

Organ-preservation surgery following failed radiotherapy for laryngeal cancer. Evaluation, patient selection, functional outcome and survival

Gino Marioni^a, Rosario Marchese-Ragona^a, Marco Lucioni^b and Alberto Staffieri^a

^aDepartment of Medical and Surgical Specialties, Section of Otolaryngology, University of Padova, Padova and ^bDivision of Otolaryngology, Vittorio Veneto Hospital, Vittorio Veneto, Italy

Correspondence to Gino Marioni, Department of Medical and Surgical Specialties, Section of Otolaryngology, University of Padova, Via Giustiniani 2, 35100 Padova, Italy
Tel: +39 049 8218626; fax: +39 049 8273113; e-mail: gino.marioni@unipd.it

Current Opinion in Otolaryngology & Head and Neck Surgery 2008, 16:141–146

Purpose of the review

Although radiotherapy is a well codified treatment for laryngeal carcinomas, the management of local recurrence after failed radiotherapy remains controversial. Total laryngectomy is the classical salvage surgical approach. Recent evidence showed that selected laryngeal recurrences may be successfully treated with partial laryngectomies with comparable survival rates, acceptable morbidity, tracheostomy closure, effective swallowing, and satisfactory voice intelligibility.

Recent findings

Recurrent laryngeal carcinoma after radiotherapy failure requires a comprehensive clinical, radiological and pathological restaging. Strict selection criteria are mandatory for the identification of radiotherapy failure cases amenable to conservative laryngeal surgery. Although larger series confirmation is necessary, conservative salvage surgery seems definitely promising. Salvage endolaryngeal laser surgery after irradiation failure allows in selected cases a mean local control rate of 65%. Selectively, supracricoid laryngectomy can be a flexible alternative to salvage total laryngectomy being conservative of laryngeal functions (mean local control rate of 85%). Selected laryngeal recurrences can be correctly treated also with vertical or horizontal supraglottic laryngectomies. In partial laryngectomies, intraoperative frozen sections are mandatory: postoperatively permanent sections have to confirm all margins.

Summary

When proper selection criteria for conservative salvage laryngeal surgery are used, laryngeal function can be preserved with oncological efficacy also after radiotherapy failure.

Keywords

irradiation failure, laryngeal carcinoma, recurrence, salvage laryngectomy, partial laryngectomy

Curr Opin Otolaryngol Head Neck Surg 16:141–146
© 2008 Wolters Kluwer Health | Lippincott Williams & Wilkins
1068-9508

Introduction

Radiotherapy is a well established treatment for selected laryngeal carcinomas with good oncologic and functional results. Reported failure rates have averaged 9–21% in T1 and 28–37% in T2 glottic carcinomas. In supraglottic laryngeal cancer, the failure rates for T1 and T2 lesions are 24–30% and 25% to 45%, respectively [1].

The management of laryngeal recurrence after failed radiotherapy remains controversial. The salvage surgery procedure aims to remove the tumor with an adequate edge of healthy tissue. Small nests of neoplastic cells lying deep below intact mucosa characterize the histological pattern of presentation of laryngeal recurrences after irradiation. These islands follow mucous glands and

blood vessels into areas of the larynx otherwise unaffected by carcinoma at a distance from the original lesion site [2]. More recently, Zbären *et al.* [3^{*}] observed a strongly marked perineural infiltration in recurrent laryngeal carcinomas, supporting the hypothesis that tumors also grew along nerves involving previously unaffected areas. This pathological evidence that clinically determines significant difficulties in correctly restaging the tumor after irradiation justified the classical choice of salvage total laryngectomy in cases of carcinoma recurrence following radiotherapy failure [4]. Surgical salvage is often performed by total laryngectomy also in the belief that increased complications are associated with partial laryngectomy of irradiated cartilage [5]. On the other hand, recent evidence confirmed that selected recurrent laryngeal cancers may be successfully treated

with partial laryngectomy also after high-dose radiation therapy failure [6]. If partial laryngectomy is to replace conventional salvage surgery, it has to achieve survival rates comparable to those of total laryngectomy, with acceptable morbidity, tracheostomy closure, effective swallowing, and satisfactory voice intelligibility.

The aim of this review is to critically analyze the available data regarding the indications, oncological and functional results of partial laryngectomies in the treatment of laryngeal carcinoma recurrence after irradiation failure.

Laryngeal carcinoma recurrence evaluation

Advances in functional salvage surgery and the tendency to avoid total laryngectomy for recurrent carcinoma emphasized the role of early diagnosis of laryngeal carcinoma recurrence after radiotherapy failure. In patients with symptoms (progressive hoarseness, dysphagia, pain, respiratory distress) or clinical signs such as severe edema or necrosis, differentiation between recurrent laryngeal carcinoma and radiotherapy sequelae is often clinically and radiologically difficult because tumor may involve multicentric localization without surface epithelium involvement [7•–9•]. Specific sites such as the laryngeal ventricle and the subglottic region are difficult to examine in the presence of important edema [8•]. Critical regions in view of conservative salvage surgery indication are also cricoarytenoid region and interarytenoid regions, thyroid and cricoid cartilages [8•]. Endoscopic evaluation followed by biopsies may exacerbate post-radiotherapy changes and initiate superimposed infections with perichondritis, healing failure and further edema [7•]. The use of PET with 18-fluorodeoxyglucose (FDG) seems to be a promising tool in differentiating locally (also submucosal) recurrent tumors from post-radiotherapy tissue sequelae: this is due to the fact that PET-FDG relies on metabolic function of neoplastic cells [7•].

Organ-preservation surgery indication following radiotherapy failure for laryngeal carcinoma requires a comprehensive diagnostic approach. The assessment of the correct tumor extension of recurrent laryngeal carcinoma may be difficult because of the residual inflammatory or functional changes associated with radiation therapy [3•]. Endoscopic and radiological workup often fails, underestimating the true extension of the recurrent carcinoma in a high percentage of cases: in a limited series Zbären *et al.* [8•] found a 50% accuracy of clinical/endoscopic/radiologic study; most tumors were underclassified.

The evaluation of clinical records of prior diagnosis and treatment is mandatory. Staging, pathological slides and clinical examination regarding prior laryngeal carcinoma should be reviewed. Previous radiotherapeutic approach (technique, doses, courses) should also be considered.

Patients have to be examined by means of fiberoptic laryngoscopy and videolaryngostroboscopy. Direct laryngoscopy under general anesthesia is useful to allow precise definition of recurrent tumor extension, to explore subsites as anterior commissure, laryngeal ventricle, subglottis, and pyriform sinus (angled rigid endoscopes 30°, 45°, 90°) may improve the preoperative staging [10], and to perform lesion biopsies. In cases of advanced recurrences, a fibroscopic evaluation of the esophagus is mandatory to rule out a synchronous malignancy of the upper digestive tract [6].

Computerized tomography (CT) or MRI are nowadays necessary radiological procedures for recurrent laryngeal carcinoma staging. Both exams can offer information about primary tumor volume, cartilage involvement, invasion of the preepiglottic space, and extension beyond the larynx. Regarding cartilage invasion, MRI seems to be more sensitive than CT to detect cartilage alterations [11,12].

Considering conservative surgical options with laryngeal carcinoma recurrence, the importance of patients' general conditions, medical comorbidities, acceptable pulmonary and swallowing functions has been emphasized [13•].

Ultrasonography of the neck has to be performed in patients with clinically evident neck metastases [with fine needle aspiration cytology (FNAC)] or carcinomas with high risk of occult lymph node metastases. Reported figures of the accuracy of fine needle aspiration cytology guided by ultrasonography range between 89 and 97% [14]. An 87–93% accuracy of CT scan in neck staging has been reported. MRI evaluation of cervical nodal metastases seems to have comparable sensitivity and specificity [15]. Distant metastasis diagnosis may obviously alter or obviate the planned type of laryngeal intervention [13•].

Salvage surgical options should be discussed with the patient and the willingness to accept a potentially lengthy rehabilitation has to be considered before concluding for partial laryngeal surgery [16]. Considering the reasonable possibility of clinical and radiological underestimation of laryngeal carcinoma recurrence after radiotherapy, the patient should be prepared for a total laryngectomy and the surgical staff should have obtained the informed consent for the procedure.

Rational conservative surgical options after failed radiotherapy

Although larger series confirmation is necessary, conservative salvage surgery seems definitely promising.

Transoral laser surgery

The most appealing features of transoral laser-assisted surgery in the treatment of radiotherapy failure are the

possibility to perform a tumor-tailored excision possibly switching intraoperatively to an open partial laryngectomy whenever the carcinoma is beyond the presumed limits. Good functional results in terms of voice quality and swallowing with lower complication rates, lower costs and shorter hospitalization times have been reported [17]. The appropriateness criteria for transoral laser laryngeal surgery after radiotherapy failure include complete endoscopic visualization of the carcinoma, tumor extension to the contralateral vocal fold not exceeding 3 mm, absence of arytenoid (except the vocal process) involvement, subglottic extension not exceeding 5 mm, supraglottic involvement extending no further than the lateral extension of Morgagni sinus, mobile vocal folds, no cartilage involvement, and strict correlation in localization and extension between recurrent lesion and primary tumor before irradiation [18]. Although anterior commissure involvement does not represent a contraindication for endoscopic laser resection after irradiation failure, extreme caution should be used because of potential persistence of deep nests of carcinoma invading visceral compartments or focally involving the laryngeal framework. In case of macroscopic involvement of the anterior commissure by recurrent carcinoma several authors prefer to perform supracricoid laryngectomy (SCL), which allows wider margins of resection [17,19].

In 2006, Motamed and coworkers [18] reviewed available literature regarding salvage endolaryngeal laser surgery after irradiation failure (comprehensively 145 cases). The average follow-up period was approximately 24 months (range 3–132 months). In 40% of the cases more than one laser-assisted surgical treatment were necessary. The mean local control rate was 65% (range 51–87%). Subsequent total laryngectomy was necessary in 25% of the cases for residual/recurrent disease or for refractory dysphagia. Motamed *et al.* [18] calculated that the mean overall local control rate (including cases that subsequently required total laryngectomy) was 83% (range 80–100%). The above mentioned literature review considered also Steiner and coworkers [20] series of 34 patients with early but also advanced recurrent glottic carcinomas (rT1–rT4) after radiotherapy. Steiner and colleagues [20] stated that extensive specific surgical experience is necessary in carbon dioxide laser excision of advanced stage recurrent cancers. Very recently, Piazza and colleagues [17] reported 22 cases of laryngeal carcinoma recurrence (rT1–rT2) after irradiation treated with carbon dioxide laser-assisted excision. Oncological results analysis showed 5-year disease-specific survival, disease-free survival, and laryngeal preservation of 95, 63, and 75%, respectively.

Most of the authors experienced increased difficulty with identifying recurrent carcinoma in irradiated tissues so

the use of frozen section has to be employed routinely. Moreover, all margins should be confirmed postoperatively by permanent section. The importance of strict follow-up with fibroscopic examination and serial imaging allowing early recurrence detection and treatment should be emphasized. The use of carbon dioxide laser excision of recurrent laryngeal carcinoma after irradiation failure does not preclude its further use for persistent or multiple recurrent disease [10].

In laser excision of recurrent laryngeal carcinoma series tracheostomy and nasogastric feeding tube are not routinely required. Complications are reported in less than 5% of cases [18]. The most commonly reported complications are granuoma formation or laryngeal edema. Laryngeal stenosis and chondronecrosis [20] are rarer [18].

Supracricoid laryngectomy

SCL with cricothyroidopexy is considered as a suitable surgical approach for supraglottic carcinoma involving the glottis, ventricle, or anterior commissure. It involves the removal of the whole thyroid cartilage, both true and false cords, the ventricles, the epiglottis, and the paraglottic and preepiglottic spaces. At least one arytenoid has to be spared to preserve phonation and sphincter functions. SCL with cricothyroidopexy is used for the treatment of advanced glottic carcinomas. It involves the resection of the infra-hyoid part of the epiglottis and the preepiglottic space. Also, with cricothyroidopexy, at least one arytenoid has to be spared. Through the conservation of a cricoarytenoid unit, SCL allows the creation of a neo-larynx permitting both swallowing and speech. Furthermore, in most of SCL cases, the tracheostoma can be closed. SCL contraindications are infiltration of both the arytenoids cartilage or of the crico-arytenoid joint or of the inter-arytenoid region; subglottic extension for more than 1 cm below the vocal fold free margin at the level of the anterior commissure; extension to the glossoepiglottic vallecula; major preepiglottic space invasion; hyoid bone invasion; outer perichondrium of the thyroid cartilage invasion; and extra-laryngeal malignancy spread. Subtotal laryngectomy with tracheohyoidopexy seems to represent a promising approach to extend laryngeal resection beyond the limits adopted for SCL. Tracheohyoidopexy allows glottic tumors with subglottic extension to be treated: not only laryngeal carcinomas with invasion of one cricoarytenoid joint, but also locally advanced laryngeal carcinomas with anterior extension through the thyroid cartilage. Available data regarding oncological and functional results of this approach are very limited, in particular for the treatment of recurrent carcinomas after irradiation failure [21].

SCL is a fascinating alternative to total laryngectomy in the treatment of selected irradiation failures of laryngeal

carcinomas being conservative of laryngeal functions [22,23^{*}]. In 1950, Hofmann-Saguez [24] first reported a 'subtotal conservative laryngectomy', an ancestor of SCL, in a 65-year-old patient with recurrent laryngeal carcinoma after radiotherapy who had refused total laryngectomy. In 2006, Marioni *et al.* [22] reviewed available series of salvage SCL after radiotherapy failure in glottic carcinoma (comprehensively 103 cases). Very recently, Pellini and coworkers [25^{*}] retrospectively described a multiinstitutional series of 78 cases of salvage SCL for supraglottic/glottic carcinoma after radiotherapy: a significant number of these cases had been previously reported in single-institution experiences that were considered in the above mentioned literature review [22]. Marioni and coworkers [22] found that 84.5% of the cases of salvage SCL for irradiation failure did not present a new local recurrence. Analyzing available data, laryngeal recurrences after salvage SCL (15.5%) were successfully treated with total laryngectomy in 66.7% of the cases [22]. The 3-year survival rate after salvage SCL ranged from 80 to 100%. The 5-year survival rate ranged from 69.04 to 100%.

Marioni *et al.* [22] reviewed functional results of SCL in carcinoma recurrence after irradiation: decannulation was possible in all except two cases with available data after a mean period ranging between 12 and 28 days. Swallowing disorders are the most common short-term complication of SCL [26]. Laccourreye and co-workers [27] performed percutaneous endoscopic gastrostomy before salvage-SCL in 10 of 12 patients and a cricopharyngeal myotomy in one patient. Overall swallowing results seemed good but recovery time was longer in irradiated than in non-irradiated patients who underwent SCL. Voice quality determined by psychoacoustic methods was 'hoarse' or 'rough and breathy' but with acceptable intelligibility. Aspiration pneumonia has been the most frequent complication of SCL for carcinoma recurrence after radiotherapy (17.5% of the cases with sufficient data). Postoperative aspiration pneumonia was the cause of death in two cases. Neo-laryngeal edema was another quite common postoperative complication of SCL for carcinoma recurrence after radiotherapy [22]. Pellini and colleagues [28] compared retrospectively the postoperative complications and functional outcomes of two groups of patients who had undergone SCL with cricothyroidotomy: one affected by untreated laryngeal carcinoma (65 cases) and the other by laryngeal recurrence after radiotherapy (17 cases). No statistical differences were found between the functional results of the two groups. In their series, the proportion of early surgical complication in patients who had received radiotherapy was significantly higher. Very recently, other experiences of salvage SCL after radiotherapy were described [29^{*}]. Although larger series confirmation is necessary, SCL is an oncologically

safe surgical approach allowing laryngeal functions conservation in selected recurrences after radiotherapy failures (G. Marioni, personal communication).

Other open partial laryngectomies

Selected laryngeal recurrences after radiotherapy can be correctly treated also with other open partial approaches.

Vertical partial laryngectomy

Contraindications of vertical partial laryngectomy (VPL) after irradiation failure can be synthesized as follows: large T3 or any T4 lesions, interarytenoid or cricoarytenoid joint involvement, bilateral arytenoid cartilage involvement or diminished mobility of both vocal folds, thyroid cartilage penetration, supraglottic extension exceeding the lateral wall of the ventricle or subglottic extension exceeding 10 mm at the anterior commissure or 5 mm at the vocal process of the arytenoid, poor pulmonary function.

In 2003, Yiotakis and coworkers [1] reviewed the reported outcomes of VPL after irradiation failure in glottic carcinoma (462 patients). Available series dimensions ranged from three to 61 cases. Median local control rate was 82% (mean 78%; range 50–100%). Sixty-six patients out of 424 with available data required completion of laryngectomy for second recurrence. In partial laryngectomies, the use of intraoperative frozen sections is necessary for maximum safety [30]. All margins have to be confirmed postoperatively by permanent section. In the event of salvage VPL failure, total laryngectomy remains a reasonable option, without apparently compromising ultimate local control [18].

Horizontal supraglottic laryngectomy

Contraindications of horizontal supraglottic laryngectomy (HSL) after radiotherapy failure are vocal fold, thyroid cartilage, or posterior commissure lesion involvement, more than minimal involvement of the tongue base or the medial wall of the pyriform sinus of the lesion, poor pulmonary function. Yiotakis and coworkers [1] reviewed the very limited available series describing oncological results of HSL in supraglottic carcinoma after irradiation failure (comprehensively 49 patients). Median local control rate was 77% (mean 61%; range 0–100%). The wide variability in oncological outcomes after salvage HSL may be reasonably due to patient selections, clinical evaluation of the lesions and limited sample size of the series.

Complications and functional results of partial laryngectomies after radiotherapy failure

The morbidity in patients undergoing partial laryngectomies after full course radiotherapy is controversial. The usually reported complications are delayed wound healing, infections, fistula formation and aspiration

pneumonia occurring in up to 25% of cases [18]. Other less common complications cited include laryngeal stenosis, laryngeal edema or granuloma formation, perichondritis, and surgical emphysema. According to Yiotakis *et al.* [1] the use of bipedicle flaps of strap muscles to replace the excised intralaryngeal soft tissue after VPL seems to facilitate the rehabilitation of selected patients.

From a functional viewpoint, swallowing impairment, aspiration, and delayed decannulation are frequently described. In VPL cases the mobile cord compensates with time and adequately protects the airway during swallowing. On the other hand, in salvage HSLs a high rate of delayed swallowing and recurrent aspiration was reported.

Neck management

Neck dissection has to be performed in all cases of laryngeal carcinoma recurrence with clinical/cytological evidences of metastatic regional disease. The indication to elective neck dissection (END) in patients staged as cN0 before salvage laryngeal surgery is controversial [31]. According to Ganly and coworkers [5], the decision for END has to be determined by rT-staging, supraglottic or subglottic extension, extra-laryngeal involvement of recurrence. In the near future, specific biological markers could be studied as hallmarks of higher risk laryngeal carcinomas to develop regional metastasis (survivin, the smallest mammalian member of the inhibitor of apoptosis proteins family, now seems very promising [32]); convincing evidence could imply that END should be considered in cN0 patients with laryngeal carcinomas that show high expression of those markers.

Conclusion

With the growing acceptance of nonsurgical, organ sparing therapies, it has become increasingly important to delineate surgical treatment strategies for patients with recurrent laryngeal cancer. Although 70–80% of laryngeal carcinoma recurrences after radiotherapy are staged as rT3/T4 and total laryngectomy is considered the treatment of choice in the majority of these cases [6,16], several studies addressing the results of different conservative options after irradiation failure for selected patients have been published. Available findings support the evidence that, when proper selection criteria for conservative salvage laryngeal surgery are used, laryngeal function can be preserved with oncological efficacy.

Acknowledgements

Professor A. Staffieri is the President of the European Study Group for Rehabilitation and Functional Surgery following Laryngectomy (EGFL).

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (pp. 175–176).

- 1 Yiotakis J, Stavroulaki P, Nikolopoulos T, *et al.* Partial laryngectomy after irradiation failure. *Otolaryngol Head Neck Surg* 2003; 128:200–209.
- 2 Brandenburg JH, Condon KG, Frank TW. Coronal sections of larynges from radiation-therapy failures: a clinical-pathologic study. *Otolaryngol Head Neck Surg* 1986; 95:213–218.
- 3 Zbären P, Nuyens M, Curschmann J, Stauffer E. Histologic characteristics and tumor spread of recurrent glottic carcinoma: analysis on whole-organ sections and comparison with tumor spread of primary carcinomas. *Head Neck* 2007; 29:26–32.
- The authors analysed histologic characteristics of 29 laryngeal recurrent carcinomas. They concluded that recurrent laryngeal tumours are often significantly understaged by endoscopy and imaging studies.
- 4 Marchese-Ragona R, Marioni G, Chiarello G, *et al.* Supracricoid laryngectomy with cricothyroidopexy for recurrence of early-stage glottic carcinoma after irradiation. Long-term oncological and functional results. *Acta Otolaryngol (Stockh)* 2005; 125:91–95.
- 5 Ganly I, Patel SG, Matsuo J, *et al.* Results of surgical salvage after failure of definitive radiation therapy for early-stage squamous cell carcinoma of the glottic larynx. *Arch Otolaryngol Head Neck Surg* 2006; 132:59–66.
- 6 Marioni G, Marchese-Ragona R, Cartei G, *et al.* Current opinion in diagnosis and treatment of laryngeal carcinoma. *Cancer Treatment Rev* 2006; 32:504–515.
- 7 De Bree R, van der Putten L, Hoekstra OS, *et al.*, on behalf of the RELAPS Study Group. A randomized trial of PET scanning to improve diagnostic yield of direct laryngoscopy in patients with suspicion of recurrent laryngeal carcinoma after radiotherapy. *Contemp Clin Trials* 2007; 28:705–712.
- The Recurrence Laryngeal Carcinoma PET Study was designed to evaluate the value of FDG-PET in the selection for direct laryngoscopy in patients of patients with suspicion of recurrent carcinoma after radiotherapy.
- 8 Zbären P, Christe A, Caversaccio MD, *et al.* Pretherapeutic staging of recurrent laryngeal carcinoma: clinical findings and imaging studies compared with histopathology. *Otolaryngol Head Neck Surg* 2007; 137:487–491.
- A retrospective study was performed on 42 recurrent laryngeal carcinomas: histologic findings were compared with the findings of the different preoperative diagnostic modalities.
- 9 Zbären P, Caversaccio M, Thoeny HC, *et al.* Radionecrosis or tumor recurrence after radiation of laryngeal and hypopharyngeal carcinomas. *Otolaryngol Head Neck Surg* 2007; 135:838–843.
- Chondroradionecrosis is an uncommon treatment complication: tumor recurrence may be present beneath intact mucosa and missed by endoscopic evaluation.
- 10 Bradley PJ, Ferlito A, Suarez C, *et al.* Options for salvage after failed initial treatment of anterior vocal commissure squamous carcinoma. *Eur Arch Otorhinolaryngol* 2006; 263:889–894.
- 11 Thoeny HC, Delaere PR, Hermans R. Correlation of local outcome after partial laryngectomy with cartilage abnormalities on CT. *AJNR Am J Neuroradiol* 2005; 26:674–678.
- 12 Becker M. Neoplastic invasion of laryngeal cartilage: radiologic diagnosis and therapeutic implications. *Eur J Radiol* 2000; 33:216–229.
- 13 Esclamado R, Day T, Flint P, Strome M. Recurrent glottic cancer. *Head Neck* 2007; 29:609–614.
- This reports on an interesting and detailed roundtable with a consultant and three experts regarding the rational salvage approaches to a case of recurrent glottic carcinoma after radiotherapy failure. The section regarding correct carcinoma recurrence correct staging is remarkable.
- 14 Knappe M, Louw M, Gregor RT. Ultrasonography-guided fine needle aspiration for the assessment of cervical metastases. *Arch Otolaryngol Head Neck Surg* 2000; 126:1091–1096.
- 15 Session RB, Picken CA. Malignant cervical adenopathy. In: Cummings CW, Fredrickson JM, Harker LA, *et al.*, editors. *Otolaryngology head and neck surgery*. St Louis: Mosby-Year Book; 1998. pp. 737–757.
- 16 Holsinger FC, Funk E, Roberts DB, Diaz DM. Conservation laryngeal surgery versus total laryngectomy for radiation failure in laryngeal cancer. *Head Neck* 2006; 28:779–784.

- 17** Piazza C, Peretti G, Cattaneo A, *et al.* Salvage surgery after radiotherapy for laryngeal cancer: from endoscopic resections to open-neck partial and total laryngectomies. *Arch Otolaryngol Head Neck Surg* 2007; 133:1037–1043.

The authors discussed the results of 71 patients with laryngeal carcinoma previously treated with radiotherapy (69 patients) and chemoradiotherapy (two patients) who underwent salvage surgery. The authors concluded that the survival rates of their series were not different from those previously reported using a more aggressive surgical approach without organ preservation.

- 18** Motamed M, Laccourreye O, Bradley PJ. Salvage conservation laryngeal surgery after irradiation failure for early laryngeal cancer. *Laryngoscope* 2006; 116:451–455.
- 19** Rifai M, Heiba MH, Salah H. Anterior commissure carcinoma II: the role of salvage supracricoid laryngectomy. *Am J Otolaryngol* 2002; 23:1–3.
- 20** Steiner W, Vogt P, Ambrosch P, Kron M. Transoral carbon dioxide laser microsurgery for recurrent glottic carcinoma after radiotherapy. *Head Neck* 2004; 26:477–484.
- 21** Rizzotto G, Succo G, Lucioni M, Pazziaia T. Subtotal laryngectomy with tracheohyoidopexy: a possibile alternative to total laryngectomy. *Laryngoscope* 2006; 116:1907–1917.
- 22** Marioni G, Marchese-Ragona R, Pastore A, Staffieri A. The role of supracricoid partial laryngectomy for glottic carcinoma recurrence after radiotherapy failure. A critical review. *Acta Otolaryngol (Stockh)* 2006; 126:1245–1251.
- 23** Farrag T, Koch WM, Cummings CW, *et al.* Supracricoid laryngectomy outcomes: the John Hopkins experience. *Laryngoscope* 2007; 117:129–132.

The authors reviewed 24 consecutive cases of SCL performed in a 5-year period. Ten of them had their SCL for post-radiotherapy recurrence/persistence of disease.

- 24** Hofmann-Saguez MR. Laryngectomie subtotale conservatrice. *Ann Otolaryngol* 1950; 67:811–816.

- 25** Pellini R, Pichi B, Ruscito P, *et al.* Supracricoid partial laryngectomies after radiation failure: a multiinstitutional series. *Head Neck* 2007; 30 Oct [Epub ahead of print].

A multiinstitutional series of 78 cases of SCL for carcinoma recurrence after radiotherapy: a significant number of these case were previously reported in single-institution experiences. After their analysis, the authors concluded that SCLs as salvage treatment modalities after radiotherapy failure should be considered as an effective tool in the modern surgical armamentarium.

- 26** Marioni G, Marchese-Ragona R, Ottaviano G, Staffieri A. Supracricoid laryngectomy. Is it time to define guidelines to evaluate functional results? A review. *Am J Otolaryngol* 2004; 25:98–104.
- 27** Laccourreye O, Weinstein G, Naudo P, *et al.* Supracricoid partial laryngectomy after failed laryngeal radiation therapy. *Laryngoscope* 1996; 106:495–498.
- 28** Pellini R, Manciocco V, Spriano G. Functional outcome of supracricoid laryngectomy with cricothyroidopexy. Radiation failure vs previously untreated cases. *Arch Otolaryngol Head Neck Surg* 2006; 132:1221–1225.
- 29** Leon X, Lopez M, Garcia J, *et al.* Supracricoid laryngectomy as salvage surgery after failure of radiation therapy. *Eur Arch Otorhinolaryngol* 2007; 264:809–814.

The authors reported oncological and functional results of nine consecutive patients treated with SCL for glottic-supraglottic carcinoma recurrence after radiotherapy.

- 30** Sewnaik A, Meeuwis CA, Van Der Kwast TH, Kerrebijn JDF. Partial laryngectomy for recurrent glottic carcinoma after radiotherapy. *Head Neck* 2005; 27:101–107.
- 31** Farrag TY, Lin FR, Cummings CW, *et al.* Neck management in patients undergoing postradiotherapy salvage laryngeal surgery for recurrent/persistent laryngeal cancer. *Laryngoscope* 2006; 116:1864–1866.
- 32** Marioni G, Marino F, Bertolin A, *et al.* Survivin expression in laryngeal squamous cell carcinomas and neck lymph node metastases. *Anticancer Res* 2006; 26:3813–3818.