

HEAD AND NECK

# Supracricoid partial laryngectomy with crico-hyoido-epiglottopexy for glottic carcinoma with anterior commissure involvement

## *La laringectomia parziale sopracricoidea con crico-ioido-pessia per il carcinoma della glottide coinvolgente la commissura anteriore*

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### SUMMARY

Glottic cancers discovered at an early stage (T1-T2) can be treated with either radiotherapy or surgery. The aim of our study is to analyse survival and functional results of supra-cricoid partial laryngectomy (SCPL) with crico-hyoido-epiglottopexy (CHEP) as surgical treatment for glottic carcinoma with anterior commissure involvement. We performed a retrospective study (1996-2013) which included patients who underwent SCPL-CHEP for glottic squamous cell carcinoma with involvement of the anterior commissure. Before surgery, all patients underwent staging including head, neck and chest CT-scan with contrast injection as well as suspension laryngoscopy under general anaesthesia. A total of 53 patients were included. The median follow-up period was 124 months. Tumour resection was complete in 96.2% of cases. The overall, specific and recurrence-free survival rates at 5 years were, respectively, 93.7%, 95.6% and 87.7%. The average period of hospitalisation was 18 days. The average time elapsed before decannulation and before restoration of oral feeding were 15 and 18 days, respectively. SCPL-CHEP is an important option for laryngeal surgical preservation. It allows adequate disease control as well as good functional results as long as the indications are well respected and the surgical techniques are mastered.

KEY WORDS: Glottic cancer • Anterior commissure • Partial laryngectomy • Survival • Functional results

### RIASSUNTO

*I tumori della glottide scoperti in fase precoce (T1-T2) possono essere trattati sia con la radioterapia, sia mediante un intervento chirurgico. Lo scopo del nostro studio è stato quello di analizzare la sopravvivenza ed i risultati funzionali della laringectomia parziale sopracricoidea con crico-ioido-epiglottopexia per trattare il carcinoma della glottide con coinvolgimento della commissura anteriore. Abbiamo condotto uno studio retrospettivo (1996-2013), che includeva pazienti sottoposti a laringectomia parziale sopracricoidea con crico-ioido-epiglottopexia per un carcinoma a cellule squamose della glottide coinvolgente la commissura anteriore. Prima dell'intervento è stato inoltre effettuato uno staging completo con TC del collo e del torace, nonché una laringoscopia diretta in sospensione in anestesia generale. 53 pazienti sono stati inclusi nel nostro studio. Il periodo mediano di follow-up è stato di 124 mesi. La resezione tumorale è stata completa nel 96,2% dei casi. I tassi di sopravvivenza, specifica e senza recidiva, a 5 anni sono stati rispettivamente 93,7%, 95,6 e 87,7%. Il periodo medio di ricovero è stato di 18 giorni. I tempi medi trascorsi prima del decannulamento e prima della ripresa dell'alimentazione per os sono stati rispettivamente 15 e 18 giorni. La laringectomia parziale sopracricoidea con crico-ioido-epiglottopexia è un'opzione importante per la conservazione chirurgica della laringe. Tale approccio consente un adeguato controllo della malattia e buoni risultati funzionali, purchè le indicazioni siano seguite pedissequamente e la tecnica chirurgica sia perfetta.*

PAROLE CHIAVE: Carcinoma della glottide • Commissura anteriore • Laringectomia parziale • Sopravvivenza • Risultati funzionali

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### Introduction

Glottic cancers discovered at an early stage (T1-T2) can be treated with either radiotherapy or surgery. Whatever the treatment, the aim is to eradicate the tumour and to maintain laryngeal functions which include phonation, breathing and swallowing to allow the best possible quality of life for patients.

Total laryngectomy is considered as an excessive treatment for T1-T2 tumours of the vocal folds, hence the development of partial surgical techniques of the larynx. Horizontal partial surgery of the larynx for glottic carcinoma was developed in the 1970s. Supra-cricoid partial laryngectomy (SCPL) or open partial horizontal laryngectomy (OPHL) type II, with crico-hyoido-epiglottopexy

(CHEP) is one of most widely used surgical techniques<sup>1</sup>. Compared to vertical partial laryngectomy (VPL), it has a low local failure rate for T1 and T2 glottic tumours with anterior commissure involvement<sup>2</sup>.

The SCPL with CHEP was first introduced in 1959 by Majer and Rieder<sup>3</sup>. The first functional results of this surgical technique were reported by Piquet et al. in 1974<sup>4</sup>. In this technique, in addition to total resection of the thyroid cartilage, both vocal folds, the paraglottic space, both ventricular folds and the infrahyoid part of the epiglottis are removed. In SCPL, at least one functional cricoarytenoid unit must be preserved<sup>5</sup>.

Since the first publications describing SCPL with CHEP, additional studies were performed to improve this surgical technique, and broadened its indication to include selected advanced stages of glottic carcinoma. Despite this, there are some reported local failures with SCPL-CHEP, which raises concern about the relevance and indication of this technique. The present retrospective study reports our experience with SCPL-CHEP in 53 cases. Our objectives were to analyse the oncologic and functional results of this technique and to compare our results with those in the literature.

## Materials and methods

We carried out a retrospective monocentric study (1995–2013) in our tertiary referral hospital. All patients were treated at the same centre.

Inclusion criteria were:

- 1) glottic squamous cell carcinoma discovered at an early stage (T1–T2) involving the anterior commissure;
- 2) no prior treatment for the glottic lesion;
- 3) a minimum of 24 months follow-up after the end of treatment.

All patients underwent staging comprising:

- 1) head and neck as well as chest CT-scan with contrast injection;
- 2) suspension laryngoscopy under general anaesthesia with laryngeal examination using 30° and 70° rigid endoscopes;
- 3) biopsies were performed during laryngoscopy;
- 4) pan-endoscopy was done under anaesthesia at the same time of the laryngoscopy to rule out synchronous lesions. A careful in-office examination of the vocal folds and arytenoid mobility was performed using transnasal flexible laryngoscopy. Extension of the lesion to the preepiglottic, paraglottic and subglottic spaces was evaluated by CT scan. All patients underwent pulmonary function tests (PFTs). In case of history of pulmonary disease and/or age > 70 years, in addition to the PFTs, patients were examined by a pulmonologist to rule out respiratory insufficiency that could contraindicate surgery.

All cases were discussed at our local head and neck cancer multidisciplinary meetings. Tumours were classified

according to the TNM classification of glottic carcinomas (UICC 2002). All patients were treated by SCPL-CHEP according to Majer and Piquet<sup>3,4</sup> technique or Guerrier technique<sup>6</sup>. All patients underwent tracheostomy during surgery. A bilateral neck dissection was performed in 43 cases.

Functional results were defined according to the following data:

- 1) time of decannulation;
- 2) time of nasogastric tube removal after ensuring through videofluoroscopy that patients recovered swallowing without inhalation with a daily oral caloric intake  $\geq$  1500 kcal;
- 3) time of discharge from the hospital.

Statistical analysis was performed using Kaplan Meier survival curves and Log-Rank comparison test with GraphPad Prism 5 software (GraphPad Software). The comparison of categorical variables and the mean ranks between different subgroups were calculated, respectively, by Fisher's exact test and Wilcoxon signed-rank test. The Kaplan Meier method was used to study survival. The log-rank test was used to compare survival curves between T1 (T1a and T1b) and T2 tumours.

## Results

Between 1996 and 2013, 53 patients underwent SCPL with CHEP (Table I). All patients presented a tumour of the vocal folds, with extension and invasion of the anterior commissure. Histological analysis of all cases showed invasive squamous cell carcinoma that was more or less differentiated. No synchronous lesion was discovered during endoscopy and no metastases were detected at initial assessment. Among patients treated using the technique of Majer and Piquet, resection of the anterior arch of the cricoid cartilage was performed in one case due to anterior subglottic extension. All patients underwent neck dissection except in 8 cases with a T1a tumour and in 2 cases with a T1b tumour (Table II).

The rate of local complications was 5.6%. Two cases of cervical abscess and one case of haematoma required drainage in the 24–72 hours postoperatively. Six patients (11.3%) presented general complications in the form of pulmonary infection (n = 5) and pulmonary embolism (n = 1). These patients showed recovery after medical treatment. No patient died during the postoperative period.

Complete tumour resection was achieved in 51 cases (96.2%). Two cases showed incomplete resection and presented 5 mm anterior subglottic extension confirmed on CT. For this reason, resection of the anterior part of the cricoid cartilage was performed in one case. Pathological examination showed massive invasion at that level and the patient underwent total laryngectomy in the two weeks following SCPL-CHEP. Surgery was followed by radiation therapy (58 Gy) targeting the surgical bed and the

**Table I.** Characteristics of the population.


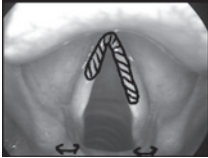
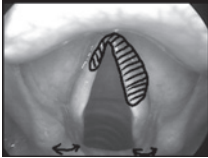
	n	%
<b>Male</b> <sup>a</sup>	53	100
<b>Smoking</b> <sup>b</sup>	46	86.7
<b>Alcohol consumption</b> <sup>c</sup>	21	39.6
<b>Classification (T)</b>		
-T1a	10	20.7
-T1b	22	43.3
-T2	21	35.8
<b>Classification (N)</b> <sup>d</sup>		
NO	53	100
<b>Surgical Technique</b>		
Surgical resection		
-Majer-Piquet <sup>†</sup>	46	86.7
-Guerrier	7	13.2
Number of preserved arytenoid cartilages		
-Two arytenoid cartilages	28	52.8
-One arytenoid cartilage	25	47.1
Neck dissection <sup>e**</sup>	43	81.1

a) Mean age 66 (38-78); b) Mean tobacco use 27 PY; c) Mean alcohol consumption 40 gr/day; d) Clinical and radiological classification; e) functional neck dissection; <sup>†</sup> partial resection of the anterior cricoid in 1 case; \*\* Neck dissection was not performed in 8 cases with T1a tumour and 2 cases with T1b tumour

level VIb lymph nodes bilaterally. For the second case, the mucoperichondrium of the anterior part of the cricoid cartilage was resected. Pathological analysis showed close surgical margins less than 2 mm. The patient received postoperative radiotherapy with 60 Gy for the surgical bed and level VIb lymph nodes bilaterally. In both cases, the remainder of lymph node levels were not irradiated given the absence of lymph node metastasis on pathological examination. Among the 43 patients who underwent neck dissection, 3 cases (6.9%) presented lymph node metastasis without capsular rupture at level III. T classification for these 3 patients was: T2 (n = 2) and T1b (n = 1). No patient was lost to follow-up. The mean follow-up period was 124 months (median = 96 months). Six cases presented local recurrence (11.3%), 12 months on average after SCPL-CHEP. Initially, 5 of these patients had a T2 tumour and 1 patient had a T1b tumour. All of these patients were treated by salvage total laryngectomy followed by radiation therapy with no local recurrence. Following laryngectomy, one of these patients presented an inoperable cervical lymph node recurrence that was treated by chemotherapy. The rest of cases (n = 52) did not show any cervical lymph node recurrence during follow-up.

During follow-up, one case showed pulmonary metastasis (1.8%), 22 months following surgery. Seven patients presented a metachronous lesion (13.2%) in the lung (n = 3), oral cavity and oropharynx (n = 2), hypopharynx (n = 1) and oesophagus (n = 1). The overall survival rate, specific survival rate and recurrence-free survival rate at 5 years, were, respectively, 93.7%, 95.6% and 87.7% (Fig. 1). We did not find any difference in survival between T1 and T2 tumours.

**Table II.** Tumour extension.

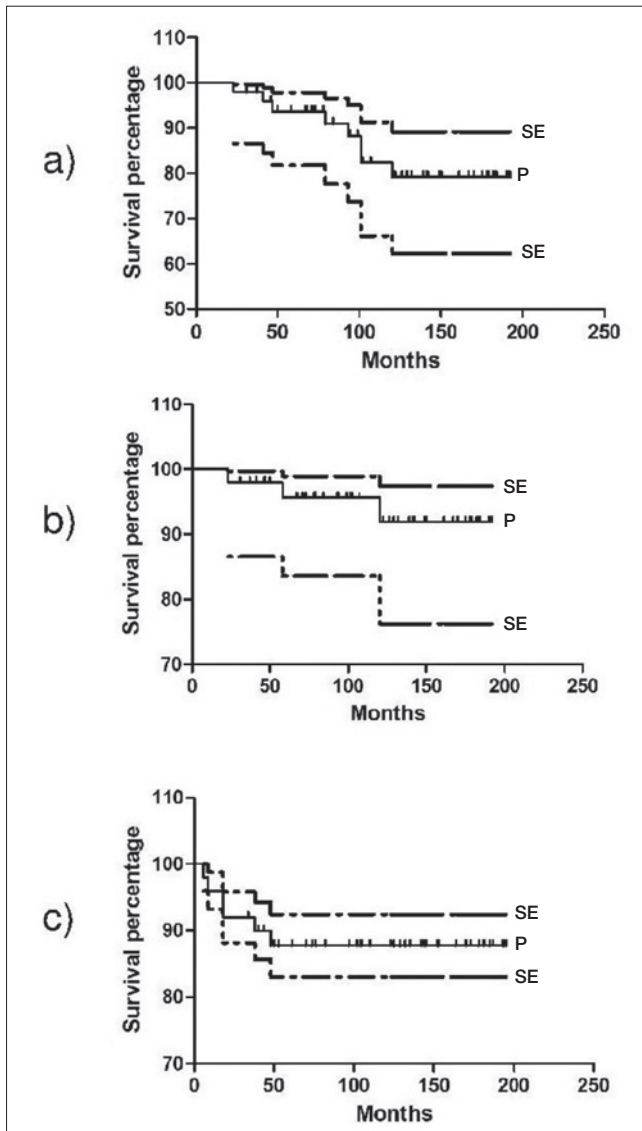
Classification (T)	Tumour extension	Endoscopic view
<b>T1a</b>	Anterior 1/3 of the vocal fold with anterior commissure involvement	
<b>T1b</b>	Tumour is limited to the anterior commissure or Tumour involves the 2 vocal folds with at least one vocal fold presenting an intact posterior 1/3	
<b>T2</b>	Tumour extends to the supraglottis and/or subglottis < 5mm Normal mobility of the vocal folds No extension to the paraglottic or pre-epiglottic space	

↔: normal vocal fold mobility

The mean period of hospitalisation was 17.8 days (15-54) with a median of 16 days. The length of hospital stay was significantly shorter for the group of patients whose age was less than the median age (p = 0.05). 98% of patients (n = 52) were able to restore oral feeding without aspiration. The average time to achieve caloric intake  $\geq$  1500 kcal/24 h was 21 days (8-45) with a median of 14 days. This period was independent of the number of cricoarytenoid units preserved during SCPL-CHEP, but it was significantly shorter in younger patients (p = 0.04). One patient underwent gastrostomy tube placement due to local recurrence that was treated by total laryngectomy and radiotherapy. The patient maintained gastrostomy tube feeding for 12 months after laryngectomy because he presented delayed surgical wound healing, followed by pharyngeal stenosis.

All patients were decannulated. The mean time elapsed before decannulation was 15 days (8-53) with a median of 13 days. One patient underwent endoscopic resection of a mucous flap on the side of the resected arytenoid cartilage to allow decannulation. As for restoration of oral feeding, the time elapsed before decannulation was independent of the number of preserved cricoarytenoid units, but it was also significantly shorter in the group of younger patients (p = 0.05).

Long-term functional results showed that two patients presented with repeated aspiration pneumonia due to impaired swallowing and frequent choking episodes. One case showed improvement on speech therapy. Thickened liquids were also used to improve bolus control and helped prevent aspiration. The second case did not improve on



**Fig. 1** Kaplan Meier survival curves. a) overall survival rate. b) specific survival rate. c) recurrence-free survival rate. P: percentage, SE: standard error.

speech therapy and required gastrostomy feeding tube placement. All patients were able to phonate audibly after SCPL-CHEP. No voice handicap index questionnaire was filled out by patients.

## Discussion

T1 and T2 glottic carcinomas can be treated by radiotherapy or surgery<sup>7</sup>. The advantages of radiation therapy are that it preserves the anatomical structures of the larynx and thus better voice quality is maintained<sup>8</sup>. In the literature, for T1 tumours, the local control rate is 89.5% at 5 years with radiotherapy alone<sup>9</sup>. After salvage surgery which is usually not conservative, the final local control rate is between 90% and 95%. In our series, we did not observe any local recurrence in patients with T1a tumours involving the anterior commissure. On the other hand, one

patient with a T1b tumour presented local recurrence, for a local failure rate of 4.5%, which is slightly lower than that reported in the literature<sup>6</sup>. For T2 tumours, the local failure rate of radiotherapy is between 25% and 30% and the local control rate reaches 90% after non-conservative salvage surgery<sup>9,10</sup>. In our series, the local failure rate for T2 tumours is 23.8% and the local control rate reaches 100% after salvage surgery followed by radiotherapy. Our results show better local control rates than those of radiotherapy alone or salvage surgery after radiotherapy<sup>11,12</sup>. Several factors affect the local control rate in case of exclusive treatment by radiotherapy of glottic tumours: male patients, low level of haemoglobin, radiotherapy dose-time fractionation, tumour volume, differentiation degree of the tumour and extension to the anterior commissure and/or to the subglottis<sup>7,13,14</sup>. The local control rate of T2 tumours extending to the anterior commissure treated by radiotherapy is between 15% and 40%<sup>15,16</sup>. These unsatisfactory results of local control rate of tumours involving the anterior commissure treated exclusively by radiotherapy can be explained by two factors: the difficulty to evaluate clinically and radiologically the extension depth of the tumour to the cricothyroid membrane as well as to the thyroid cartilage, and the technical difficulties to irradiate this part of the larynx<sup>17</sup>. However, with the emergence of intensity modulated radiation therapy (IMRT), one could ask if there is better disease local control in tumours extending to the anterior commissure. In addition, there are many concerns that IMRT under-doses the anterior commissure, but it has been shown that with careful treatment planning this can be avoided. Moreover, some studies showed that IMRT provides at least equal overall coverage of the entire larynx compared to 2D techniques<sup>18</sup>. These data as well as the impact of IMRT on local control rate need to be confirmed by further studies.

For many years, VPL represented the only conservative surgical treatment for T1 and T2 glottic tumours. VPL, is called this because of the vertical thyrotomy carried out for tumour excision. It involves three type of resections: cordectomy, hemiglottectomy and fronto-lateral hemilaryngectomy. These resections are not well adapted in case of massive involvement of the anterior commissure. In fact, they do not allow adequate excision of the cricothyroid membrane, the thyroid cartilage or the anterior part of the paraglottic space even if a fronto-lateral hemilaryngectomy is performed, which results in a high local recurrence rate at the level of the thyroid cartilage and pre-laryngeal tissue. The local recurrence rates following VPL are, respectively, 13.1% and 22.3% for T1b and T2 glottic lesions<sup>19</sup>. SCPL with CHEP according to the technique of Majer and Piquet or Guerrier allows optimal resection of glottic tumours. It enables adequate tumour resection in case of massive involvement of the anterior commissure and/or less than 5 mm extension to the subglottis. The near total laryngectomy with epiglottic reconstruc-

tion according to the Tucker technique<sup>20</sup> is an alternative to SCPL-CHEP. It has a common point with the SCPL according to the Guerrier technique, of preserving the posterior part of the thyroid cartilage and not to dissect the pyriform sinus mucosa. These two techniques differ by the reconstruction procedure; the first uses the epiglottis to reconstruct the anterior part of the resected thyroid cartilage, and the second performs a CHEP for anterior laryngeal reconstruction<sup>6</sup>. Local control rates for T1 and T2 carcinoma of the vocal folds treated by the Tucker technique and SCPL are equivalent. They vary between 90% and 95% for T1 tumours and from 80% to 90% for T2 tumours. These rates exceed 95% if we take into consideration salvage surgery by total laryngectomy<sup>6 21</sup>.

The recurrence-free survival rate at 5 years that we achieved in our study (87.7%) is consistent with literature data on SCPL-CHEP (80% to 86.8%)<sup>6 22 23</sup>. The lack of a significant survival difference between the group of patients with T1 and T2 tumours has also been reported in the literature<sup>6</sup>. Disease control failure can be local, regional (lymph nodes) and general (metastasis). In our study, when we analysed the 6 cases in whom we performed total laryngectomy salvage surgery, 4 patients (66.6 %) had a subglottic extension more than 5 mm. Tumour extension to the subglottis is considered as a limitation for the indication of SCPL and any extension to the subglottis more than 5 mm is considered as a contraindication for this type of surgery; otherwise, a supratracheal partial laryngectomy should be performed with different functional and oncologic outcomes<sup>6 24</sup>. The regional recurrence rate is very low in our experience (1.8%) which is concordant with the literature (1.2% to 5.7%)<sup>6 25</sup>. Metastatic lesions are also rare in our series (1.8%), which is consistent with the experience of other teams<sup>6</sup>. On the other hand, our cohort had 13.2% of metachronous lesions which is higher than the mean rate reported in the literature (9.8%)<sup>6 25 26</sup>. This relatively high rate is probably due the high life expectancy of patients treated for T1-T2 glottic carcinomas. Currently, endoscopic laser surgery and transoral robotic surgery represents an alternative to open surgery<sup>27 28</sup>. For transoral robotic surgery, we do not have enough hindsight to determine the effectiveness of this treatment, especially in T1 and T2 tumours with anterior commissure involvement. Concerning laser surgery, it should be done by an experienced surgeon. One of the limiting factors of laser surgery is the quality of exposure of the larynx and in particular the anterior commissure<sup>28</sup>. In many cases, in order to facilitate laryngeal exposure, neck hyperextension and the use of curare may be necessary<sup>28</sup>. For patients with poor endoscopic laryngeal exposure, SCPL should be considered as an alternative to endoscopic laser resection of lesions extending to the anterior commissure to ensure the best possible resection quality. Laser resection represents a type IV cordectomy extended to one or both vocal folds. Treatment of T2 tumours by laser re-

section shows a local control rate of 85%<sup>29 30</sup>. This rate reaches 90% after taking into account salvage surgery or radiotherapy performed to treat local recurrence after endoscopic laser resection<sup>29-31</sup>. The two main factors influencing local control are involvement of the anterior commissure and extension to the laryngeal ventricle. It appears that local disease control is better with surgery, without any difference between endoscopic and open surgery, in contrast to radiotherapy that shows a lower local control rate, especially when the tumour extends to the anterior commissure and/or to the subglottis. Salvage surgery following radiotherapy allows local control optimisation, but unfortunately it is usually non-conservative surgery. The very low rate of histological lymph node metastasis allows considering not to perform neck dissection in patients with no clinical and radiological adenopathy, but adequate clinical and radiological (CT-scan) follow-up should be done.

In our study, we analysed the early functional results of SCPL-CHEP. The results that we obtained are satisfactory and concordant with literature data<sup>32</sup>. All patients were decannulated and 98% of patients restored oral feeding with adequate daily caloric intake. In the literature, the average time for nasogastric feeding tube removal is 15 to 19 days<sup>6 25</sup> in comparison to 21 days (median=14 days) in our series. One patient had a gastrostomy feeding tube (1.8%) for a local recurrence with delayed surgical wound healing after salvage laryngectomy and radiotherapy. In the literature, the rate of permanent gastrostomy feeding tube placement is 1.2%<sup>6</sup>. In all published series, the authors emphasise the risk of postoperative aspiration pneumonia and swallowing difficulties especially in elderly patients. This point is consistent with our results and we think that PFTs should be systematic for all patients. Moreover, we insist that patients older than 70 years should be referred to pulmonary consultation before making the decision whether to perform partial laryngeal surgery. Our results showed that the number of preserved cricoarytenoid units does not affect the time or quality of swallowing restoration. In our series, the average time of decannulation was 15 days, which is quite consistent with the literature<sup>6 12</sup>. As for restoration of oral feeding, the time elapsed before decannulation was significantly shorter in the group of younger patients. We found no series that discusses the need to maintain a tracheotomy tube in the setting of SCPL-CHEP. In contrast, the percentage of patients with a tracheotomy after radiotherapy is between 0.5% and 2.2%<sup>9 10</sup>. Moreover, when performing partial laryngeal surgeries with an external approach, complete tumour resection should be a main goal in order to avoid adjuvant radiotherapy toxicity, which is usually considered a relevant issue and can be associated with delayed decannulation due to the development of supraglottic stenosis<sup>33</sup>. The short period of hospitalisation (17.8 days) in our study is explained by the fact that young patients

show a rapid decannulation and restoration of oral feeding periods. In the literature, the functional outcomes in case of endoscopic laser resection seem to be better whatever the size of the tumour (T1-T2), with a low percentage of tracheotomy and swallowing disorders and shorter hospital stay<sup>31,33</sup>. Nevertheless, the number of published series for T1 and T2 tumours with anterior commissure involvement treated by endoscopic laser resection is still low with selected cases and restricted cohorts of patients.

## Conclusions

SCPL with CHEP is an important option for laryngeal surgical preservation, especially for tumours with anterior commissure involvement and/or subglottic extension less than 5 mm. It allows adequate disease control and good functional results as long as the indications are well respected and the surgical techniques are mastered.

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