PARTIAL LARYNGECTOMY FOR RECURRENT GLOTTIC CARCINOMA AFTER RADIOThERAPY

Aniel Sewnaik, MD,1 Cees A. Meeuwis, MD, PhD,1 Theo H. van der Kwast, MD, PhD,2 Jeroen D. F. Kerrebijn, MD, PhD1

1 Department of Otolaryngology Head and Neck Surgery of the Erasmus Medical Center, Dr. Molenwaterplein 40, 3015 GD Rotterdam, The Netherlands. E-mail: a.sewnaik@erasmusmc.nl
2 Department of Pathology of the Erasmus Medical Center, Rotterdam, The Netherlands

Accepted 5 July 2004
Published online 4 November 2004 in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/hed.20125

Abstract: Background. Early laryngeal cancer is treated with surgery or radiotherapy. A partial laryngectomy instead of a total laryngectomy can be used for treating patients with radiation failures.

Methods. Patients were grouped by the two types of partial laryngectomies we performed: group I, endoscopic laser surgery (n = 42); and group II, frontolateral partial laryngectomy (n = 21).

Results. With CO2 laser treatment, 14 of 24 patients (no involvement of the anterior commissure) and eight of 18 patients (involvement of the anterior commissure) were cured. With the frontolateral partial laryngectomy, we achieved local control in 15 of 21 patients.

Conclusions. If the surgeon is familiar with the different techniques of, and indications for, partial laryngectomy, this can be a good and satisfying treatment in selected patients with radiation failure for glottic cancer. © 2004 Wiley Periodicals, Inc. Head Neck 27: 101–107, 2005

Keywords: glottic recurrent laryngeal cancer; radiotherapy; partial laryngectomy; endoscopic laser surgery; frontolateral partial laryngectomy

Correspondence to: A. Sewnaik

Abstract: Background. Early laryngeal cancer is curable with either radiotherapy or surgery.1 The aim of the treatment is tumor control with maximal preservation of function.2 In most centers in northern Europe and North America, radiotherapy is the primary treatment for patients with small laryngeal tumors.3 The main argument for the choice of this kind of treatment is the supreme posttreatment quality of voice.1,4,5 Local recurrences after radiotherapy for glottic lesions occur in 5% to 20% for T1 tumors and 25% to 30% for T2 tumors.6 Once a recurrence is confirmed by histologic examination, a surgical salvage procedure is the only chance of cure. This can be either a total laryngectomy or a partial laryngectomy, the latter through an external approach or an endoscopic (laser) procedure. A total laryngectomy is often performed because a wide surgical margin can be obtained, and modern speech prostheses allow an adequate functional rehabilitation. However, in selected patients, sufficient surgical margins can be obtained with a partial laryngectomy, so that these patients retain their own functional larynx. Unlike total laryngectomy, a partial laryngectomy is not a defined operation but merely a common
denominator for a variety of procedures all aimed at preserving part of the larynx. These procedures include endoscopic laser resection, horizontal (supraglottic partial procedures), vertical (hemilateral, frontolateral) partial laryngectomy, and supraccricoid procedures (cricohyoidoepiglottopexy, cricohyoidopexy). The goal of this study was to review the oncologic and functional results, the indications, and the complications of various partial procedures for glottic recurrences after radiotherapy.

**MATERIAL AND METHODS**

Between 1980 and August 2002, 63 partial laryngectomies were performed at the department of Otolaryngology Head and Neck Surgery of the Erasmus Medical Center Rotterdam in The Netherlands for recurrent (after previous radiotherapy) or second primary carcinomas of the larynx. Previous treatment had consisted of radiation of 66 to 70 Gy, in 2-Gy fractions, five to six times per week. The patients were grouped according to the two types of partial laryngectomies we performed: group I, endoscopic laser surgery \( n = 42 \); and group II, frontolateral partial laryngectomy \( n = 21 \). Before 1997, most patients were treated with laser surgery, because external procedures were not routinely performed during this period. The medical records were studied for oncologic and functional follow-up, postoperative complications, length of rehabilitation, and other clinical information. From 1997 forward, both operative reports and information concerning rehabilitation were recorded on standard forms. Patients treated with a frontolateral laryngectomy received a questionnaire to assess swallowing and difficulties with their voice. These questionnaires were sent out at least 3 months after surgery. All recurrent tumors were squamous cell carcinomas except for one undifferentiated carcinoma.

Routine workup before salvage surgery consisted of a chest x-ray and ultrasonography of the neck, if indicated, combined with fine-needle aspiration. CT scans of the larynx were performed in only a minority of patients.

**Group I, CO₂ Laser Surgery \( n = 42 \).** The indications for laser surgery are listed in Table 1. The intent of the procedure was cure of disease in all patients. The group consisted of 40 men and two women, ranging from 45 to 79 years of age. The primary tumor had been classified as Tis in four patients, T1 in 34 patients, and T2 in four patients. Thirty-five patients had a recurrent glottic tumor, and seven patients had a second primary glottic laryngeal tumor. The period of recurrence after radiation therapy ranged from 5 months to 14 years.

Surgery was carried out with the patient under general anesthesia with use of high-frequency jet ventilation. The face and eyes of the patient are protected from laser reflections with wet gauze. The tumor is excised by use of laser settings between 5 and 10 watts at an intermittent or continuous pulse. Frozen sections are not routinely used for reasons that will be discussed later. Antibiotics are not given unless a significant amount of cartilage is exposed. Postoperatively, oral feeding is started immediately, and the patient is usually discharged the day after the operation.

**Group II, Frontolateral Laryngectomy \( n = 21 \).** Indications for frontolateral laryngectomy are listed in Table 2. All patients were men, with an age range of 48 years to 94 years. The primary tumor had been classified as Tis in two patients, T1 in 12 patients, and T2 in seven patients. Nineteen patients had a recurrent glottic tumor, and two patients had a second primary glottic laryngeal tumor. The period of recurrence after radiation therapy ranged from 4 months to 32 years.

The technique of a frontolateral laryngectomy is described by Weinstein and Laccourreye. It must, however, be kept in mind that after radiotherapy, the tissues are more susceptible to edema and necrosis, and some modifications are necessary. The procedure is as follows. The patient is started on antibiotics (amoxicillin clavulanic acid, 1.2 g three times per day for 1 week). Before the operation, an endoscopy is performed. To accurately judge the distal extent of the tumor in relation to the cricoid, which is the caudal limit of the resection, a needle may be brought into the larynx through the skin over the cricoid cartilage. After a tracheostomy, a midline approach of the larynx is made. The outer layer of the perichondrium is elevated from the cartilage on both

<table>
<thead>
<tr>
<th>Table 1. Indication for CO₂ laser surgery.</th>
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<tbody>
<tr>
<td>Limitation of the tumor to the glottis</td>
</tr>
<tr>
<td>Limited supraglottic extension</td>
</tr>
<tr>
<td>No subglottic extension</td>
</tr>
<tr>
<td>Normal mobility of both vocal cords</td>
</tr>
<tr>
<td>No extension in the anterior commissure</td>
</tr>
<tr>
<td>Complete endoscopic tumor visualization</td>
</tr>
</tbody>
</table>

HEAD & NECK February 2005
sides but is left attached to the inner side of the thyrohyoid muscle, because in previously irradiated patients the perichondrium is useless for reconstruction as a separate layer. A paramedian cartilage cut is made on the lesser-involved side, and the larynx is opened through the paraglottic tissues and vocal cord. The second cartilage cut is made with a direct view of the tumor, and the resection is completed. Frozen sections are taken from the wound edges. As much bare cartilage as possible, with the exception of the arytenoids, to reduce the risk of airway obstruction, is covered. The remaining strap muscles are used to cover the defect, and the skin is closed, leaving a suction drain. A nasogastric feeding tube is left behind. Postoperatively, oral feeding is started on day 7; the tracheostomy is also removed at that time if this is considered safe.

RESULTS

**Group 1, CO₂ Laser Surgery.** Results are summarized in Table 3. Forty-two patients were treated with laser surgery for recurrent disease after radiotherapy. Follow-up after first laser surgery ranged from 17 to 215 months (average, 77 months). Although strictly a contraindication for laser surgery, 18 patients had tumor extending into the anterior commissure. The reason for this was that before 1997, an external procedure was not offered, and patients refused a total laryngectomy for relatively small tumors. A total of 42 patients were treated with laser surgery. After first laser surgery, 20 patients had a recurrence, and 22 patients remained tumor free after one or two laser procedures. In 24 cases, the patients met the criteria (Table 1) strictly (no extension of tumor in the anterior commissure). Fourteen patients were cured with one laser treatment, and 10 patients had a recurrence. One patient with a second recurrence was cured with a second laser treatment, and the other nine were managed with a total laryngectomy. One patient had a recurrence after total laryngectomy and died of his disease. The recurrences occurred between 1 and 48 months after laser treatment (average, 13 months). It must be noted, however, that although the criteria for laser surgery were met in this group of patients, a number of these patients would have currently been treated through an external approach, mostly because of tumor volume.

In the subgroup of patients \( n = 18 \) with tumor extending into the anterior commissure, eight patients were cured with one or more laser procedures; 10 patients went on to have a total laryngectomy for a new recurrence.

**Complications.** Two patients with tumor extending in the anterior commissure had a chondritis of the thyroid cartilage develop. One patient was successfully treated with antibiotics, and the other required surgical intervention; both patients retained their larynx. No other complications were seen.

**Functional Follow-up.** There were no functional problems observed in this group. None of the patients needed a tracheostomy or a nasogastric tube. Most of the patients left the hospital the day after the operation.

**Group 2, Frontolateral Partial Laryngectomy.** Results are summarized in Table 4. Twenty-one patients were treated with a frontolateral procedure. Follow-up ranged from 16 to 62 months (average, 41 months).

One patient was treated with a total laryngectomy 2 weeks after the partial laryngectomy be-

### Table 2. Indications for frontolateral partial laryngectomy.

<table>
<thead>
<tr>
<th>Tumor limited to the glottis</th>
<th>Limited supraglottic extension</th>
<th>Limited subglottic extension (1 cm)</th>
<th>Extension in the anterior commissure</th>
<th>Normal vocal cord mobility</th>
<th>No cartilage involvement</th>
<th>No arytenoid involvement</th>
</tr>
</thead>
</table>

### Table 3. Results of CO₂ laser treatment.

<table>
<thead>
<tr>
<th>Involvement of anterior commissure</th>
<th>No. patients</th>
<th>CO₂ laser successful</th>
<th>Salvage total laryngectomy after CO₂ laser failure</th>
<th>Failure of salvage total laryngectomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>No involvement</td>
<td>24</td>
<td>14</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Involvement</td>
<td>18</td>
<td>8</td>
<td>8</td>
<td>2</td>
</tr>
</tbody>
</table>
cause of residual tumor in the operative margins on final pathologic examination, although perioperative frozen sections had been negative. Another patient was converted to a cricohyoidopiglottopexy (CHEP) in the direct postoperative period for the same reason. Another patient was treated with a total laryngectomy after 6 weeks because of a nonfunctional larynx. Only three patients had a recurrence, 4 to 5 months after surgery. They were successfully treated with a total laryngectomy (10 months–3 years follow-up). Twelve patients are still alive with no evidence of disease after a frontolateral laryngectomy. One patient died of heart failure 1.5 years after the operation, with no evidence of disease at the time of death. One patient died 4 weeks after the operation because of heart failure after a period of severe untreated dyspnea. Two patients had a neck recurrence, one in level 2 and the other in level 6. One patient chose not to be treated and died with the recurrence. The other patient is still alive with no local recurrence.

Complications. In the direct postoperative period, we had one case of postoperative hemorrhage. One patient had a postoperative pulmonary infection, which was treated with antibiotics. Two patients had a laryngeal-cutaneous fistula, which closed spontaneously within 3 weeks of conservative treatment.

The long-term complications (after 3 months) encountered in a total of six patients were persistent dyspnea \( (n = 5) \) and cartilage necrosis \( (n = 3) \). Dyspnea was mainly caused by edema and was treated with one or more laser procedures (Table 5). In two patients, a permanent tracheostomy remains because of secondary fibrosis of the larynx. All cases of cartilage necrosis were successfully treated with minor sequestrotomy and antibiotics.

Functional Follow-up. Postoperatively, the tracheostomy was removed after 5 to 26 days (median, 10 days). In two patients, the period of tracheostomy was prolonged (45 and 58 days) because of a laryngeal cutaneous fistula and dyspnea. The nasogastric feeding tube was removed after 12 days (range, 1–34 days). All the patients resumed an unrestricted full oral diet within days of removal of the feeding tube. The average length of the hospital stay was 12 days (range, 7–28 days). With a questionnaire, we investigated whether the patients were satisfied with their voices after operation. Fourteen patients were satisfied with their voice and experienced no social inconvenience. Only one patient with a whispering voice was not satisfied. All patients had an unrestricted full oral diet (Table 6).

**DISCUSSION**

The standard treatment for recurrent glottic carcinoma after radiotherapy is a total laryngectomy. This study shows, however, that in selected cases, a partial procedure is safe and effective. In our clinic, laser surgery, frontolateral partial laryngectomy, and CHEP are the main partial procedures performed after radiation failure. Selection of patients and choice of the right procedure are the key issues. A guideline is presented in Figure 1.

In the period of 1980–1996, 42 patients with a glottic recurrence were treated with CO\(_2\) laser. This is a relatively small group, but recurrences after radiotherapy for T1 or T2 glottic tumors

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**Table 4. Oncologic follow-up for frontolateral partial laryngectomy.**

<table>
<thead>
<tr>
<th>Outcome on follow-up</th>
<th>No. patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease free</td>
<td>15</td>
</tr>
<tr>
<td>Postoperatively converted</td>
<td>3</td>
</tr>
<tr>
<td>Recurrence</td>
<td>3</td>
</tr>
</tbody>
</table>

**Note.** In three patients, there was no evidence of disease at time of death.

**Table 5. Number of and the reason for endoscopies after frontolateral partial laryngectomy.**

<table>
<thead>
<tr>
<th>Reason for endoscopy</th>
<th>No. endoscopies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyspnea</td>
<td>8</td>
</tr>
<tr>
<td>Granulation tissue</td>
<td>3</td>
</tr>
<tr>
<td>Recurrent</td>
<td>3</td>
</tr>
</tbody>
</table>

**Table 6. Functional results after frontolateral partial laryngectomy.**

<table>
<thead>
<tr>
<th>Functional result</th>
<th>No. patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airway</td>
<td></td>
</tr>
<tr>
<td>No airway problem</td>
<td>13</td>
</tr>
<tr>
<td>Permanent tracheostomy</td>
<td>2</td>
</tr>
<tr>
<td>Swallowing</td>
<td></td>
</tr>
<tr>
<td>Nonrestricted full oral diet</td>
<td>15 (all patients)</td>
</tr>
<tr>
<td>Speech</td>
<td></td>
</tr>
<tr>
<td>Patient satisfied with speech</td>
<td>14</td>
</tr>
<tr>
<td>Whispering voice</td>
<td>1</td>
</tr>
</tbody>
</table>
occur in only 5% to 20% and 25% to 30%, respectively, and only a small portion of these qualify for laser surgery. Although the results of primary treatment of small glottic carcinoma with CO₂ laser surgery are well documented, few reports deal with laser treatment of recurrent glottic carcinoma after radiation therapy.

If the criteria were strictly met, in our study more than 52% of the patients retained their larynx when treated by laser surgery. Only one patient in this group died of disease after total laryngectomy for a further recurrence, suggesting that little or no extra risk is involved for the patient. Our results are similar to those of CO₂ treatment of recurrent glottic carcinoma reported in the literature. Blakeslee et al reported a 40% success rate and think that extension of the tumor into the anterior commissure is a contraindication for laser surgery. Casiano et al found a 5-year cure rate of 51% in previously irradiated patients, and the success rate was reduced (45% vs 65%) if the anterior commissure was involved.

Outzen and Illum reported similar results. After salvage procedures, a 5-year cure-rate of 98% was achieved. All these reports deal with a small number of patients, all groups being smaller than 20. Most authors regard extension of the tumor in the anterior commissure as a contraindication to laser surgery. Like Casiano et al, we found a higher recurrence rate in anterior commissure involvement (67% vs 42%), and nearly 60% of these patients finally underwent a total laryngectomy (the others could be salvaged with another partial procedure).

If the tumor extends into the anterior commissure, survival is not compromised; however, 70% lose their organ because of a new recurrence. These findings confirm our opinion that extension into the anterior commissure is a contraindication to laser surgery, and we, therefore, recommend an external procedure. However, in patients with poor general health, laser surgery can still offer a good alternative because of the short surgical time, few complications, and fast rehabilitation.

In the frontolateral partial laryngectomy group, we found a control rate of 71%. This is consistent with the literature. Kooper et al found an oncologic control rate of 88%. Other studies report control rates of between 70% and 100%. Rehabilitation after frontolateral partial laryngectomy was generally rapid; most patients left the hospital within 2 weeks of the operation on a full oral diet with the tracheostomy removed. Complete endolaryngeal wound healing was never completed at that time and was frequently observed to take up to 3 months. Complications were few and well manageable in our series, but the two main concerns after a frontolateral procedure are cartilage necrosis and airway problems. Modification of the surgical technique can mostly prevent these problems. In the patients who had cartilage necrosis, a substantial area of cartilage had been left uncovered during surgery. Hardillo has shown that healing of bare cartilage has a risk of forming granulation tissue and scar tissue. Therefore, covering the bare cartilage is strongly recommended. For this purpose we prefer to fold the thyrohyoid muscle with the outer layer of perichondrium attached to it around the remaining cartilage. If all the cartilage cannot be covered, the cartilage may serve as a stent and can easily be removed at a later stage if necessary, but repeat endoscopies may be required to remove granulations and assess tumor control in the meantime. As in supraglottic laryngectomy, denuded cartilage of the arytenoids should not be covered, because local edema at the widest part of the larynx will compromise the main airflow.

A false vocal cord may be used to reconstruct a vocal cord and/or cover cartilage. For the reason mentioned previously, this should only be carried out unilaterally.

We investigated the subjective feelings of the patients about the voice and swallowing by means of a questionnaire. Except for one patient, all were satisfied with their voices. They did not have any social inconvenience with their voices. All our patients have a normal diet without any restrictions. Other authors also report satisfactory speech and swallowing.

An alternative for recurrent laryngeal cancer is a CHEP. This procedure is performed in pa-
tients with a bulky tumor or extension in one of the arytenoids. We have performed 11 CHEPs with satisfactory functional results, but these are not reported because of short follow-up.

In partial laryngectomy procedures, the resection margins cannot be as wide as in total laryngectomy. The use of intraoperative frozen sections is the key to maximum safety. It must be kept in mind that a frozen section of postirradiation tissue is difficult to examine, and stellate-shaped growth or perineural growth may be missed. The pathologist should be aware that a good orientation of the resection margin in the frozen section is of utmost importance, allowing the microscopic examination of the full length of the surface lining epithelium. Failure to achieve this may lead to a false-negative outcome. Diagnostic pitfalls can be squamous cell metaplasia of subepithelial laryngeal glands and ducts. Particularly, necrotizing sialoadenitis may be confused with squamous cell carcinoma, leading to a false-positive report. Distinguishing between dysplasia and carcinoma in situ from irradiation-related atypia of the lining epithelium might also be difficult in frozen sections. Furthermore, inflammation caused by previous radiotherapy makes the interpretation of frozen sections of the margins difficult. It is extremely important to prepare the patient beforehand, not only for conversion to a total laryngectomy during surgery but also for the possibility of a reoperation in the direct postoperative phase. Because of the often tight resection margins and to facilitate maximum orientation, frozen sections should be taken from the wound, not from the specimen. The difficult interpretation of the frozen margins is one of the reasons surgeons may decide not to perform partial laryngectomy in patients who had radiation fail.17,24 The main reason for us not to routinely perform frozen sections during laser surgery is that the laser evaporates the margin and adds a factor of heat damage. It is also more difficult to obtain adequate tissue from the wound for frozen section.

CONCLUSION

In conclusion, if the surgeon is familiar with the different techniques of, and indications for, partial laryngectomy, this can be a good and very satisfying treatment in selected patients with glottic cancer who had radiation fail. On the other hand, if the patient or procedure is not selected carefully, this may lead to disaster, and patients should be mentally capable of coping with a possible conversion to total laryngectomy perioperatively or postoperatively.

Acknowledgment. We thank Professor L. Feenstra, MD, PhD, and J. Borgstein, MD, their kind support.

REFERENCES


