrospectively reviewed the charts of 18 consecutive patients with anterior webs treated at our university hospital between 2003 and 2010. The endoscopic technique consisted of the section of the web with the CO₂ Acublade system, immediate application of mitomycin C and placement of a silastic stent. No tracheostomy was required. The stent was removed 3 weeks later. Patients had a vocal evaluation pre and postoperatively. It consisted of a video-stroboscopic examination, the global score of the Voice Handicap Index, the global and roughness scores of the perceptive voice evaluation according to Hirano, acoustic and aerodynamic parameters. Eighteen patients were included in the study with a mean age of 46 years (min. = 5, max. = 76). Twenty-two percent were women. All patients had postoperative speech therapy. The mean follow-up is 48.4 months (3–87 months).

At the last follow-up, none of the patients had recurrence of the laryngeal web. The grade G of dysphonia significantly decreased from 2 to 1 ($p = 0.035$). CO₂ laser resection of anterior webs with mitomycin C application and placement of a silastic stent for 3 weeks induces a good morphological result with absence of web reformation but without substantial voice improvement observed in our series.

Keywords Anterior glottis web · CO₂ laser surgery · Mitomycin C · Voice · Hoarseness · Voice Handicap Index · Perceptive voice assessment

Introduction

Glottic webs are defined as the abnormal presence of scar tissue covered by an epithelium between the vocal folds [1, 2]. They are divided into anterior, posterior or complete webs, anterior webs being the most common [1]. Anterior webs are most often acquired. They are due to surgical procedures or non-iatrogenic laryngeal trauma [3]. They cause hoarseness and can be associated with difficult breathing. Many treatment modalities have been published using endoscopic or external approaches with or without stenting [3–6].

The aim of this study is to present our results on 18 patients that were treated by an endoscopic approach introduced by Lichtenberger [7], with mitomycin C application and silastic stenting during 3 weeks and to assess the efficiency of this treatment modality.

Materials and methods

The charts of all consecutive patients treated for anterior laryngeal web, between 2003 and 2010 in our institution,

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Fig. 1 Endoscopic view of an anterior glottic web

using Lichtenberger's technique were included in this retrospective study.

Patients were assessed pre and postoperatively by videostroboscopic examination, the global score of the Voice Handicap Index (VHI), the global and roughness scores of the perceptible voice evaluation according to Hirano, measurements of acoustic and aerodynamic parameters.

Statistical analysis was performed using the Wilcoxon signed rank test. Statistical significance was set at p value <0.05 . Results are expressed in median value and 95 % confidence intervals.

Surgical technique

The endoscopic surgery was performed under general anesthesia using jet ventilation. Suspension laryngoscopy allowed the visualization of the anterior web (Fig. 1). Care was taken to place the laryngoscope's tip 3–4 mm superior to the anterior commissure to allow an easy placement of the stent. The anterior web was cut using the CO₂ laser with the Acublade system (Lumenis, Santa Clara, CA, USA), with a 10 W power and a superpulse mode. The Acublade system allows the traveling of the laser wave on a straight line. Depending on the length of the line and the type of mode selected (continuous or superpulse), the system calculates the appropriate power [8].

A cottonoid soaked with mitomycin C (2 mg/ml) was applied twice at the surgical site, each time for 2 min.

The stent was hand-made using a silastic sheet (thickness: 0.25 mm) that was folded and glued using a silicone glue (Dow Corning, Midland, USA). A small tract allowing the passage of a Dermalon 2/0 thread was created by inserting a pediatric epidural needle when folding the silastic sheet.

Using a 30° endoscope and the Lichtenberger needle holder (R. Wolf 826750; M 954790) (Fig. 2), the silastic

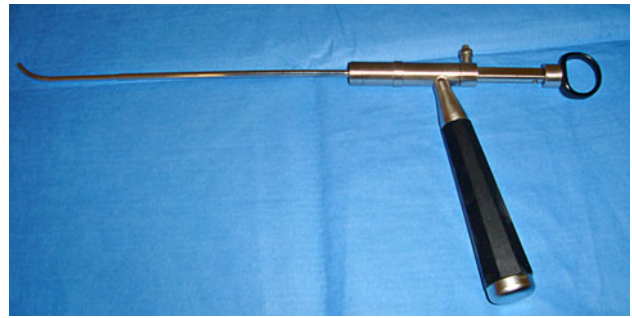


Fig. 2 Lichtenberger needle holder

sheet was fixed at the anterior commissure after adaptation of its antero-posterior and supero-inferior dimensions according to the dimensions and extension of the web. The stent has the shape of a rectangle that crosses the glottis plan by 2–3 mm superiorly and inferiorly. The thread was passed from the endo-larynx to the skin, starting with the inferior puncture site and finishing with the superior puncture site. The superior site is at the median portion of the thyroid cartilage. Because of irregular calcification, this puncture might be difficult and may be replaced by a puncture at the base of the epiglottis. The thread is tied at the skin level through a button (Fig. 3a–c). It is important to mention that changing the site of the puncture due to calcifications does not necessitate changing the size of the stent, it is only the site of puncture that is modified if calcification of the thyroid cartilage is encountered.

Postoperative follow-up

The patient received, after the surgery, an antibiotic treatment for 1 week (amoxicillin + clavulanic acid 1 g tid), proton pump inhibitors (twice a day) for 6 weeks, inhaled steroids (twice a day) for 1 week.

Mild cough might be experienced during the first hours. Laryngeal spasm must be monitored for in the postoperative period in children. A relative vocal rest is encouraged for the first week postoperatively. The position of the stent was controlled once a week by a fiberoptic laryngoscopy (Fig. 4). The stent was removed 3 weeks later by a short procedure under general anesthesia.

Results

Eighteen patients were enrolled in this study. There were 14 men and 4 women with a mean age of 46 years (5–76 years). Ten patients (55.5 %) developed the web after CO₂ laser cordectomies, 3 (16.7 %) after CO₂ laser treatment of laryngeal papillomatosis, 3 (16.7 %) after prolonged intubation and 2 patients (11.1 %) had congenital webs. None of the

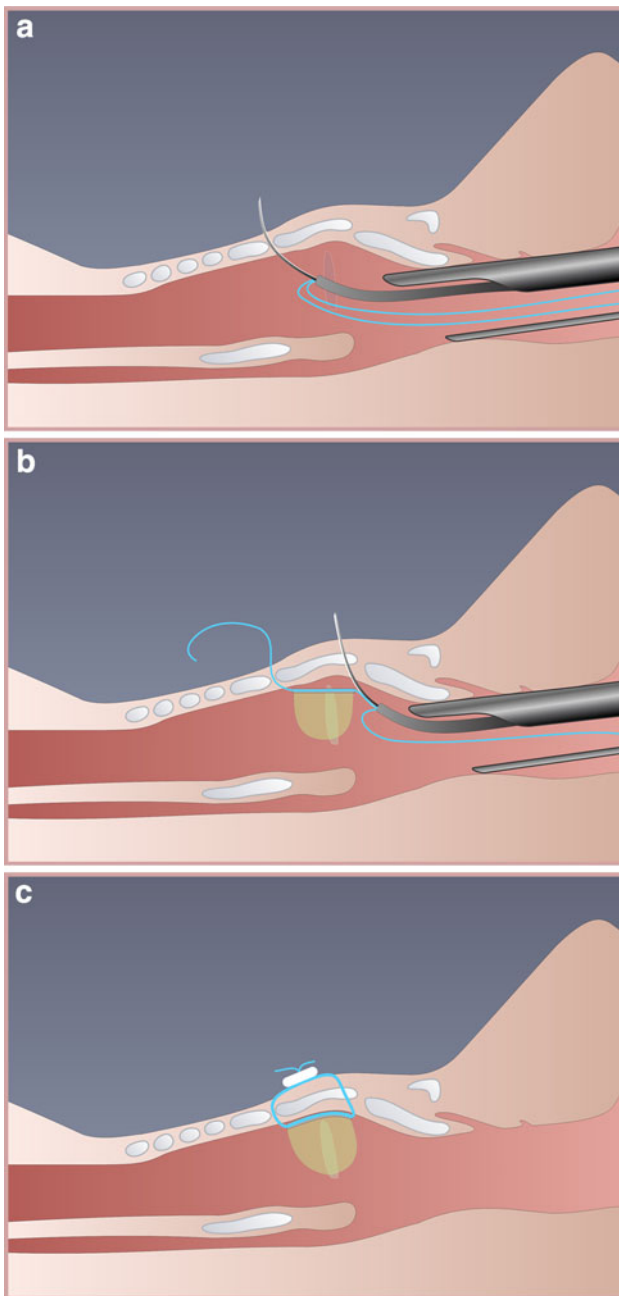


Fig. 3 a–c Steps of placement of the silastic sheet

patients had a tracheostomy prior, during or after the treatment of the glottis web. The stent was very well tolerated for 3 weeks. No dyspnea or dysphagia was observed.

After the removal of the stent, patients were seen at follow-up visits at 1 month, 3 months and then at variable intervals depending on the underlying pathology. The mean follow-up is 48.4 months (3–87 months). There were no early complications related to the surgical technique. The postoperative laryngoscopy showed the absence of the anterior web in all the patients (Fig. 5).

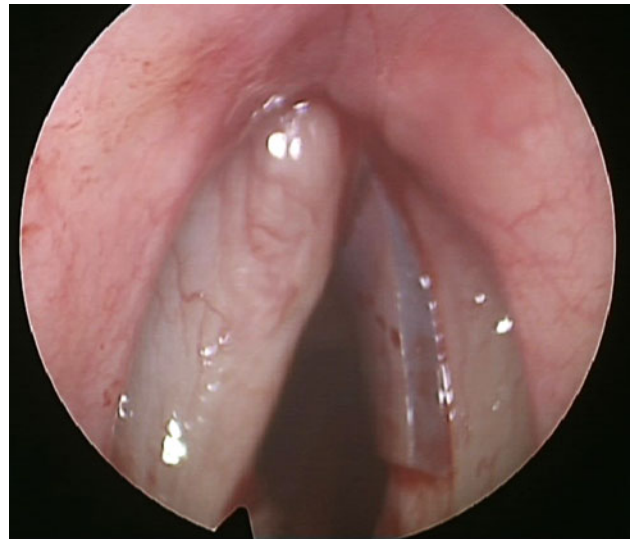


Fig. 4 View of the silastic sheet in place after CO₂ laser resection of the silastic sheet

Speech therapy was started after the removal of the stent in all the patients. The statistical analysis of the voice parameters comparing the results at the last follow-up with those recorded preoperatively is reported in Table 1. They show a statistically significant improvement of the grade G of hoarseness according to Hirano's scale (G pre = 2, G post = 1, $p = 0.035$). The other parameters did not reach statistical significance.

Discussion

The treatment of anterior laryngeal webs remains controversial. Many techniques have been described in the literature. Each of them has advantages and drawbacks.

External approach by a laryngofissure and use of an endolaryngeal keel was first described by MacNaught [9] in 1950 and then by Montgomery [10] in 1970. Its drawbacks are the need of an external cervical approach, the anterior thyrotomy, the placement of a keel, the tracheostomy, the need of a second procedure to remove the keel after 3–4 weeks [1, 3] and the risk of granuloma formation at the anterior commissure [1, 11].

Endoscopic section of the anterior web using CO₂ laser or cold instruments without laryngeal stenting was first described by Jackson and Coates [12] in 1930; it was developed by Stasney [13] in 1995 who coupled the ideas of Chevalier Jackson with new technologies. It needed multiple procedures of section and dilation to reach good results; however, it remained insufficient due to the formation of scar tissue. Nowadays, it is not used [2].

Endoscopic section of the anterior web using CO₂ laser or cold instruments with laryngeal stenting is the most

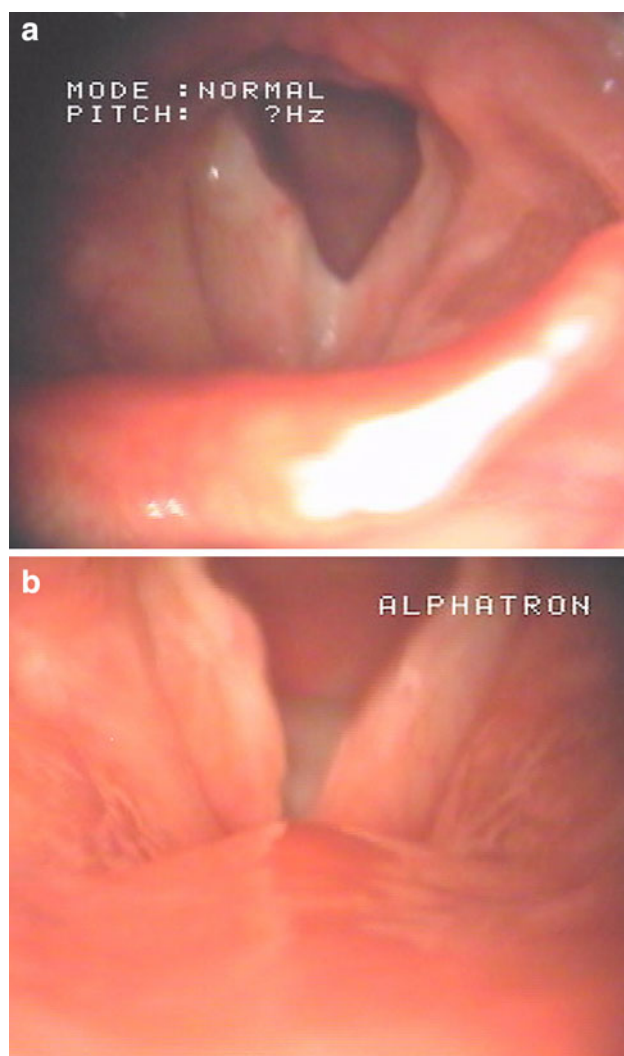


Fig. 5 **a, b** Preoperative view showing the anterior laryngeal web and postoperative view after removal of the silastic stent

Table 1 Voice parameters pre and postoperatively

	Preoperative values	Postoperative values	<i>p</i>
G	2	1	0.035
R	2	1	0.083
VHI	54	46	0.263
MPT (s)	11.31	11.28	1
PQ (ml/s)	327	395	0.722
FR (Hz)	145	185	0.286
F0 (Hz)	211	222	0.944

G grade, R roughness, VHI Voice Handicap Index, MPT maximal phonation time, PQ phonatory quotient, FR frequency range, F0 fundamental frequency

popular technique. In 1924, Haslinger [14], using an endoscopic approach, placed a silver keel fixed through the cricothyroid and the thyrohyoid membranes. The technique

was not very successful, because the keel did not have the shape of the anterior commissure. In 1979, Dedo [15] used a triangular shaped Teflon keel that was kept in place for 2–4 weeks, without the need of a tracheostomy and with good results. Parker and Das Gupta [16] were the first to use a silastic keel. Casiano and Lundy [17] reported the section of the web in three patients using transoral laser surgery and placement of a laryngeal stent in an ambulatory setting without reporting airway compromise. The vocal quality was improved. Since then, many authors used this technique without airway compromise and with good vocal results; however, the duration of the stenting differs between the authors and the incidence of web recurrence is variable [2, 18–20].

In the endoscopic section of the anterior web with mucosal/skin flap technique, after section of the glottic web, a pediculated or free mucosal flap is used to cover the involved surface of the vocal folds [5, 6, 21, 22]. Isshiki et al. [5] used free mucosal and skin flaps for the treatment of large glottic webs. Their experience on four patients revealed better vocal results with the mucosal flap. Hsiung and Wang [23] used bilateral mucosal flap (buccal mucosa) with spectacular voice outcomes.

In 2010, Izadi [1] described the butterfly technique in two patients with good results. It consists of the suture of a portion of the external perichondrium of the thyroid cartilage, through a median thyrotomy approach, after section of the web through direct vision. The perichondrium was sutured with vicryl 4/0 threads at the four corners on the vocal folds, the body of the butterfly being at the anterior commissure.

The use of mitomycin C has been advocated to prevent recurrences. Mitomycin C is an antimetabolic agent that has been used for more than 20 years in ophthalmology through local applications for the prevention of scars in pterygium and glaucoma surgeries [24, 25]. Many recent publications have reported good results in the treatment of stenosis and webs of the upper aero-digestive tract [3, 26–30]. Rahbar et al. [30] reported the results of the treatment of 15 patients (22 surgeries) with glottic, subglottic or tracheal stenosis with CO₂ laser resection and mitomycin application (0.4 mg/ml for 4 min). Ninety-three percent of the patients reported functional improvement and no complications were mentioned. Mitomycin C has also been used to prevent restenosis after meatotomies [26] and choanal atresia treatments [27].

The use of mitomycin C in upper aerodigestive tract surgeries has been inspired by its use in ophthalmology [3] where the concentration is 0.2 or 0.4 mg/ml [31, 32]. Hu et al. [33] demonstrated on fibroblast cultures that the action of mitomycin C was dose-dependent and that it started at 0.2 mg/ml. The concentration most often used in airway surgery is 0.4 mg/ml [26–30]. Many technical aspects

need to be clarified: (1) the time of mitomycin application varies between 2 and 5 min, however, this time is not the real exposition of tissues to the mitomycin if the product is not washed away; (2) the real dose delivered to the tissues is impossible to evaluate, because the mitomycin is delivered on a cottonoid applied on the surgical site; (3) washing of the product is not systematic by all authors [3].

In our study, we used mitomycin at 2 mg/ml for 2 min without washing it away. The application was performed two times. No local or general complications were observed in our study. This is consistent with the results found in the literature [3, 26–30]. Objective voice parameters were not significantly improved because despite the resection of the web and the improvement of respiration, the vocal folds remain scarred. Even if there is a small voice improvement, our patients' number is too small to show it.

Comparing our results to those of the literature is difficult because there are only small published series reporting subjective results [2, 17, 18]. Liyanage et al. [2] reported satisfactory results at 6 months on a series of patients treated with CO₂ laser resection of the laryngeal web and placement of a silastic sheet fixed to the skin through the cricothyroid membrane kept in place for 2 weeks. In our study, the silastic sheet was fixed at the level of the supra and subglottis to ensure its stability at the anterior commissure, and removed after 3 weeks. We used mitomycin to prevent the recurrence of the web.

Conclusion

Lichtenberger's technique helps to obtain good morphological results for the treatment of anterior glottic webs without substantial voice improvement observed in our series.

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Conflict of interest The authors declare that they have no conflict of interest.

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