



A modified technique of laryngotracheal reconstruction without the need for prolonged postoperative stenting

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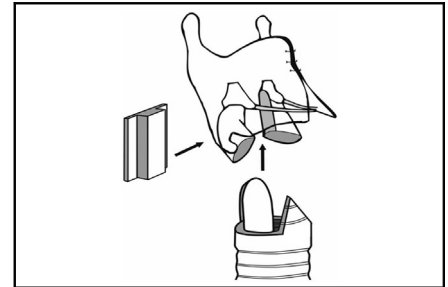
ABSTRACT

Objectives: Repair of laryngotracheal stenosis with pronounced side-to-side narrowing and involvement of the glottis is challenging and usually requires laryngotracheal reconstruction with rib cartilage interpositions. This technique, as first described by Couraud, needs prolonged postoperative stabilization with Montgomery T-tubes, imposing significant morbidity and discomfort on patients. We describe our initial experience with a modified laryngotracheal reconstruction technique that avoids the need for prolonged postoperative stenting.

Methods: From November 2012 through May 2015, a series of 5 adult patients with glottosubglottic stenosis were operated in our institution. All patients had pronounced scar formation in combination with advanced side-to-side narrowing extending up to the level of the vocal folds. Operative technique consisted of a complete anterior and posterior laryngeal split followed by rib cartilage interposition in the cricoid plate posteriorly to enlarge the glottosubglottic diameter. The lateral edges of the rib graft were trimmed in such a way that lateral flanges were created, which allowed stable positioning of the graft. The distal trachea was then slid into the larynx, and the posterior defect was completely covered with a liberal membranous flap. The anterior part of the larynx was enlarged with a V-shaped segment of the anterior tracheal wall.

Results: This technique provided immediate stability without the need for temporary endoluminal stenting. The perioperative course was uneventful in all patients, and functional outcome was excellent.

Conclusions: We conclude that this modified technique of laryngotracheal reconstruction represents a valid treatment option for patients with complex glottosubglottic stenosis, avoiding the need for prolonged postoperative stenting. (*J Thorac Cardiovasc Surg* 2016;152:1008-17)



Scheme of the modified technique of laryngotracheal reconstruction.

Central Message

Herein presented modifications of the Couraud technique make laryngotracheal reconstructions feasible without prolonged postoperative T-tube stenting.

Perspective

Laryngotracheal reconstruction in adults usually requires a prolonged postoperative T-tube stenting for stabilization of the newly reconstructed airway. We present our first experience with a modified technique of laryngotracheal reconstruction that leads to an immediate stability and thus facilitates the repair as a single-stage procedure.

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Laryngotracheal stenoses in adults are an infrequent problem and require a sophisticated surgical approach to offer optimal results to affected patients. Stenoses restricted to the subglottic region can be repaired with excellent results by means of the Grillo or Pearson technique.^{1,2} When the subglottic stenosis extends to the level of the vocal folds,

however, surgical repair becomes more challenging.³ In such a situation, classic subglottic resections do not provide satisfactory results,⁴ because these complex stenoses require not only a resection of all scar formations but also an enlargement of the airway lumen. Such a technique was originally described by Couraud and colleagues.^{5,6} They reported on 12 patients with severe glottosubglottic stenosis treated with a laryngeal enlargement. An anterior and a posterior vertical cricoidotomy was performed, and a 3- to 5-mm wide periosteal graft was inserted anteriorly

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Abbreviations and Acronyms

| | |
|------|--|
| POD | = postoperative day |
| R | = [vocal] roughness |
| B | = [vocal] breathiness |
| H | = [vocal] hoarseness |
| MEF | = maximum expiratory flow |
| ENT | = ear, nose, and throat |
| FEES | = fiberoptic endoscopic evaluation of swallowing |

and posteriorly between the two edges of the cricoid. The width of the reconstructed larynx was maintained by a T-tube, which remained in place for 3 months until complete healing and coverage by mucosal ingrowth had occurred. One of their patients died; the remaining 11 patients were reported to have good functional results with fair to good quality of voice.⁶ Additional information about this technique derives from a pooled Spanish experience, which reported on 20 patients treated the same way between 1986 and 2011. Results were described as good, and T-tubes could be removed after a mean of 60 days (range, 28-180 days).⁴ Thus the Couraud technique seems to offer satisfactory outcome, however, it carries the disadvantage of requiring prolonged postoperative stenting with Montgomery T-tubes until complete stabilization and mucosal coverage have been achieved.

In pediatric patients, laryngotracheal reconstructions represent an established and frequently applied technique, with series of more than 100 patients reported from Lausanne and Cincinnati.^{7,8} In this population, the cartilage grafts are trimmed with lateral flanges and sutured with 6-0 sutures to the two halves of the split cricoid plate.⁹ This maneuver leads to an immediately stable reconstruction of the naturally floppy pediatric airway. Nevertheless, the lack of mucosal coverage, as well as the difficult perioperative handling of small children, often makes the temporary implantation of a laryngotracheal mold for internal stenting necessary.

We therefore hypothesized that by adapting the pediatric technique of immediate stabilization and combining it with a complete coverage with healthy mucosa, laryngotracheal reconstruction in adults could be achieved in a single-stage procedure without the need for prolonged postoperative T-tube stenting. This case series summarizes our initial experience with the first 5 patients who were treated in this way.

MATERIALS AND METHODS

Patients

From November 2012 to May 2015, a total of 75 laryngotracheal operations were performed in pediatric and adult patients in our department. Among these, 5 adult patients were found to have the unique disease entity of a glottosubglottic stenosis extending up to the level of the vocal folds. The type of the stenosis was mainly a side-to-side narrowing, so classic

resection techniques (Pearson technique, Grillo technique) were not applicable. In all 5 patients, the airway, respiration, swallowing and phonation were preoperatively evaluated by transnasal flexible laryngoscopy. All patients (except patient 5, who had a permanent tracheostomy before the operation) underwent spirometry for functional quantification of the degree of upper airway obstruction (JAEGER Master Screen Body spirometer; PanGas AG, Dagersellen, Switzerland). Flexible bronchoscopy under general anesthesia was performed to define precisely the type and the extension of the airway problem. In addition, imaging with a cervical computed tomographic scan was done in all cases. Preoperative, perioperative, and postoperative patient management was performed by a dedicated laryngotracheal team consisting of thoracic surgeons, phoniatricians, speech therapists, and anesthetists.

Surgical Method

Patients were positioned in the supine position with an overextended neck, and ventilation through a laryngeal mask was installed. Patient 5 was ventilated through the preexisting tracheostomy. Intravenous anesthesia was used for induction and maintenance of anesthesia. After cervical incision and mobilization of the strap muscles, the glottis, the subglottis, and the cervical trachea were dissected anteriorly and laterally as far as needed without impairing the blood supply too extensively. In patient 5, the existing tracheostomy was incorporated into the skin incision. Lateral preparation was performed close to the trachea by blunt dissection or use of electrocautery at a very low energy level. Recurrent nerves were not routinely dissected, and recurrent nerve monitoring devices were not used. The trachea was then transected under bronchoscopic guidance at the lower end of the stenosis, and crossstable ventilation through the distal tracheal stump was initiated.

Resection of the diseased segment was started by removal of the cricoid arch. A complete anterior split of the thyroid cartilage was performed precisely in the midline, with the thyroid notch used as the leading structure to avoid lateral deviation and damage to the vocal folds. In the next step, all scar formations at the anterior surface of the cricoid plate were removed, either with the scalpel or with the help of an electric drill. Thereafter, the cricoid plate was completely split vertically in the midline, with the mucosal incision reaching up almost to the interarytenoid fold. The interarytenoid muscle was transected in case of scarring. The posteromedial parts of the two halves of the cricoid plate were carefully dissected posteriorly away from the hypopharynx to create a space for the later insertion of the cartilage graft. A rib cartilage graft was harvested through a 5-cm skin incision above the costal arch. Muscles were dissected and the cartilaginous part of a rib was isolated. Care was taken to avoid opening of the pleural space. A 3-cm large rib was harvested, and the resulting defect was covered by muscles. The cartilage was trimmed to a width of 4 to 5 mm, with 2 posterior flanges of 2 to 3 mm extending to both sides. This graft was snapped between the two cricoid halves, with the flanges extending on both sides posterior to the cricoid plate. The cartilage graft was secured with 4 to 6 stitches of 6-0 polydioxanone suture.

The distal trachea was then tailored in such a way that a long dorsal mucosal flap and an anterior V-shaped cartilage segment was created. A jet ventilation catheter was introduced through the laryngeal mask, crossstable ventilation was stopped, and the anastomosis was performed under jet ventilation (TwinStream; Carl Reiner GmbH, Vienna, Austria). In a first step, a running stitch of 5-0 polydioxanone suture was placed between the dorsal mucosal flap and the proximal dissection line of the glottic mucosa, without yet bringing the two parts into full contact. Stitches at the anterior part of the anastomosis were then prepared, and the two halves of the anterior thyroid cartilages were spread apart to allow interposition of the V-shaped distal anterior tracheal segment (Figure 1 and Video 1).

The distal trachea was then stepwise brought into direct contact with the laryngeal skeleton by gently pulling on the anterior single stitches. The posteriorly running suture was straightened until full adaptation and complete

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