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Reversible immediate and definitive lateralization of paralyzed vocal cords

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Abstract The author reports on glottis dilation operations based on the endoextralaryngeal suture technique he has developed. In all, 101 patients were operated on for bilateral recurrent nerve paralysis using different variations of the above method, of which 73 have had more than 1 year of follow-up. Dilation was performed in 52 patients following tracheostomy, whereas no tracheostomy was performed in 21 patients. In 9 cases irreversible laterofixation without tracheostomy was performed with good results. In 12 patients a reversible glottis dilating operation was carried out without tracheostomy not long after the development of bilateral paramedian position of the vocal cords. Tracheostomy was necessary in 1 of 12 patients, who underwent reversible glottis dilating operations. In this case later reoperation, using a definitive endoscopic glottis dilating operation, was performed with success. Three patients required reoperation using open surgical procedures after irreversible endoscopic laterofixation methods.

Key words Vocal cord paralysis · Laser · Endoextralaryngeal suture · Reversible cord laterofixation

Introduction

According to international statistics, bilateral recurrent nerve paralysis is mostly caused by injuring the nerves during thyroidectomy. In order to avoid this complication careful exposure of the recurrent nerves is required during operations for malignant thyroid gland changes. If both recurrent nerves are injured, the vocal cords take up a paramedian position, which can be either temporary or permanent.

The glottic chink between the vocal cords can be of different sizes. If both vocal cords are paralyzed, the glottic chink might be 0.5 mm in one patient and 1.5 mm in another one. If the glottic chink between the paralyzed vocal cords is 0.5 mm or less, immediate intervention is usually required. When the glottic chink between the paralyzed vocal cords is more than 1.5 mm, the patient's breathing, even in relaxation, is somewhat more difficult than with the vocal cords functioning in normal way, but immediate intervention is usually not necessary.

Bilateral abductor vocal cord paralysis was initially treated by an operation that required open surgical exposure of the larynx from the outside. The latter techniques were greatly changed in 1948 when Thornell [27] described an endolaryngeal approach of arytenoidectomy in patients with bilateral abductor paralysis of the vocal cords. This endoscopic method of performing an arytenoidectomy opened the way for many modifications. Over the next 30 years several authors, especially Kleinsasser [10, 11], varied Thornell's technique of vocal cord lateralization. Naumann and Lang [24] in 1981 and Martin [23] in 1985 simplified these operations by using fibrin glue to hold the vocal cord in a lateral position. However, this method required a stent to be placed in the larynx after lateralization, which was left in place for a certain amount of time.

Kirchner [8] in 1979 and Ejnell et al. [3] in 1982 further refined surgery for lateralization of paralyzed vocal cords by using an extra-endolaryngeal suture technique. Ossoff et al. [25] in 1984, Remsen et al. [26] in 1985, and Lim [22] in 1985 introduced use of the laser to widen the glottis in abductor vocal cord paralysis.

The widespread use of endoscopic operations in vocal cord paralysis has been hindered by their requirement of above-average technical skills and knowledge. Endolaryngeal arytenoidectomy with submucous cordectomy and an attempt to save the mucous membrane is not always easily performed. It is also technically difficult to suture the mucous membrane endoscopically. Even the smallest technical fault is likely to result in prolapse of the mucous membrane or scarring in the operating field, as noted by

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Bánfai [1] in 1976 and Kirchner [9] in 1982. Endolaryngeal sutures may also tear through the mucous membrane, resulting in a lateralized vocal cord slipping back to pre-treatment positions.

A posterior commissure scar can develop after laser arytenoidectomy, resulting in cord medialization to narrow the endolaryngeal lumen. Granuloma and scar formation may diminish the immediately good result some months after laser cordectomy.

From 1977 to 1980 methods based on a new endoextralaryngeal suture technique were developed by Lichtenberger in animal experiments [12–14]. The variations of the methods introduced into clinical practice in 1981 by Lichtenberger [15, 17, 18] and then by Lichtenberger and Toohill [19, 20] and Woodson et al. [28] were used successfully, without tracheostomy, in creating the immediate reversible endoscopic lateralization of paralyzed vocal cords standing in paramedian positions after thyroidectomy or viral infection and causing dyspnea or asphyxia.

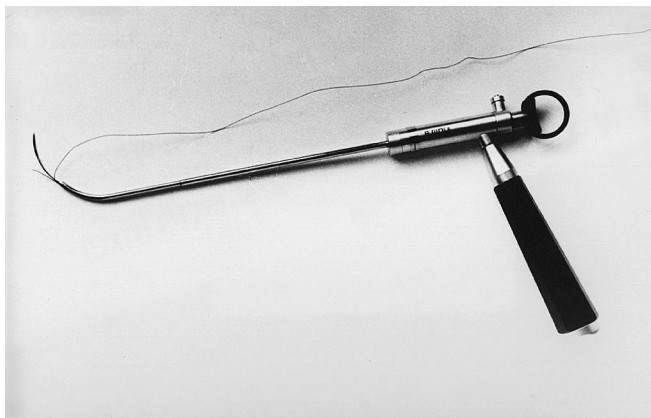
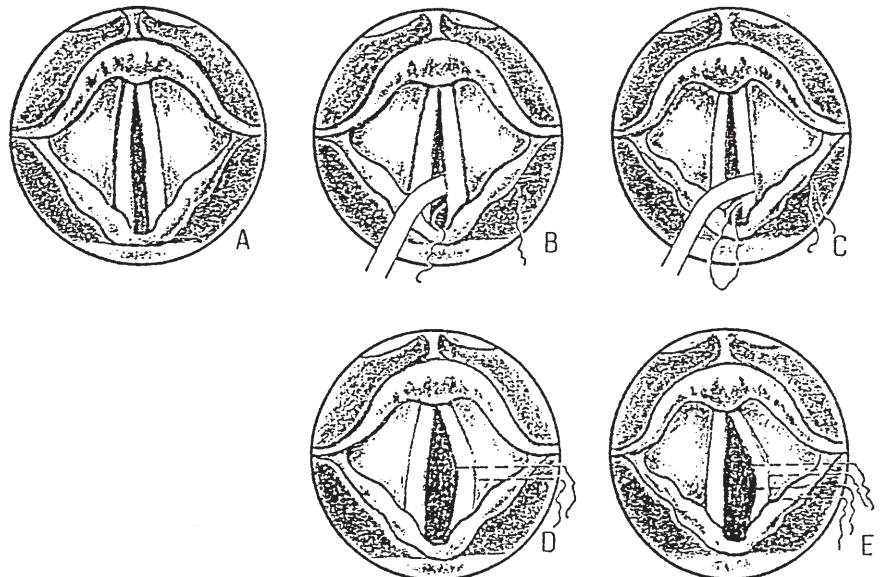


Fig. 1 The Lichtenberger endoextralaryngeal needle carrier

Fig. 2 **A** The paralyzed vocal cords. **B** One end of the laterofixing thread is pushed through the larynx below the posterior third of the vocal cord. **C** The other end of the laterofixing thread is pushed through above the posterior third of the vocal cord. **D** The ends of the fixing thread are pulled and knotted above the sternohyoid muscle on the laterofixing side. **E** Status after pulling and knotting the ends of both threads



Patients and methods

Between 1 January 1981 and 1 November 1998 we performed operations on 101 patients, using different versions of our methods based on the endoextralaryngeal suture technique. From the 101 patients, 73 patients have had more than 1 year's follow-up. We therefore evaluated these 73 cases in this review. Glottis-dilating operations were carried out without tracheostomy in 12 patients using reversible endoextralaryngeal laterofixation (REExL), 9 patients using endoextralaryngeal laryngomicrosurgical lateralization with arytenoidectomy (EExLL with aryt), and 52 patients after previous tracheostomy using EExLL or EExLL with arytenoidectomy.

The majority of the patients arrived at our department after previous tracheostomy. In the first decade after 1981 we performed glottis-dilating operations without tracheostomy in only some patients [16]. This approach was based on the only available anesthesia without intubation involving gamma-hydroxy-butyric acid combined with diazepam [5, 6, 21]. However, this method resulted in excessive sedation that required special postoperative care for several hours because of the lasting slackening of the soft parts around the larynx. Since the introduction of jet-anesthesia in our department, we have performed more glottis-dilating operations without tracheostomy, including procedures immediately after the diagnosis of bilateral paramedian position of the vocal cords following thyroidectomy.

Reversible endoextralaryngeal lateralization (REExL)

This procedure is indicated when the vocal cords are in the paramedian position. However, the cause of this paramedian position is not necessarily paralysis and in such cases there is a chance for spontaneous recovery after a certain period of time (for instance, immediately after thyroid surgery or viral infection). The operation can be performed without tracheostomy with jet-anesthesia. However, scars inside the larynx are a contraindication.

In the first period, the operation was performed under intratracheal intubational anesthesia. However, the intubation tube made it complicated to lead the lateralizing threads through the larynx, particularly when the larynx was small. That is why we chose anesthesia without intubation, which left more room for manipulations in the larynx [5, 6, 21]. The laterofixing threads were fixed with the help of the endoextralaryngeal needle carrier (Fig. 1).

The skin was cut in the same line of the previous incision of thyroidectomy, the skin-platysma flap was pulled up, and the laryngoscope was introduced. The paralyzed vocal cords were

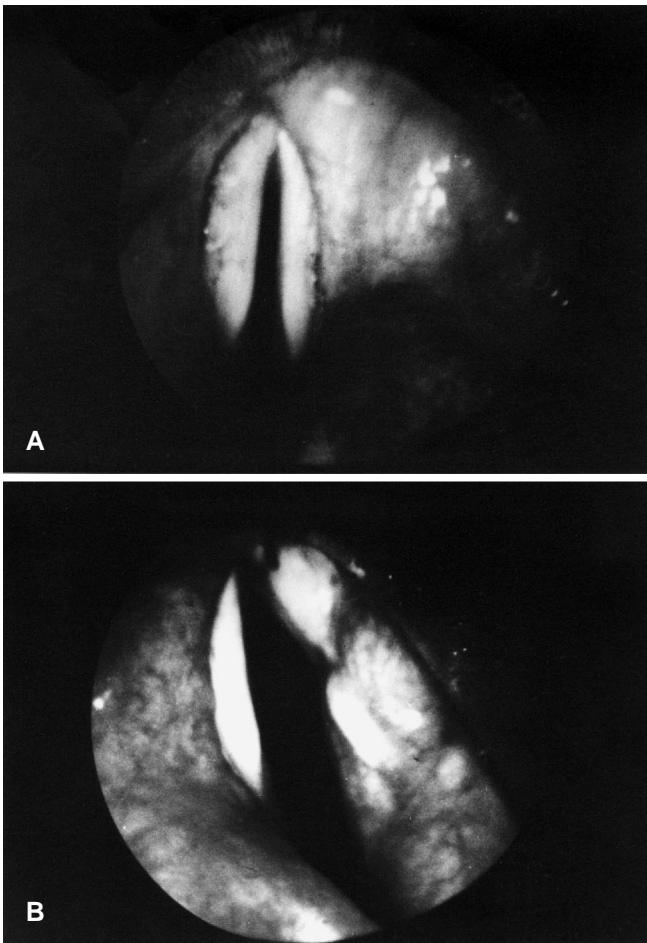


Fig. 3 **A** The paralyzed vocal cords. **B** Status after reversible lateralization of the right vocal cord

brought into the field of vision (Figs. 2A, 3A). One end of the laterofixing thread was pushed through the larynx below the posterior third of the vocal cords (Fig. 2B), a similar stitch was made, this time above the posterior third of the vocal cord (Fig. 2C), and the ends of the fixing thread were pulled (Figs. 2D, 3B) and knotted above a small silicon sheet placed on the thyroid cartilage or above the sternohyoid muscles on the laterofixing side.

In recent years, we have performed surgery under jet-anesthesia in some cases by using proximal jet-insufflation and using two threads instead of one, as they are less likely to cut into the substance of the vocal cord in this way (Fig. 2E). The skin-platysma flap was then turned back and the wound was closed.

Lately, on the recommendation of Jóri et al. [7], we knot the ends of the fixing threads not against a silicon sheet over the thyroid cartilage but over the sternohyoid muscle of the same side. The alteration of our method seems to have further simplified the procedure by eliminating an unnecessary step. The glottic chink is wide enough, as exemplified by Fig. 4, showing lateralization of the left vocal cord 10 days after surgery.

Endoextralaryngeal laryngomicrosurgical lateralization (EExLL)

This technique has been published in detail [17–20] and is illustrated in Fig. 5A–F. This procedure is indicated when the paralyzed vocal cords are in the paramedian position and the cricoarytenoid joint is not ankylotic. The glottic chink is at least 1–1.5 mm prior to the operation. The operation can also be performed without tracheostomy under jet-anesthesia.

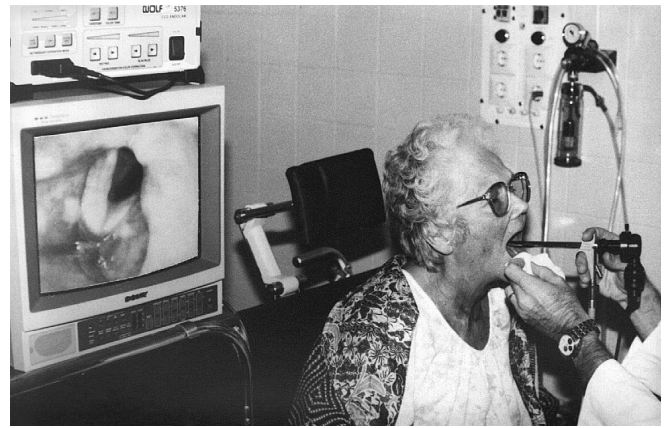


Fig. 4 Patient 10 days after reversible lateralization of the left vocal cord

Endoextralaryngeal laryngomicrosurgical lateralization with arytenoidectomy (EExLL with aryt.)

As illustrated in Fig. 6A–F, this procedure is indicated when the paralyzed vocal cords are in the median or paramedian position and/or there is ankylosis of the arytenoid cartilage(s). This operation can also be performed without tracheostomy using jet-anesthesia [19, 20].

Results

Analyzing the result of the 12 reversible glottis-dilating operations without tracheostomy, the following was found. The vocal cords remained irreversibly paralyzed in 7 patients, but no further operation was needed to achieve adequate breathing and voice production since the glottis was of satisfactory size. In 3 patients the movement of the vocal cord on one side became normal 3–5 months after surgery. In 1 patient both vocal cords became mobile 4 months after surgery.

After the reversible glottis-dilating operation in 12 patients, permanent tracheostomy was required in only one patient. This patient had 72-h intubation prior to cord lateralization and this was complicated by inflammation of the larynx. However, we achieved an adequate airway after an irreversible glottis-dilating operation in a second stage and could remove the tracheostomy cannula in this case as well. Breathing of the patients whose normal vocal cord functioning returned on one side has become perfect and voices are clearly understandable. Breathing problems have ceased also in those patients whose vocal cords are permanently unable to move. However, voices are weaker than normal but adequate for everyday communication.

Analyzing the result of the 76 irreversible definitive glottis-dilating operations, the following was found. From 61 patients having more than one year follow-up, 57 patients had a larynx wide enough and 1 patient was lost after the operation (within the control period). The death was caused by post-operative cardiac arrest. In 3 patients the endoscopic operations were unsuccessful, and the larynx

Fig. 5 A–F Stages of the endoextralaryngeal laryngomicrosurgical lateralization

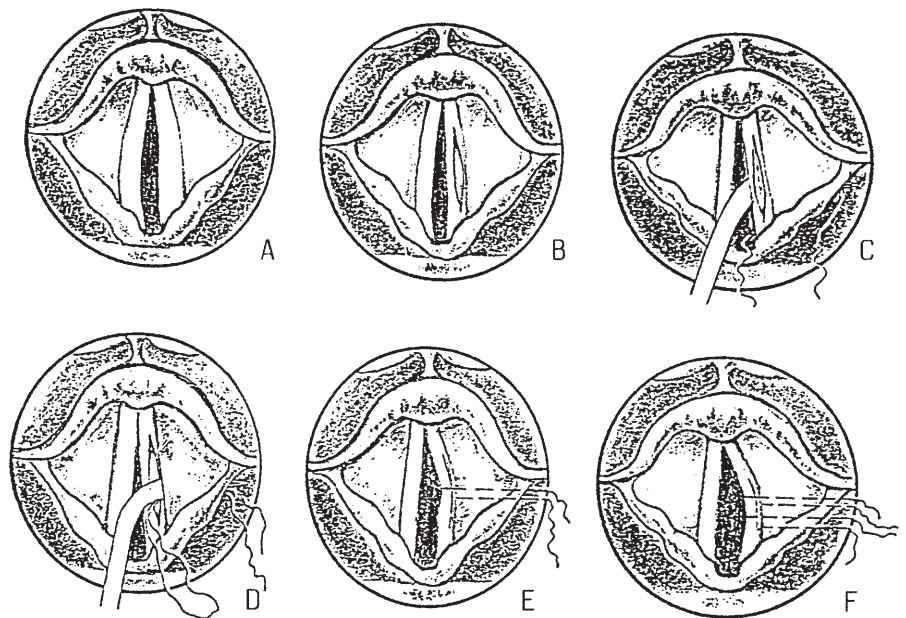
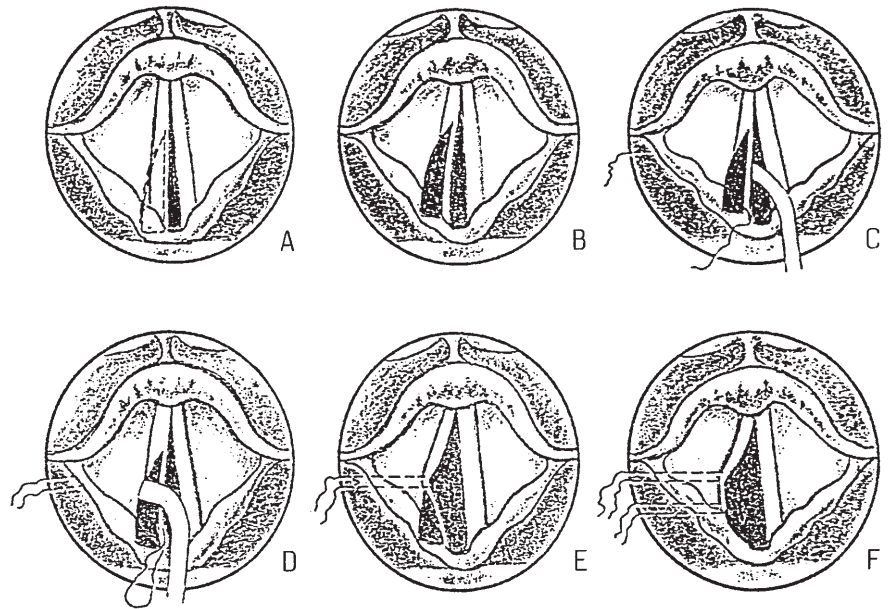


Fig. 6 A–F Stages of the endoextralaryngeal laryngomicrosurgical lateralization with arytenoidectomy



had to be opened again and repaired by Réthi I-II operations. (Remark: In 9 patients the first operation had already improved the size of the larynx; however, another contralateral operation was necessary to get a satisfactory result.)

Voice quality remained quite good after irreversible glottis dilation operations in 41 of 60 patients and was only slightly weaker and slightly hoarser than normal voices. Eleven patients had weaker, hoarser voices, while voices of 8 patients were very hoarse and very weak, but patients were still able to have everyday communication.

Discussion

On the basis of our experience to date, we recommend performing reversible glottis-dilating operations instead of tracheostomy in cases where both vocal cords are in a

paramedian position and the patient suffers from dyspnea, but it is not certain that the vocal cords are paralyzed irreversibly. This situation can occur after thyroidectomy or viral infections. If the dyspnea is serious, the patient should be intubated orotracheally prior to being taken to the institution where the glottis-dilating operation is to be performed.

We find the considerations and arguments of Jóri et al. [7] and Ejnell et al. [2, 4] to be significant and worth following as regards the performance of lateralization as early as possible. It seems highly probable that the efficiency of this method of lateralization is the best when no fibrosis or ankylosis has developed, since either makes it difficult to push the paralyzed vocal cords to the side or results in failure. If paralysis of the vocal cords is proved, a definitive irreversible endoscopic glottis-dilating operation must be carried out with or without tracheostomy.

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