

# Analyses of functional and oncologic outcomes following supracricoid partial laryngectomy

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Received: 5 August 2014 / Accepted: 21 October 2014 / Published online: 31 October 2014  
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**Abstract** To review the functional and oncologic outcomes of patients who received supracricoid partial laryngectomy (SCPL) with cricohyoidoepiglottopexy (CHEP) or cricohyoidopexy (CHP) in our institution. A total of 208 patients who received SCPL with CHEP or CHP from our institution from 1995 to 2007 were involved. Among them, 190 cases were patients with squamous cell carcinoma of the larynx (T1–T4, N0–N2), 14 cases were patients with recurrent larynx cancer and 4 cases were patients with laryngeal stenosis. Forty-four patients also received unilateral neck dissection, and 41 patients received a bilateral neck dissection. All patients were assessed at functional outcome and complications of their treatment. Also, the oncologic outcomes, such as disease-specific survival, total survival, and local recurrence, were measured for patients with tumor. Decannulation was achieved in nearly all patients, with the average time to decannulation being  $20 \pm 11.52$  days in CHEP patients and  $28 \pm 8.92$  days in CHP patients ( $P < 0.05$ ). The average nasogastric tubes were removed, days postoperation, was  $18 \pm 7.39$  days in CHEP patients and  $25 \pm 13.87$  days in CHP patients ( $P < 0.05$ ). The 5-year local recurrence rate was 5.77 %, the 5-year disease-specific survival was 82.7 %, and the 5-year overall survival was 84.1 %. The patients with CHEP had a better recovery than the patients with CHP. SCPL was a well-tolerated procedure with generally good functional outcomes for patients with advanced laryngeal cancer, also for some patients with laryngeal stenosis.

**Keywords** Supracricoid partial laryngectomy · Aspiration · Laryngeal functional reconstruction · Cricohyoidoepiglottopexy · Cricohyoidopexy

## Introduction

Laryngeal cancer is a relatively common malignant tumor occurring in the head and neck area and accounting for approximately 5 % of all tumors [1]. Historically, a total laryngectomy has been the primary choice of surgical treatment for advanced tumors of the larynx. However, this procedure brings huge pain and inconvenience to patients, including creation of a permanent tracheostoma and loss of natural voice. Therefore, various treatment modalities have been applied to preserve laryngeal function such as radiation therapy or chemoradiation therapy [2, 3]. Also, many alternative surgical techniques, such as supracricoid partial laryngectomy (SCPL), have been developed to take place of a total laryngectomy when treated with laryngeal cancer, and may be used in patients as a salvage procedure after radiation therapy [4–6]. Since the inception of the SCPL, this surgical technique has been refined in Europe as the primary surgical therapy for intermediate and advanced stage laryngeal cancer. Laccourreye and Weinstein [7, 8] first introduced the technique in English in 1990. Currently, SCPL is still widely used for the treatment of glottic cancer and supraglottic cancer [9]. Additionally, these procedures can be used for those who have failed radiotherapy or for those who have recurred following laser or surgical treatment [10–13].

Compared with Europe, the data of functional and oncologic outcomes following SCPL in China were limited, consisting of smaller series and shorter follow-up times. In this study, we present a large single institutional review

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analyzing the oncologic results and basic functional outcomes of SCPL in Northeast China.

## Materials and methods

### Ethical consideration

The study was approved by China Medical University Ethical Committee.

### Clinical data

A total of 208 patients (187 males and 21 females) were enrolled in the present study with an average age of  $57.75 \pm 8.98$  years (range 42–79 years). All patients received SCPL from 1995 to 2007 in the First Affiliated Hospital of China Medical University. According to the classification criteria set by the Union for International Cancer Control in 2002, 62 patients were diagnosed with supraglottic cancer (45 with stage T2, 15 with T3, and 2 with T4) and 128 with glottic cancer (59 with T1b, 51 with T2, 17 with T3, and 1 with T4). All of these patients had bilateral vocal cord involvement. Among these patients, 149 patients were categorized as N0, 28 as N1, and 13 as N2; all were confirmed by pathology. The other 14 patients had recurrent laryngeal cancer following laser treatment, other kinds of partial laryngectomy, or radiotherapy. Three patients had laryngeal stenosis after laser treatment, and 1 had glottic adhesion and laryngeal stenosis secondary to laryngeal trauma. Most details about patients can be found in Table 1.

### Surgical procedures

Supracricoid partial laryngectomy was classified according to the type of reconstruction: cricothyroidopiglotomy (CHEP) and cricothyroidopexy (CHP) [14]. One-hundred thirty-six patients received CHEP and 72 patients received CHP. Unilateral or bilateral arytenoid cartilage was preserved if possible. If the epiglottic root was also involved, the lesion part of the epiglottis was also resected. The hyoid bone was resected and the lingual root (or with the incisal edge of the epiglottis) was pulled forward to connect to the submental muscle. To repair the neolarynx, the transverse incisal edge of the postcricoid mucosa was sewn with the internal incisal edge of cricoid cartilage. Next, 3–4 vicryl polyglactin 910 absorbable sutures were threaded across the cartilaginous ring in 1/4 of the anteriorcricoid mucosa. The needle was inserted along the lingual root (or with the epiglottis) and drawn out from the submental muscles to the anastomose cricoid cartilage, lingual root, and submental muscles.

**Table 1** Characters of patients

| Characteristic                  | No. of patients (%) |
|---------------------------------|---------------------|
| Sex                             |                     |
| Male                            | 187 (89.9)          |
| Female                          | 21 (10.1)           |
| Age (years)                     |                     |
| Mean (SD)                       | 57.75 (8.98)        |
| Tumor site and T classification |                     |
| Supraglottic                    | 62 (29.8)           |
| T <sub>2</sub>                  | 45 (72.6)           |
| T <sub>3</sub>                  | 15 (24.2)           |
| T <sub>4</sub>                  | 2 (3.2)             |
| Glottic                         | 128 (61.5)          |
| T <sub>1b</sub>                 | 59 (46.1)           |
| T <sub>2</sub>                  | 51 (39.8)           |
| T <sub>3</sub>                  | 17 (13.3)           |
| T <sub>4</sub>                  | 1 (0.8)             |
| Recurrent                       | 14 (6.7)            |
| Laryngeal stenosis              | 4 (1.9)             |
| N classification                |                     |
| N0                              | 149 (78.4)          |
| N1                              | 28 (14.7)           |
| N2                              | 13 (6.8)            |
| Reconstruction                  |                     |
| CHEP                            | 136 (65.4)          |
| CHP                             | 72 (34.6)           |
| Neck dissection                 |                     |
| Unilateral                      | 44 (21.2)           |
| Bilateral                       | 41 (19.7)           |

SD standard deviation, CHEP cricothyroidopiglotomy, CHP cricothyroidopexy

According to the site of T and the status of N, 44 and 41 patients received unilateral or bilateral neck dissection, respectively (selective or modified radical). A nasogastric feeding tube was always placed and a tracheostomy was always performed. The nasogastric tube was removed after the patient regained swallow function of both solids and liquids without aspiration. After that, the tracheostomy tube was removed and the stoma was closed if the patient tolerated it well without dyspnea.

### Statistical methods

The *t* tests analyses were used as appropriate to identify significant differences in functional variables between the CHEP and CHP groups. The 5-year recurrence and survival rates were determined using the Kaplan–Meier method. *P* < 0.05 was deemed to indicate statistical significance. All the analyses were performed using a commercially

available software program (SPSS version 13.0; IBM Corporation, USA).

## Results

### Complication

There were no serious complications postoperation. No patients died during surgery or during the hospitalization period postsurgery. Seven cases (3.37 %) experienced slight wound infection. No skin flap necrosis, pexy rupture, or pharyngeal fistula occurred. Fifteen patients (7.21 %) had aspiration pneumonia from complications of swallowing; all of them were treated and cured with anti-inflammatory therapy without further complications. Two patients (0.97 %) had hematoma. One patient (0.48 %) had a laryngeal stenosis and refused to receive a second surgery resulting in long-term tracheostomy.

### Pronunciation

After surgery, all patients underwent voice therapy to optimize the functional results provided by the new larynx configuration. Self-evaluation of voice was performed by patients at 6 months postoperation, using Voice Handicap Index questionnaire (VHI) [15]. The VHI is a validated voice-specific quality of life questionnaire consisting of 30 questions focusing on voice disorder in daily life. The questionnaire rated from zero to four, according to the severity of symptoms (“good”, “reasonable”, “poor”, and “severe”). A higher VHI score indicated a higher level of voice-related problems.

In this study, all patients experienced full vocabulary pronunciation recovery. Upon comparison between CHEP ( $49.52 \pm 10.38$ ) and CHP ( $51.63 \pm 8.79$ ) groups, we noticed the scores of VHI were not statistically different ( $P = 0.571$ ). If arytenoid cartilages were preserved, pronunciation was often clearer but the VHI was not improved statistically ( $P = 0.438$ ).

### Aspiration

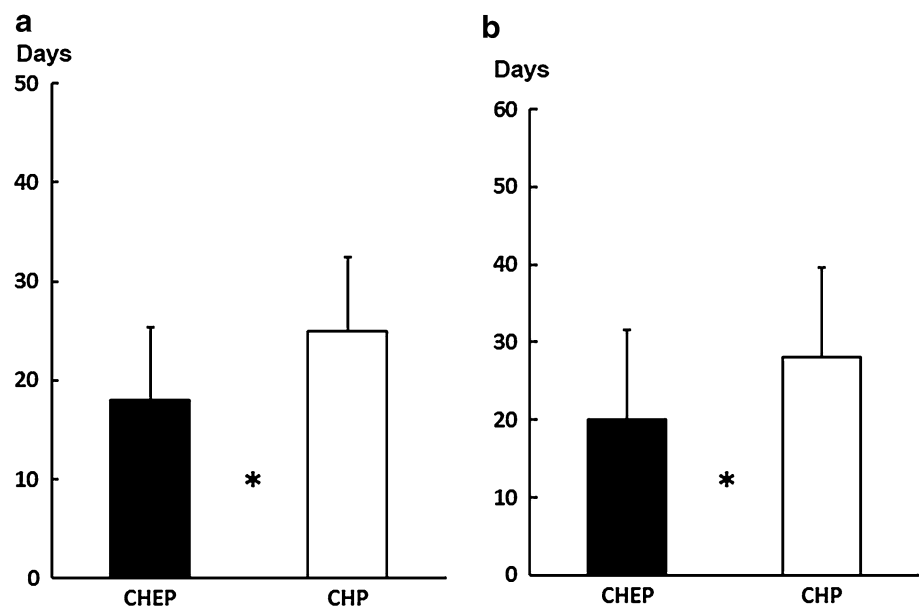
All patients began to practice swallowing from 10 days postsurgery and the aspiration was assessed daily until the aspiration disappeared, then the nasogastric tube was removed. Of the 136 patients with CHEP, 27 had no aspiration, 89 had slight aspiration, and 20 had moderate aspiration. After patients achieved normal oral deglutition without aspiration, the nasogastric tube removed. The average nasogastric tube removed days postoperation was  $18 \pm 7.39$  days.

All 72 patients with CHP showed different degrees of aspiration: slight in 30 patients, moderate in 39 patients, and severe in 3 patients. For the three patients with severe aspiration, the silica gel tube was used to assist with food consumption. After 2 months, severe aspiration disappeared, and the nasogastric tube was removed at an average of  $25 \pm 13.87$  days postsurgery. As shown in Fig. 1a, the patients with CHEP had better swallow functional recovery than patients with CHP had ( $P = 0.034$ ).

### Decannulation

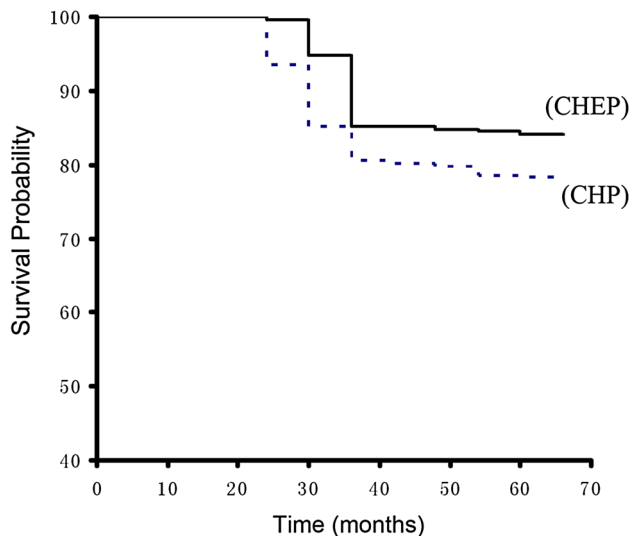
After the nasogastric tube was removed, the tube for tracheostomy was also prepared to be removed according to

**Fig. 1** The functional recovery of patients. Patients were grouped into CHEP (shown in black) and CHP (shown in white), which both were shown on the x axis. The y axis indicates the number of nasogastric tube removed days (a) or decannulation days (b) postoperation in each group (\* $P < 0.05$ )



**Table 2** Oncologic outcomes of patients

| Oncologic outcomes             | CHEP | CHP |
|--------------------------------|------|-----|
| Death caused by cancer         | 7    | 9   |
| Death caused by other diseases | 5    | 9   |
| Local recurrence               | 7    | 5   |
| Regional metastasis            | 3    | 4   |
| Distant metastasis             | 9    | 12  |
| Second primary tumor           | 5    | 3   |



**Fig. 2** Five-year overall disease-specific survival rate of patients. The *black line* represents the survival of the CHEP group. The *blue lines* represent the survival of the CHP group ( $P > 0.05$ )

the breathing status. Of the 136 patients with CHEP, 135 were decannulated (99.3 %), with average decannulation achieved by  $20 \pm 11.52$  days. One patient who did not receive decannulation had a thick postcricoid mucosa in the inlet of the remnant larynx and refused to receive a second surgery for reconstruction.

The decannulation rate of patients with CHP was 100 %, with the average decannulation achieved by  $28 \pm 8.92$  days. The patients with CHEP had an earlier decannulation postsurgery than the patients with CHP had ( $P = 0.041$ , shown in Fig. 1b).

#### Follow-up and oncologic outcomes

Patients with laryngeal cancer were followed for a median of 65.4 months, with three being lost to follow-up. Details were shown in Table 2. The 5-year overall disease-specific survival of the CHEP (84.15 %) and CHP (78.18 %) groups had no significant difference between them ( $P = 0.092$ , as shown in Fig. 2). The overall disease-

specific survival for all patients was 82.7 %, and the overall survival was 84.13 %.

#### Discussion

In this study, we reviewed the outcomes of patients with SCPL in our institution. Our results showed that SCPL is a well-tolerated procedure with generally good functional outcomes for patients with advanced laryngeal cancer, also for some patients with laryngeal stenosis. And the patients with CHEP have a better recovery than the patients with CHP.

When the SCPL have been widely used as an alternative to total laryngectomy for patients with laryngeal cancer, the successful rehabilitation of patients should also be considered, including those with both lower complications in the hospital and a good function in the long term [16]. The complications following SCPL include aspiration pneumonia, laryngocutaneous fistulas, subcutaneous emphysema, wound infection, wound hematoma, and myocardial infarction etc., which ranged from 16.3 to 34.3 % as reported [17–20]. Among them, aspiration pneumonia was reported as the most common to incur. Serious cases with aspiration pneumonia could even cause death, so some patients have to suffer a total laryngectomy to avoid aspiration [19, 21, 22]. In our patient group, there were no serious complications that occurred. Wound infection was 3.37 %, aspiration pneumonia was 7.21 %. After several weeks, they could take foods by mouth and no patient died by complications.

Good functional results translate into recovery of the three main functions of the larynx: voice, breathing, and swallowing [23, 24]. Tracheotomy decannulation and removal of gastric feeding tubes are usually reported metrics regarding the SCPL procedure indicating proper functioning of the neoglottis [12, 25, 26]. All patients in this study experienced full vocabulary pronunciation recovery. And we successfully decannulated nearly all patients with a mean time of 3–4 weeks after surgery. Compared with most studies, reporting a mean time of decannulation around 5–6 weeks [27, 28], the mean time until decannulation of this patient group was not bad. Some studies have reported removing nasogastric feeding tubes from 16 days to 2.3 months after surgery [17, 25, 28]. Our data shows all patients had their nasogastric feeding tubes removed in 18–25 days after surgery on average, indicating that by this time they were able to fully support themselves on PO intake.

Our data also shows the difference of functional recovery between the CHEP group and CHP group: patients with CHEP seemed to have a shorter recovery period than those with CHP in the early postoperative

period. This difference indicated that the epiglottis was an important factor to retain or resume larynx function. But incredibly, there was no difference of the aspiration pneumonia rate after SCPL between the CHEP and CHP groups.

The oncological outcomes of this group were also acceptable. As different institutions reported that the three-year overall survival rate following SCPL ranged from 71.4 to 95.7 %, and the five-year survival rate ranged from 65 to 90 % [20, 21, 28–33]. In this study, the 5-year oncologic outcome was 84.13 %, which was in line with previous reports [21], and seems a little lower than expected. The reason may be that the survival rate of recurrence or advantage stage cases, which were most involved in this study, was lower than that of earlier stage patients.

Undoubtedly, local control is the principal objective of surgeries that aim for laryngeal preservation. The reported local recurrence rate ranged from 2.6 to 25 % [20, 21, 28–33]. The difference may be due to the patient group constitution that was selected from T1 to radiation therapy failure patients. Our patient group also includes T3, T4, and recurrence cases. So the local recurrence rate of 5.77 % was reasonable.

In conclusion, our data indicated that the patients with CHEP had a better recovery than the patients with CHP. SCPL was a well-tolerated procedure with generally good functional and oncologic outcomes for patients with advanced laryngeal cancer, also for some patients with laryngeal stenosis.

**Acknowledgments** This work was supported by Scientific Research Grants (30540080) from the National Natural Science Foundation of China and a grant from the Society for the Promotion of International Oto-Rhino-Laryngology (SPIO) of Japan.

**Conflict of interest** Authors declare no conflict of interest concerning this article.

## References

- Parkin DM, Bray F, Ferlay J, Pisani P (2005) Global cancer statistics, 2002. *CA Cancer J Clin* 55(2):74–108
- Forastiere AA, Goepfert H, Maor M, Pajak TF, Weber R, Morrison W, Glisson B, Trotti A, Ridge JA, Chao C, Peters G, Lee DJ, Leaf A, Ensley J, Cooper J (2003) Concurrent chemotherapy and radiotherapy for organ preservation in advanced laryngeal cancer. *N Engl J Med* 349(22):2091–2098
- Silver CE, Beitler JJ, Shaha AR, Rinaldo A, Ferlito A (2009) Current trends in initial management of laryngeal cancer: the declining use of open surgery. *Eur Arch Otorhinolaryngol* 266(9):1333–1352
- Majer EH, Rieder W (1959) Technic of laryngectomy permitting the conservation of respiratory permeability (cricohyoidopexy). *Les Annales d'oto-laryngologie* 76:677–681
- Luna-Ortiz K, Mosqueda-Taylor A (2006) Supracricoid partial laryngectomy as a primary treatment for carcinosarcoma of the larynx. *Ear Nose Throat J* 85(5):337–341
- Piquet JJ, Desaulty A, Decroix G (1974) Crico-hyoido-epiglottopexy. Surgical technic and functional results. *Ann Otolaryngol Chir Cervicofac* 91(12):681–686
- Laccourreye H, Laccourreye O, Weinstein G, Menard M, Brasnu D (1990) Supracricoid laryngectomy with cricohyoidoepiglottopexy: a partial laryngeal procedure for glottic carcinoma. *Ann Otol Rhinol Laryngol* 99(6 Pt 1):421–426
- Laccourreye H, Laccourreye O, Weinstein G, Menard M, Brasnu D (1990) Supracricoid laryngectomy with cricohyoidopexy: a partial laryngeal procedure for selected supraglottic and transglottic carcinomas. *Laryngoscope* 100(7):735–741
- Holsinger FC, Laccourreye O, Weinstein GS, Diaz EM Jr, McWhorter AJ (2005) Technical refinements in the supracricoid partial laryngectomy to optimize functional outcomes. *J Am Coll Surg* 201(5):809–820
- Luna-Ortiz K, Pasche P, Tamez-Velarde M, Villavicencio-Valencia V (2009) Supracricoid partial laryngectomy with cricohyoidoepiglottopexy in patients with radiation therapy failure. *World J Surg Oncol* 7:101
- Sewnaik A, Hakkesteegt MM, Meeuwis CA, de Gier HH, Kerrebijn JD (2006) Supracricoid partial laryngectomy with cricohyoidoepiglottopexy for recurrent laryngeal cancer. *Ann Otol Rhinol Laryngol* 115(6):419–424
- Pellini R, Pichi B, Ruscito P, Ceroni AR, Caliceti U, Rizzotto G, Pazziaia A, Laudadio P, Piazza C, Peretti G, Giannarelli D, Spriano G (2008) Supracricoid partial laryngectomies after radiation failure: a multi-institutional series. *Head Neck* 30(3):372–379
- Zietek E, Jaworowska E, Tarnowska C, Wasilewska M, Sieczka J (1992) Partial supra-cricoid reconstructive laryngectomy with CHP and CHEP: surgical technique and oncologic results. *Otolaryngol Pol* 46(4):379–387
- Laccourreye H, Menard M, Fabre A, Brasnu D, Janot F (1987) Partial supracricoid laryngectomy. Technics, indications and results. *Ann Otolaryngol Chir Cervicofac* 104(3):163–173
- Jacobson BH, Johnson A, Grywalski C, Silbergleit A, Jacobson G, Benninger MS, Newman CW (1997) The voice handicap index (VHI) development and validation. *Am J Speech Lang Pathol* 6(3):66–70
- Gallo A, Manciocco V, Simonelli M, Pagliuca G, D'Arcangelo E, de Vincentiis M (2005) Supracricoid partial laryngectomy in the treatment of laryngeal cancer: univariate and multivariate analysis of prognostic factors. *Arch Otolaryngol Head Neck Surg* 131(7):620–625
- Benito J, Holsinger FC, Perez-Martin A, Garcia D, Weinstein GS, Laccourreye O (2011) Aspiration after supracricoid partial laryngectomy: incidence, risk factors, management, and outcomes. *Head Neck* 33(5):679–685
- Clayburgh DR, Graville DJ, Palmer AD, Schindler JS (2012) Factors associated with supracricoid laryngectomy functional outcomes. *Head Neck* 35(10):1397–1403
- Mercante G, Grammatica A, Battaglia P, Cristalli G, Pellini R, Spriano G (2013) Supracricoid partial laryngectomy in the management of t3 laryngeal cancer. *Otolaryngol Head Neck Surg* 149(5):714–720
- Sanchez-Cuadrado I, Castro A, Bernaldez R, Del Palacio A, Gavilan J (2011) Oncologic outcomes after supracricoid partial laryngectomy. *Otolaryngol Head Neck Surg* 144(6):910–914
- Pinar E, Imre A, Calli C, Oncel S, Katilmis H (2012) Supracricoid partial laryngectomy: analyses of oncologic and functional outcomes. *Otolaryngol Head Neck Surg* 147:1093–1098
- Zhang SY, Lu ZM, Chen LS, Luo XN, Ge PJ, Song XH, Chen SH, Wu YL (2012) Supracricoid partial laryngectomy cricohyoidoepiglottopexy (SCPL-CHEP) versus vertical partial laryngectomy for the treatment of glottic carcinoma. *Eur Arch Otorhinolaryngol* 270(3):1027–1034

23. Marquez Moyano JA, Sanchez Gutierrez R, Roldan Nogueras J, Ostos Aumente P, Poyato Zamorano C (2007) Supracricoid partial laryngectomy: quality of life assessment. *An Otorrinolaringol Ibero Am* 34(1):53–66
24. Schroder U, Jungehulsing M, Klussmann JP, Eckel HE (2003) Cricohyoidopexy (CHP) and cricohyoidoepiglottopexy (CHEP). Indication, complications, functional und oncological results. *HNO* 51(1):38–45
25. Webster KT, Samlan RA, Jones B, Bunton K, Tufano RP (2010) Supracricoid partial laryngectomy: swallowing, voice, and speech outcomes. *Ann Otol Rhinol Laryngol* 119(1):10–16
26. Marioni G, Marchese-Ragona R, Pastore A, Staffieri A (2006) The role of supracricoid laryngectomy for glottic carcinoma recurrence after radiotherapy failure: a critical review. *Acta Otolaryngol* 126(12):1245–1251
27. Caicedo-Granados E, Beswick DM, Christopoulos A, Cunningham DE, Razfar A, Ohr JP, Heron DE, Ferris RL (2012) Oncologic and functional outcomes of partial laryngeal surgery for intermediate-stage laryngeal cancer. *Otolaryngol Head Neck Surg* 148(2):235–242
28. Goncalves AJ, Bertelli AA, Malavasi TR, Kikuchi W, Rodrigues AN, Menezes MB (2009) Results after supracricoid horizontal partial laryngectomy. *Auris Nasus Larynx* 37(1):84–88
29. Deganello A, Gallo O, De Cesare JM, Ninu MB, Gitti G, de' Campora L, Radici M, de' Campora E (2008) Supracricoid partial laryngectomy as salvage surgery for radiation therapy failure. *Head Neck* 30(8):1064–1071
30. Lewin JS, Hutcheson KA, Barringer DA, May AH, Roberts DB, Holsinger FC, Diaz EM Jr (2008) Functional analysis of swallowing outcomes after supracricoid partial laryngectomy. *Head Neck* 30(5):559–566
31. Park JO, Joo YH, Cho KJ, Kim NG, Kim MS (2011) Functional and oncologic results of extended supracricoid partial laryngectomy. *Arch Otolaryngol Head Neck Surg* 137(11):1124–1129
32. Pellini R, Mancio V, Spriano G (2006) Functional outcome of supracricoid partial laryngectomy with cricohyoidopexy: radiation failure vs previously untreated cases. *Arch Otolaryngol Head Neck Surg* 132(11):1221–1225
33. Soudry E, Marmor Y, Hazan A, Marx S, Sadov R, Feinmesser R (2008) Supracricoid partial laryngectomy: an alternative to total laryngectomy for locally advanced laryngeal cancers. *J Laryngol Otol* 122(11):1219–1223