Open Partial Resection for Malignant Glottic Tumors

13c

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Core Messages

> The quality of primary treatment is crucial for the results of laryngeal tumor therapy and the patient's life.

> Endoscopic resection was not able to replace open partial resection totally.

> Patient selection is based on the tumor's extent, the surgeon's expertise, and patient's expectations and/or demands.

> The main indication for open partial resection are glottic cancers with involvement of supraglottic or subglottic structures, one-sided slightly impaired mobility, or extension into the anterior commissure to the other vocal fold.

> Contraindications for oncological reasons include invasion of the thyroid cartilage, arytenoid fixation, interarytenoid invasion, subglottic extension with involvement of the cricoid cartilage, lesions that extend outside the larynx, and preepiglottic space invasion.

13c.1 Introduction

Several surgical options for treating laryngeal carcinoma can be used that allow resecting the tumor with oncologically safe margins and preservation of laryngeal function. The quality of the primary treatment is crucial for the results of laryngeal tumor therapy and the patient's life. Treatment includes addressing regional lymphatic drainage. The treatment strategy is based on the primary site of the tumor, its extension into the laryngeal structures, and the existence of regional and distant metastases.

Transcervical open partial resection for glottic cancer found its earliest application in the treatment of glottic malignant tumors. As these tumors produce early symptoms, the patients often present with localized disease. The first transcervical cordectomy for a vocal fold carcinoma was carried out by Brauers in 1834 [1]. Around the turn of the 19th century, cordectomy was the most frequently practiced procedure, and it produced rather good results for certain indications [2].

Despite some trials on laryngeal preservation as an alternative to total laryngectomy, the era of partial resection started in the 50th of the last century. Among the pioneers of function-preserving laryngeal surgery was Leroux-Robert, who advocated frontolateral partial resection [3]. Several modifications of open partial resection were described over the following years by Lore, Conley, Ogura, Silver, Mayer, and Piquet. It was predominantly Italian and French head and neck surgeons who developed and advocated open partial resections as extensive as subtotal laryngectomy for more advanced glottic cancer.

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Conditions for the development of partial resection were the knowledge of tumor spread and laryngeal function as well as improved endoscopic diagnosis. This led to an exact pretherapeutic classification of tumor spread and reliable posttherapy follow-up. In 1962, Kleinsasser introduced the microscope into direct laryngoscopy and laryngeal surgery [4, 5].

During the last two decades, open partial resection was at least partially replaced by transoral endoscopic resection via microlaryngoscopy. After a phase that saw endoscopic resection of T3–T4 cancers, endoscopic resection became a helpful additional method of surgical therapy for laryngeal cancer, but it did not push open partial resection completely out of the picture. Conservation surgery for glottic cancer still includes transcervical open partial resection as well as transoral endoscopic resection.

13c.2 Selection of Patients for Open Partial Laryngeal Resection

Patient selection is based on the tumor's extent, the surgeon's expertise, and the patient's expectations and/or demands. In 1988, Kleinsasser presented three arguments for performing open partial resection [6]: (1) excellent access to the tumor; (2) adaptation of extending the resection to the tumor size; (3) the possibility of immediate reconstruction

With a T1 vocal fold cancer, the tumor is limited to the vocal cord, with normal clinical mobility. In case of sufficient tumor exposition through the operating microscope, these carcinomas can normally be resected by a transoral endoscopic approach. Dysplastic lesions, carcinoma in situ, and T1a vocal fold carcinoma are the most appropriate lesions for microlaryngoscopic transoral resection. Superficial involvement of the anterior commissure (bilateral Tis and T1b) is not a contraindication for an endoscopic approach. However, with deeper invasion of Broyle's tendon secondary to the large anterior defect, the oncological and functional results may be unsatisfactory. Therefore, in most cases of T1, a vocal fold carcinoma with deep involvement of the anterior commissure, and with T1b tumors, we prefer an open transcervical approach. We also perform open partial resection for small glottic cancers in case of inadequate exposure.

Indications for open partial resection are glottic cancers with involvement of supraglottic or subglottic structures or one-sided, slightly impaired mobility, extension into the anterior commissure to the other vocal fold or in tumors after resection leading to glottic insufficiency and thus to an impaired voice and a decreased quality of life.

T2 glottic cancers are an inhomogeneous group of lesions. Due to large tissue defects after endoscopic removal of large T1 and T2 tumors transoral resection should not be the treatment of choice for functional reasons. T2 carcinomas that extend to the ventricle or the paraglottic space or that present with fixation of the vocal fold posteriorly with highly differentiated squamous cell carcinoma and expanding borders are suitable for a vertical partial resection in carefully selected cases. The craniocaudal diameter should not extend more than 2 cm. Open partial resection of T2 tumors with involvement of the anterior commissure should be performed cautiously because of possible cartilage infiltration and invasion or even penetration of the cricothyroid ligament. Depending on the tumor site and grading, neck dissection has to be performed.

Similar to large T2 vocal fold carcinomas, T3 tumors may require open partial resection in selected cases. Arytenoid infiltration and tumor grading are especially important to the decision making about whether to perform an open partial resection. With T3 glottic carcinoma, a neck dissection should be performed simultaneously.

With T4 glottic carcinomas, vertical partial resection is not a therapeutic option. Surgery with total removal of the thyroid cartilage, such as cricohyoidopexy (CHP) or cricohyoidoepiglottopexy (CHEP), may be indicated. These surgical techniques can be used as an alternative to laryngectomy. There are many advantages of vertical partial resection in comparison to cricohyoidopexy. By using vertical partial resection, the patient is able to phonate naturally at the glottic level postoperatively. Phonation at the supraglottic level remains an exception after transcervical resection leading to unfavorable functional results. Additionally, aspiration is prevented by a reconstructed, functioning glottic sphincter. The indication for open partial resection with glottic reconstruction also depends on the patient's request for an immediately sonorous voice with sufficient volume to maintain quality of life.

13c.3 Contraindications

Contraindications for oncological reasons include invasion of the thyroid cartilage, arytenoid fixation, interarytenoid invasion, subglottic extension with involvement of the cricoid cartilage, lesions that extend outside the larynx, and preepiglottic space invasion. As all of the patients have to be tracheotomized for several days, the surgery is contraindicated in elderly patients and patients with severe cardiopulmonary disease.

13c.4 Surgical Techniques

The authors prefer a midline incision from the superior thyroid incision down to the trachea in order to perform a tracheotomy as the first step. Alternatively, two horizontal incisions may be possible but do not provide the same good overview of the larynx. The medial cervical fascia is carefully prepared and the infrahyoid muscles pulled aside. The isthmus of the thyroid gland with the entire pretracheal and prelaryngeal tissue is resected including the prelaryngeal Delphian node. The technique of thyreotomy is nearly the same as it was during the early 20th century [7–9, 13, 14].

The perichondrium is paramedially incised vertically to ensure good protection of the medial thyrofissure afterward. The cartilage is divided in the midline or paramedian with a circular or oscillating saw, ensuring that the underlying tissue is not damaged. Then, the spot where the anterior laryngeal artery penetrates the cricothyroid ligament is found, indicating the exact midline. After medial incision of the cricothyroid membrane, the soft tissues of the larynx are incised with a blunt curved knife (Herrmann) up to the petiolus.

The endolaryngeal surface is now totally exposed for examination and resection under the operating microscope. Depending on the site and size of the lesion in the glottis, a cartilage window can be resected with the tumor in a small frame at the upper and lower border of the thyroid.

Generally, the vocal fold is not completely resected. The tumor resection is adapted to the extent of the lesion. If possible, the tumor is resected in one bloc. Additionally, we perform circular lateral as well as deep resections for free margins. This helps the pathologist determine the resection margins more exactly. For immediate control, frozen sections can be carried out. In any case of positive margins, the patient must undergo revision surgery.

According to its volume and extent, the defect is reconstructed by a false cord flap including parts of the epiglottis if necessary [7, 9–12]. This flap, pedicled cranioposteriorly, is fixed as far forward as possible into the anterior commissure with respect to the exact insertion of Broyle's tendon. Sometimes the glottic level of the flap has to be filled up with fat or cartilage. The main idea of this type of resection is that there is least one straight vertical margin to establish a new anterior commissure by a flap covered by healthy, well vascularized mucosa on at least at one side. For bilateral lesions with superficial tumor growth on the contralateral side, cordectomy type I, and if necessary type II, can be applied. Exact reconstruction of the anterior commissure is important for achieving a good functional result. It should be reconstructed in the typical V-shape for good glottic closure, especially with advanced resection. The functional result of the operation is predominantly influenced by the remaining volume of the vocalis muscle and the flap. The thyrofissure is closed with 2–0 Vicryl sutures via three pairs of drill holes performed before the split of the thyroid.

Before closure we create a so-called Miculicz stent (latex glove filled with cotton gauze), which is inserted in the laryngeal lumen to prevent bleeding and swelling. The external perichondrium is then closed with 3–0 Vicryl suture. The stent can be taken out 1 day after surgery. The distal end of the stent is led out through the cricothyroid ligament and fixed to the cuffed tracheal cannula. Only in patients with large flaps involving the laryngeal ventricle is a feeding tube recommended.

13c.5 Reconstructive Surgery for Glottic Defects

Resection and reconstruction vary depending on the site, size, and growth of the tumor. According to the site and size of the tumor, there are different thyroid cartilage resections. These resections respect the reconstruction of the anterior commissure, in contrast to most of the previously published modifications of laryngeal
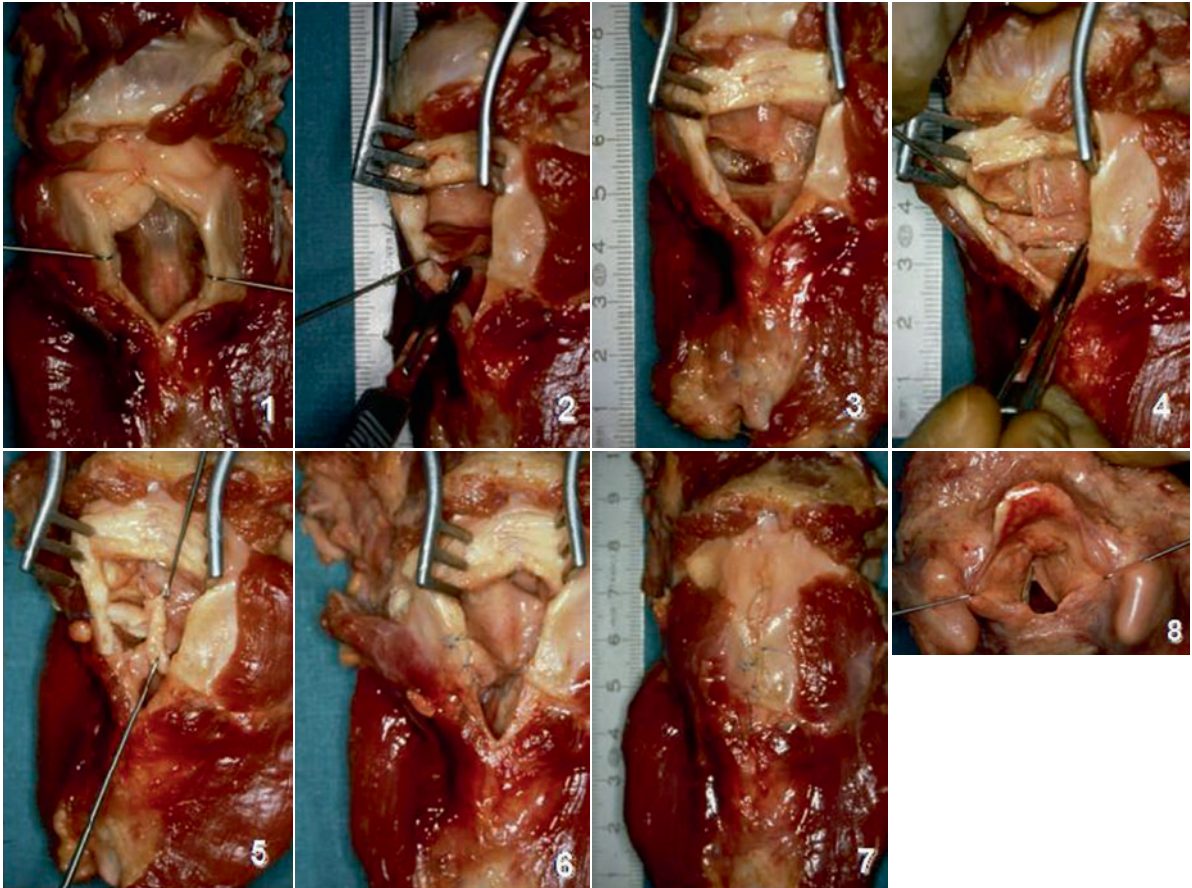
Fig. 13c.1. 1–8 Figures present a open partial resection of the right vocal fold with cordectomy in a cadaver larynx. A false cord flap is transposed to the glottis level for immediate reconstruction

partial resections, especially the frontolateral resection from Leroux-Robert, which results in a round anterior commissure with mostly a bad functional outcome. Several examples are shown in Figures 13c.1–13c.4.

13c.6 Postoperative Care

The Miculicz stent has to be fixed thoroughly and removed on the first postoperative day. The patient must be watched closely because the stent may cause acute respiratory distress if it is acutely displaced. In most cases, the tracheal cannula can be removed within 24 hours after surgery. With advanced resections, the tracheal cannula can stay in place up to 1 week, and a feeding tube

may be necessary. Temporary swallowing dysfunction after extended cordectomy is rare. When present, it is mostly caused by edema in the arytenoid region.

Regular follow-up care is required for all patients with head and neck cancer, preferably at least every 6–12 weeks during the first postoperative year. Additionally, postoperative voice therapy may significantly improve the functional outcome. In some patients the flap becomes atrophic, leading to glottic insufficiency and development of supraglottic phonation. In these cases, medialization of the flap with septal cartilage or fat injection can be carried out after 2 years of tumor-free survival. Secondary to the pull-down of the ventricular fold, cystic lesions may develop that may mimic a recurrence underneath the flap. In these cases, diagnostic microlaryngoscopy with adjustment procedures to the flap is mandatory.

Fig. 13c.2. T2 vocal fold carcinoma. Primary glottic reconstruction can be performed immediately after tumor resection during the same procedure by reconstructing the vocal fold or creating a counterpart for the intact contralateral vocal fold. Depending on the defect, a ventricular fold flap or an enlarged ventricular fold flap with parts of the epiglottis is transpositioned to the glottic level and fixed by sutures to create a sufficient glottic closure. In this case, the carcinoma was excised with a cartilage window. To create more volume for the new vocal fold, parts of the upper rim of the ipsilateral thyroid are placed underneath the flap
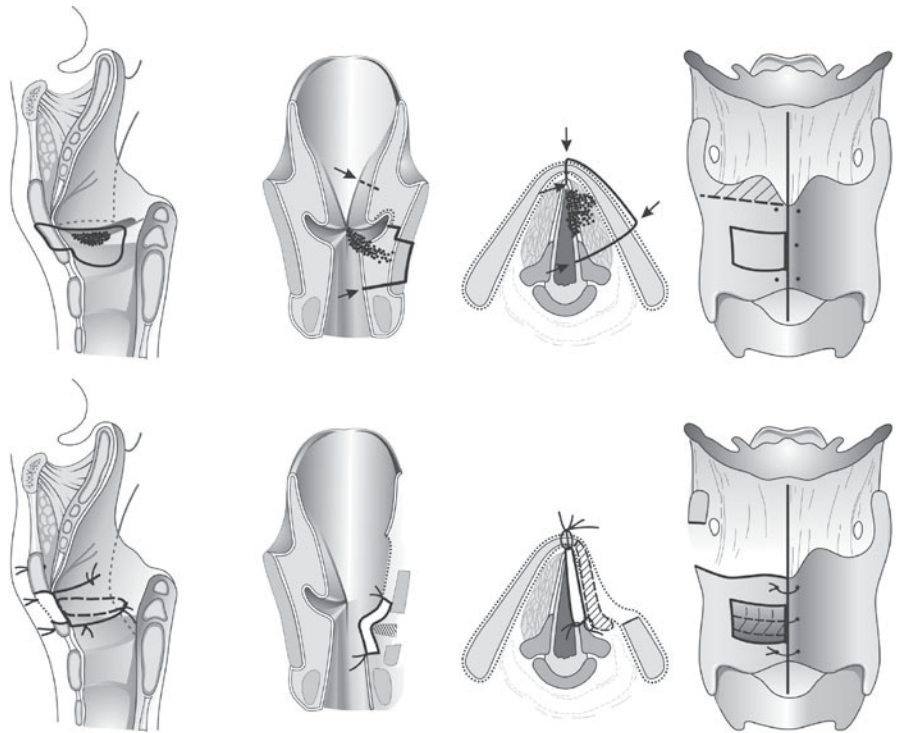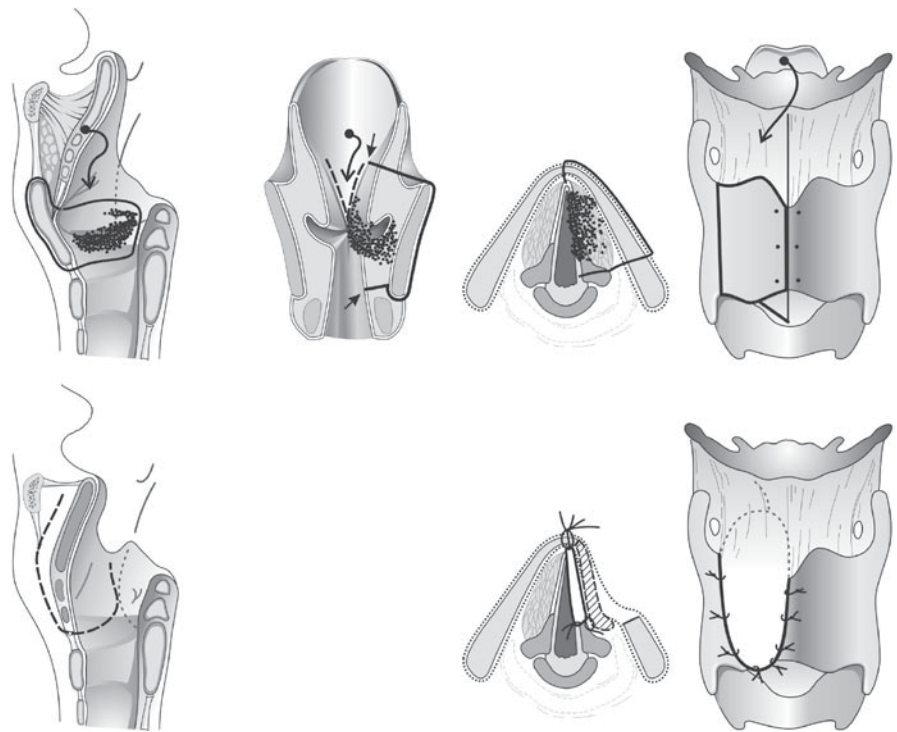
Fig. 13c.3. T2–T3 vocal fold carcinoma with involvement of the ventricular fold, resulting in a large defect including major parts of the thyroid cartilage. In these cases, an epiglottis sliding flap can be performed [9–11, 15, 16]
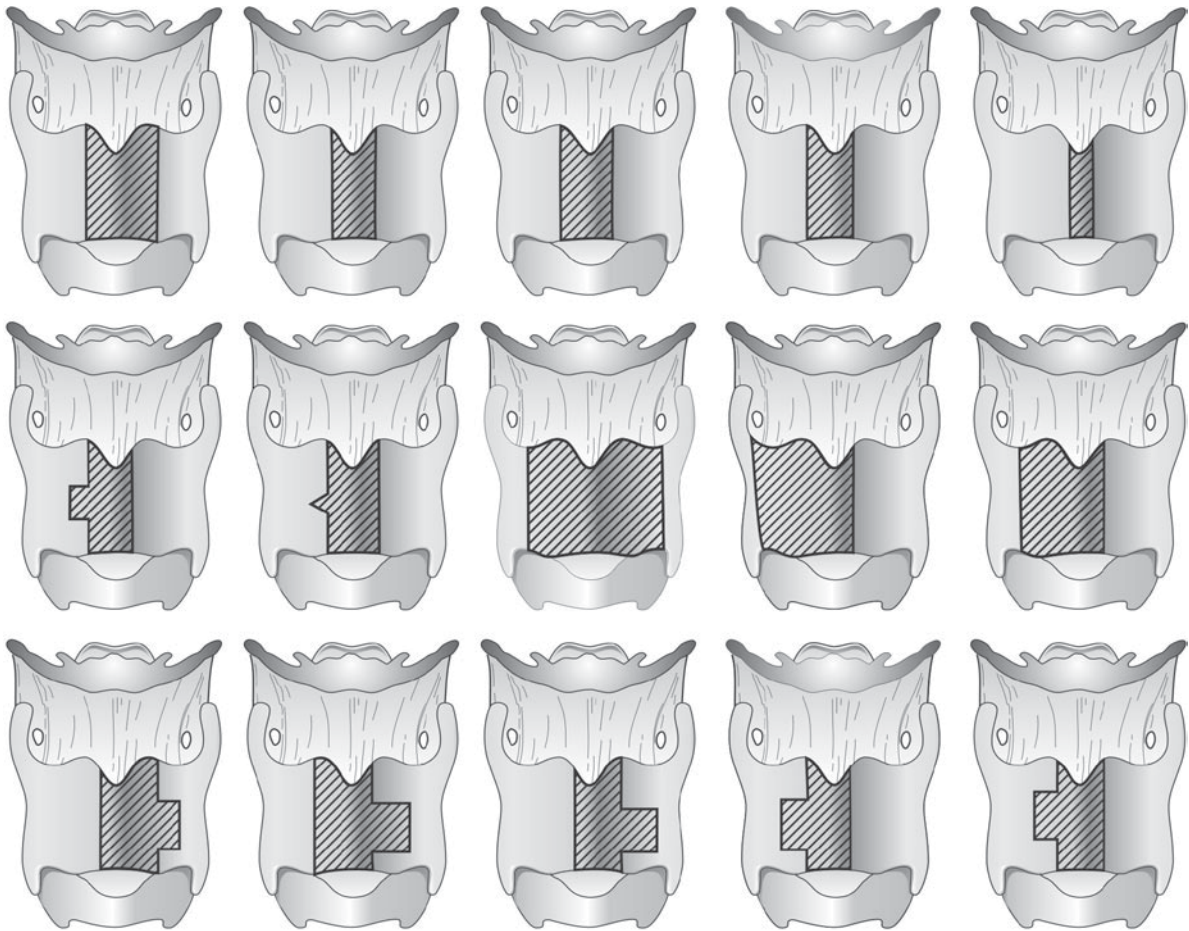
Fig. 13c.4. Various cartilage resections during open vertical partial resections

References

1. Brauers (1834) zit. bei Kahler, O.: Die bösartigen Neuerungen des Kehlkopfs. In: Denker A, Kahler O (eds) Handbuch der Hals-Nasen-Ohrenheilkunde, Bd. V. Springer, Berlin, 1929 (S.441)

2. Bruns V (1978) Die Laryngektomie zur Entfernung intralaryngealer Neubildungen. Berlin 1887, zit. bei Kahler, O.: Die bösartigen Neuerungen des Kehlkopfs. In: Denker A, Kahler O (eds) Handbuch der Hals-Nasen-Ohrenheilkunde. Bd. V. Springer, Berlin 1929 (S.441)

3. Leroux-Robert J (1975) A statistical study of 620 laryngeal carcinomas of the glottic region personally operated upon more than five years ago. Laryngoscope 85:1440–1452

4. Kleinsasser O (1962) Die Laryngomikroskopie (Lupenlaryngoskopie) und ihre Bedeutung für die Erkennung der Vorerkrankungen und Frühformen des Stimmlippenkarzinoms. Arch Ohrenheilkd 180:724–727

5. Kleinsasser O (1965) Weitere technische Entwicklung und erste Ergebnisse der "endolaryngealen Mikrochirurgie". Laryngol Rhinol Otol 44:711–727

6. Kleinsasser O (1988) Tumors of the larynx and hypopharynx. Thieme-Verlag, Stuttgart/New York

7. Neel HB, Devine KD, DeSanto LW (1980) Laryngofissure and cordectomy for early cordal carcinoma: outcome in 182 patients. Otolaryngol Head Neck Surg 88:79–84

8. Daly JF, Kwok FM (1975) Laryngofissure and cordectomy. Laryngoscope 85:1290–1297

9. Friedman M, Toriuni DM (1987) Glottic reconstruction following hemilaryngectomy:false cord advancement flap. Laryngoscope 97:882–884

10. Tucker HM, Wood BG, Levine H, Katz R (1979) Glottic reconstruction after near total laryngectomy. Laryngoscope 89:609–618

11. Sedlacek K (1965) Predni a lateralni rekonstrukcni laryngektomie se stazenim epiglottis. Ceskoslovenska Otolaryngol 14:328–334

12. Kambic V, Radsel Z, Smid L (1976) Laryngeal reconstruction with epiglottis after vertical hemilaryngectomy. J Laryngol Otol 90:467–473

13. LeJeune FE, Lynch MG (1955) The value of laryngofissure. Ann Otol Rhinol Laryngol 64:256–262

14. McGavran MH, Spjut H, Ogura J (1959) Laryngofissure in the treament of laryngeal carcinoma: a critical analysis of success and failure. Laryngoscope 69:44–53

15. Kleinsasser O (1987) Chirurgische Behandlung der Larynx- und Hypopharynxkarzinome. In: Kleinsasser O (ed.) Tumoren des larynx und des hypopharynx. Thieme Verlag, Stuttgart