

SINGLE-STAGE LARYNGOTRACHEAL RECONSTRUCTION

TEK AŞAMALI LARİNGOTRAKEAL REKONSTRÜKSİYON

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Abstract

Glottis-subglottic stenoses are a unique entity of airway stenoses. They often require reconstruction techniques with an enlargement of the larynx in contrast to a sole resection of a stenotic airway segment. This enlargement is usually achieved by the interposition of autologous rib cartilage grafts. In experienced centers such a repair can be done in a single-stage procedure without the need of prolonged stenting with T-tubes or silicone molds. A precise surgical technique is essential in order to preserve the delicate function of the larynx. The proximity of the disease to the vocal cords requires dedicated interdisciplinary teams consisting of thoracic surgeons, anesthesiologists, ENT surgeons and speech therapists. In experienced hands excellent long-term outcomes can be achieved.

Keywords: Airway stenosis, subglottic stenosis, laryngotracheal reconstruction, cartilage graft, Montgomery T-Tube

Özet

Glottis-subglottik darlıklar hava yolu darlıkları arasında özel bir öneme sahiptir. Bu darlıklar sıklıkla sadece stenoz gelişen segmentin çıkarılmasından ziyade larinksin özel bir rekonstrüksiyon tekniğiyle genişletilmesini gerektirirler. Bu genişletme genellikle otolog kostal kırık greftlerinin interpozisyonu ile sağlanır. Deneyimli merkezlerde böyle bir onarım, tek aşamalı bir işlemle uzun süreli silikon mold ya da t tüp stent koyulmasını gerektirmeden yapılabilir. Larinksin hassas fonksiyonel yapısını korumak için kusursuz bir cerrahi teknik esastır. Hastalığın vokal kordlara olan yakınlığı, göğüs cerrahisi, anesteziyolojist, KBB cerrahisi ve konuşma terapistini içeren interdisipliner bir takımın oluşturulmasını gerektirmektedir. Deneyimli ellerde uzun dönemli mükemmel sonuçlar elde edilebilir.

Anahtar kelimeler: Hava yolu darlığı, subglottik stenoz, larinotrakeal rekonstrüksiyon, kartilaj grefti, Montgomery T-Tüp

INTRODUCTION

Despite advances in surgical and endoscopic techniques, the treatment of laryngotracheal stenosis remains challenging. Whereas stenoses limited to the subglottic area can be treated with cricotracheal resections with excellent long-term results. However, the involvement of the glottis (Figure 1) often necessitates the addition of reconstructive techniques, which aim to enlarge the laryngeal diameter (1, 2). This is usually achieved by an anterior or/and posterior laryngofissure and the interposition of a cartilaginous autograft. Dependent on the type of laryngotracheal reconstruction, stabilization of the larynx by Montgomery T-Tube stenting or silicone molds may be required (3-5). Recently, we described a modified, single-stage technique for laryn-

gotracheal reconstruction, which does not require such a prolonged stabilization (Figure 2) (2). Herein, we provide a concise summary of the surgical technique of single-stage laryngotracheal reconstruction.

SURGICAL TECHNIQUE OF SINGLE STAGE LARYNGOTRACHEAL RECONSTRUCTION

Total intravenous anesthesia is introduced and a laryngeal mask is placed (Figure 3A). If the patient has a pre-existing tracheostomy, this can be used but additionally the laryngeal mask should already be placed. Before the surgical procedure is started, flexible bronchoscopy is again performed by the surgical team to confirm the extent, grade and height of the anastomosis. Afterwards, the surgical field including the costal arch is prepped and draped. The fol-

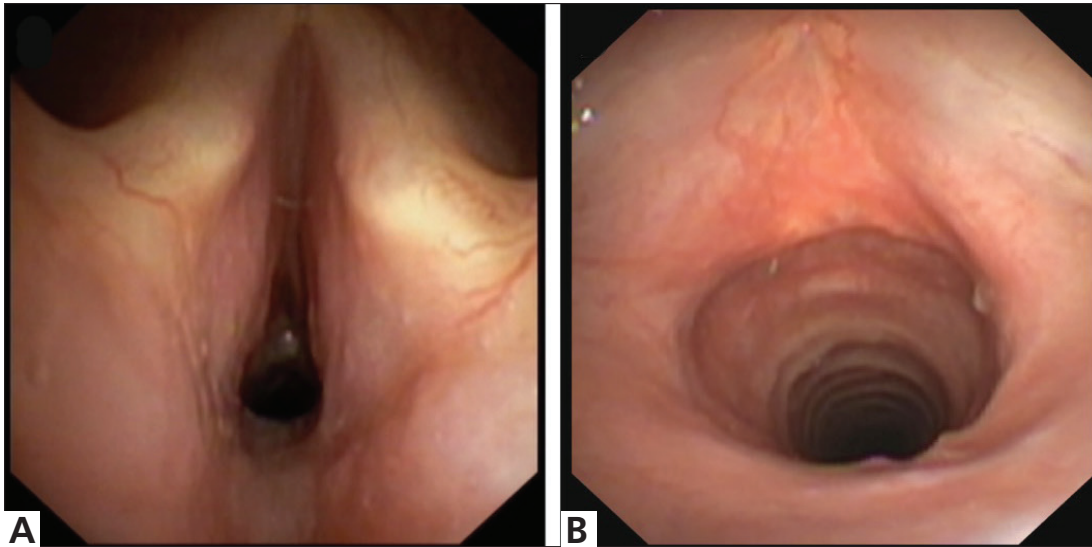


Figure 1. **A.** Preoperative bronchoscopy showing a glotto-subglottic side-to-side stenosis in a patient with idiopathic subglottic stenosis. **B.** Post-operative bronchoscopy three months after single-stage laryngotracheal reconstruction. Adopted from Hoetzenecker et al. (11).

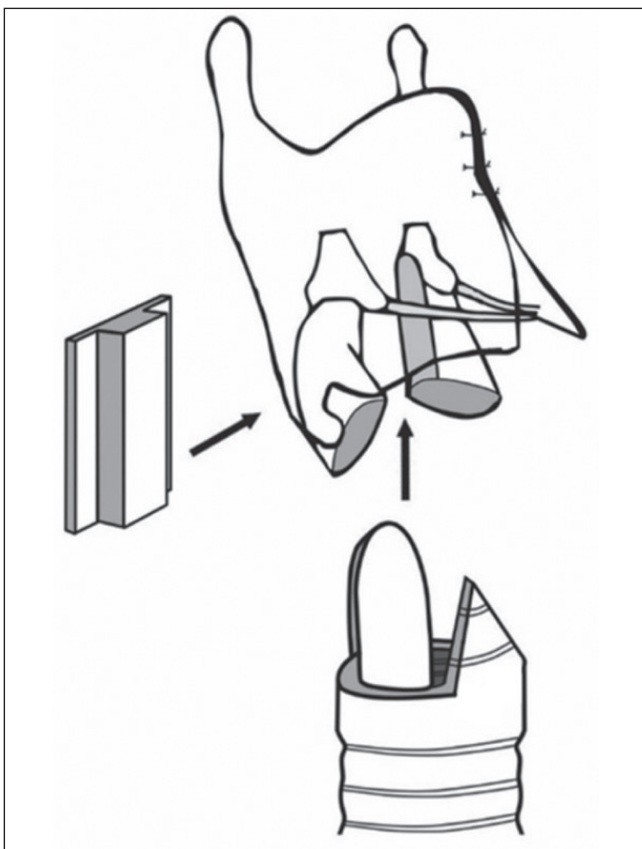


Figure 2. Schematic drawing of the surgical procedure. Adopted from Hoetzenecker et al. (2).

lowing surgical landmarks have to be identified: the thyroid notch, the cricoid arch and the jugulum (Figure 3B). A collar incision is performed above the cricoid arch. The platysma and the subcutaneous tissue are divided and mobilized. The

strap muscles are separated in the midline and the trachea, the cricoid and the thyroid are dissected starting from the midline. A retractor ring helps to expose the surgical field. The thyroid cartilage has to be completely mobilized from the adjacent connective tissue (Figure 3C). The cricothyroid muscle is lifted off the cricoid arch and preserved. Caution is required not to injure the recurrent nerves during lateral mobilization. It is important to stay close to the trachea during preparation using low-level cautery and scissors. Moreover, the lateral vascular supply of the trachea should be preserved. After opening the pretracheal fascia, the anterior and lateral aspect of the cervical and thoracic trachea has to be freed and mobilized until the carina is reached. This is mandatory to obtain a tension-free anastomosis at the end of the procedure. The cricothyroid membrane is divided, and the cricoid arch is removed by using heavy scissors. The lateral arch should be preserved as far as possible since this would unnecessarily destabilize the larynx. The trachea is separated from the cricoid plate and lifted off the esophagus. Afterwards, cross-table ventilation with a sterile endotracheal tube can be initiated. The distal tracheal rings affected by the stenosis can be removed already at this stage of the procedure. Care has to be taken to preserve a sufficient mucosal flap for a later coverage of the posterior cartilage graft. The vocal cords have to be identified with a small hook in order to avoid unintended injury during lateral dissection. Next, a dorsal mucosectomy of the cricoid plate can be performed if scar formation on the cricoid plate is evident. The cephalad border of the mucosectomy must not reach too close the vocal cords, as a sufficient rim of mucosa will be necessary to perform the anastomosis. Next, a partial

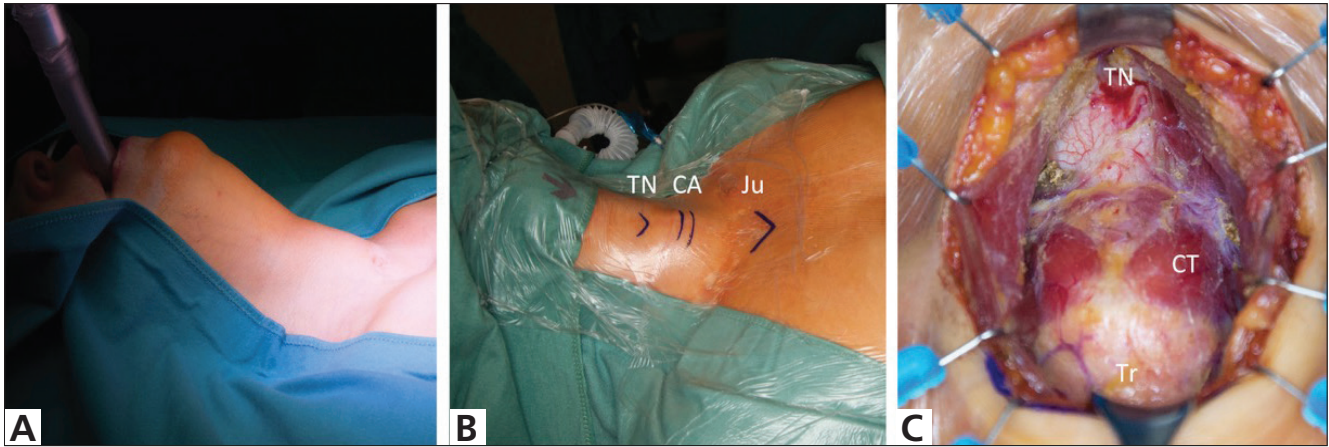


Figure 3. A. The operation is started with the patient ventilated through a laryngeal mask. B. Identification of the surgical landmarks thyroid notch (TN), cricoid arch (CA) and jugulum (Ju). C. Surgical situs after exposing the thyroid cartilage with the thyroid notch (TN), the cricothyroid muscle (CT) and the trachea (Tr).

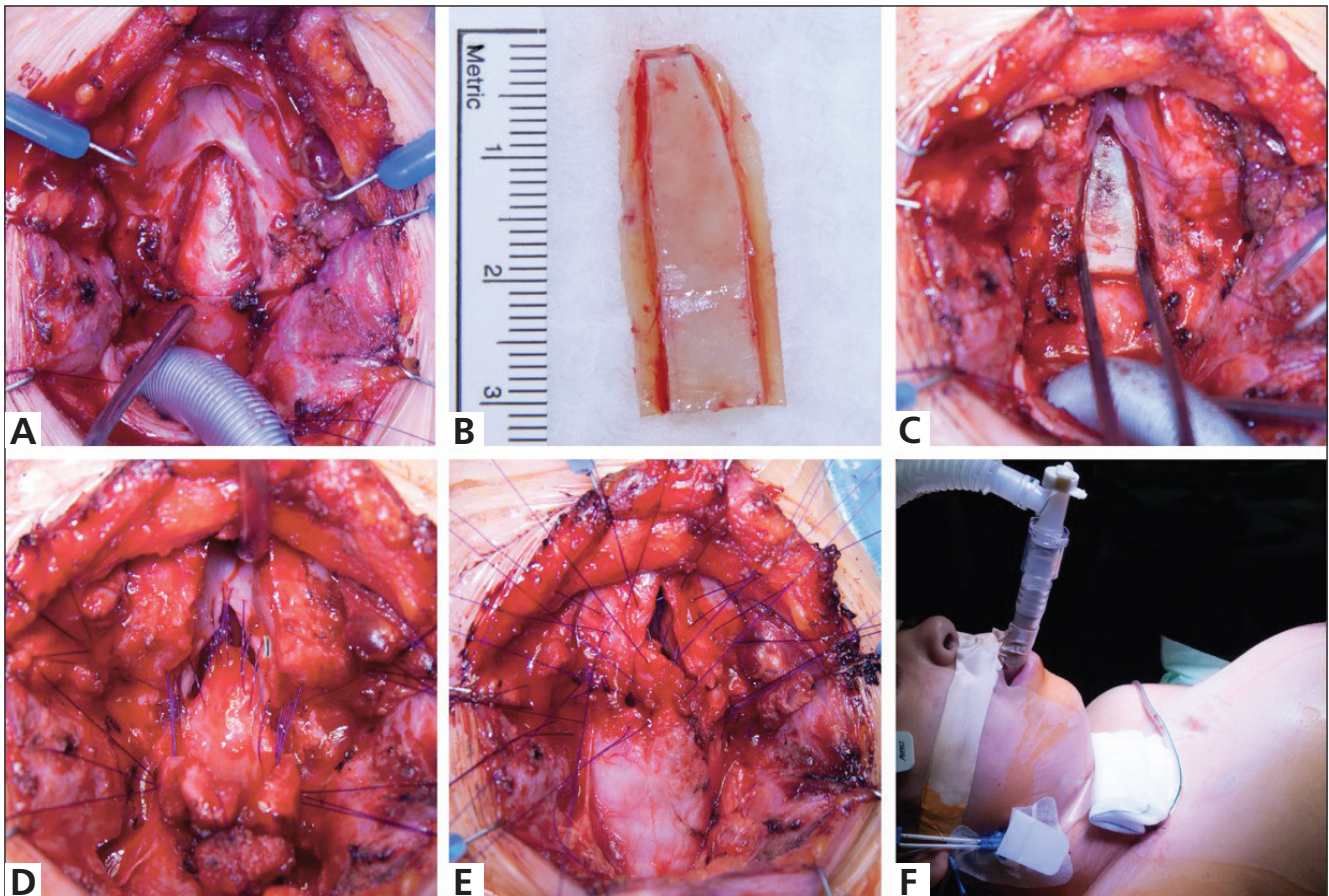


Figure 4. Key steps of a single-stage laryngotracheal reconstruction. Anterior and posterior laryngeal split **A.**, tailored rib cartilage graft **B.** and the cartilage graft interpositioned into the posterior laryngeal split **C.** The cartilage graft is covered with a liberal distal dorsal mucosal flap **D.** and the anterior split is closed with a V-shaped wedge of the distal trachea **E.** After completion of the anastomosis and wound closure, the laryngeal mask can be removed **F.** Adopted from Hoetzenecker et al. (11).

anterior laryngofissure is performed in the midline of the thyroid cartilage. Retraction sutures on both sides facilitate the exposure of the posterior glottis. A complete posterior split is performed by dividing the cricoid plate exactly in the mid-

line (Figure 4A). In case of relevant interarythenoid fibrosis, this scar tissue has to be divided by fine dissecting scissors leaving the mucosa intact. Both parts of the cricoid plate are pushed laterally and detached from the esophageal wall.

This is necessary to create a small pocket, in which the rib cartilage is later inserted beneath.

An incision is made at the costal arch and an approximately 3 cm long cartilage graft is harvested. Special attention should be paid not to injure the pleura. The cartilage is tailored with two lateral flanges, which will prevent the graft from dislocation (Figure 4B). The width and thickness of the cartilage graft have to be adapted to the individual patient. The graft is interpositioned into the divided cricoid plate (Figure 4C). Although the graft is already held in position by the lateral flanges, it can be secured using six 6-0 PDS sutures. At the distal trachea a dorsal mucosal flap is prepared and at the anterior portion of the trachea is shaped in a V-shaped wedge. A Jet ventilation catheter is now introduced through the laryngeal mask and advanced into the distal trachea. Jet ventilation facilitates to create a tubeless operation field and the reconstruction can be completed without the need for intermitting phases of apnea. A 6-0 running PDS suture is placed between the mucosal flap and the glottic mucosal rim (Figure 4D). 4-0 PDS single sutures are placed at the lateral and anterior aspects of the anastomosis. The patient's head is positioned in slight anteflexion and both ends of the anastomosis are gently approximated. Nerve hooks are used to tighten the posterior 6-0 running suture until the cartilage graft is fully covered with the distal mucosal flap. In the anterior portion, the V-shaped wedge of the trachea has to fit into the partial laryngofissure (Figure 4E). The cranial part of the laryngofissure is precisely closed with 4-0 PDS sutures, which is necessary to restore the anterior commissure of the glottis and after that the Jet catheter can be removed and conventional ventilation is presumed through the laryngeal mask. Airway patency, presence of glottic swelling and symmetric reconstruction of the glottis are checked with flexible bronchoscopy. Afterwards, the wound is closed by adapting the strap muscles, subcutaneous tissue and the platysma. The laryngeal mask is removed at the end of the operation (Figure 4F). If significant stridor and respiratory distress becomes evident, a temporary utility tracheostomy is placed distally of the anastomosis. This can be removed after the glottic swelling has resolved within the first days after surgery.

Comment

Although most techniques of subglottic resections were pioneered more than 50 years ago, complex stenoses involving the glottis still represent an ongoing challenge in laryngotracheal surgery (6). Couraud and coworkers established a surgical technique with anterior and posterior cartilage interposition to treat glotto-subglottic stenoses. The classical Couraud repair, however, lacks a mucosal coverage of

the cartilage grafts. To provide stabilization and to prevent excessive granulation formation, prolonged stenting with a Montgomery T-Tube for at least 3-6 months was therefore necessary. Despite this prolonged stenting, decannulation was achieved in most of the patients (3). Using a similar approach, Terra et al. reported a success rate of 80% with a mean follow-up of 23 months (4).

Using the modified technique described herein, the prolonged internal stenting mentioned above is not necessary owing to the fact that the reconstruction is immediately stable, and the rib cartilage is completely covered with healthy mucosa. Our initial experience of five patients has been published in 2016. All patients had an excellent functional outcome (2). Currently, our total experience comprises 12 patients, who were operated using the surgical technique described herein. We could confirm the good functional results in this updated cohort of patients (unpublished data).

CONCLUSION

The management of laryngotracheal stenosis requires a dedicated team of thoracic surgeons, anesthesiologists, ENT surgeons and speech therapists. This is especially important for glotto-subglottic stenosis, representing one of the most challenging conditions in airway surgery. Besides restoration of a sufficient airway patency the preservation of the two other laryngeal functions, namely voice and deglutition, is equally important. In experienced hands, definite treatment without further interventions can be obtained in >95% of patients (2, 7-10). The treatment of such patients, however, should be restricted to specialized centers in order to guarantee good long-term outcomes and a satisfying quality of life of patients suffering from this rare, complex disease.

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