COMPARISON OF DIFFERENT SURGICAL APPROACHES IN T2 GLOTTIC CANCER

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Abstract: *Background.* The purpose of this study was to evaluate retrospectively the oncologic results of endoscopic and open surgical techniques in treating T2 glottic carcinomas.

Methods. The medical chart of 354 patients with T2 glottic cancer managed with primary surgery were reviewed. Laser microsurgery and frontolateral partial laryngectomy were compared for disease-specific survival and local control rates, incidence of major complications, and related tracheostomies. Additionally, the influence of the anterior commissure invasion on these oncologic parameters was evaluated.

Results. No statistically significant differences were found between the surgical procedures regarding our oncologic parameters. A lower incidence of tracheotomies and complications were comparatively found for laser surgery. Tumor invasion of the anterior commissure did not seem to influence the oncologic results.

Conclusion. Transoral surgery seems to be the treatment of choice for T2 glottic cancer. In our view, open partial laryngectomy should be reserved for those cases in which the lesion cannot be adequately exposed by direct microlaryngoscopy. © 2011 Wiley Periodicals, Inc. *Head Neck* **34:** 73–77, 2012

According to data released by the American Cancer Society, approximately 10,000 new cases of laryngeal carcinoma are diagnosed each year in the United States, and 3900 deaths occur yearly as a result of this disease.[1] During the last 3 decades, significant advances in voice rehabilitation, delivery of radiation, and conservative surgical techniques have allowed the therapeutic focus to shift to "organ preservation."[2] Since transoral CO_2 laser surgery was introduced into laryngeal oncology, its indications have been significantly expanded from early laryngeal carcinomas to intermediate and advanced stages, so that it is currently considered a viable alternative to traditional treatment strategies.[3–6]

Comparison between available management options for early glottic cancer, including conservative surgery and radiotherapy, is complicated. Until recently, there have been no prospective, randomized controlled studies comparing the available treatment modalities for early glottic cancer.[7] Moreover, treatment of early glottic cancer with anterior commissure involvement remains controversial.[7] The purpose of the present retrospective study was to compare the efficacy of various available surgical techniques in treating T2 glottic carcinomas. Additionally, the surgical modalities were compared in patients with and without invasion of a T2 glottic tumor into the anterior commissure.

MATERIALS AND METHODS

This study was based on the analysis of the medical charts, operative reports, and pathology reports of all patients who underwent primary surgical treatment for T2 glottic carcinomas at an academic tertiary referral center (Department of Otorhinolaryngology, Head and Neck Surgery, University of Erlangen–Nuremberg, Germany) between 1977 and 2004. All pathology reports were re-reviewed and staging was conducted according to the 2009 American Joint Committee on Cancer and Union Internationale Contre le Cancer classification.[8] Medical records from 354 patients were examined. Patients with insufficient data, regional and/or systemic disease, second primary tumors, or distant metastases at the time of diagnosis, histology other than squamous cell carcinoma, and patients who received primary or adjuvant radiotherapy/chemotherapy, were excluded from the study cohort. In total, adjuvant radiotherapy/chemotherapy had been given in 62 cases. The criterion for this was the positive resection margins at the end of the surgical treatment (R+), the presence of lymphangiosis carcinomatosa (L1), or hemangiosis carcinomatosa (V1). Additionally, only patients who were observed for at least 60 months were

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Table 1. The different types of procedures and the outcomes for the study patients.

Surgical technique	No. of cases	Overall survival, %	Disease-specific survival, %	Local control, %
Transoral microsurgery	143	64.5	90.8	89.4
Vertical partial laryngectomy	128	69.5	92.6	93.9
Total no. of cases	271	66.9	91.7	91.5

evaluated. In accord with the pathology reports, 13 patients had positive resection margins at the end of the surgical treatment (R+ status). Neck dissection had been performed in 55 patients with cN+ status, with positive lymph nodes in 15 cases, which were then excluded from the study cohort.

Consequently, 271 cases were included in the analysis, including 259 men (95.6%) and 12 women (4.4%). Therefore, the male-to-female ratio was 22:1. The mean age of the study group was 61.48 years, ranging between 35 and 97 years old. No significant differences were noted regarding age and sex distribution between the groups of patients undergoing different surgical procedures. The mean follow-up period was 11.6 years. The 2 available surgical techniques (transoral laser microsurgery and frontolateral partial laryngectomy) were compared for disease-specific survival and local disease control rates. Surgical techniques were also compared for the incidence of major complications (requiring intensive medical treatment, blood transfusion, surgery, or intensive care unit admission), and related (temporary and permanent) tracheostomies. Comparisons of disease-specific survival and local disease control rates were made between the patient groups with and without anterior commissure involvement, and a comparison

between the 2 available surgical techniques within the group of patients with involvement of the anterior commissure. Five-year disease-specific survival rate was defined as the percentage of patients who did not die of the tumor of interest within 5 years divided by the total number of patients. Local disease control reflects tumor recurrence at the primary site and was calculated from the date of surgery to the date when local recurrence was diagnosed or to the date of the last follow-up. Local recurrence was defined as invasive carcinoma that developed at the anatomic site of the primary tumor after completion of initial treatment. Statistical analysis was performed using the Kaplan–Meier method with 95% confidence intervals and the chi-square test. The software SPSS version 17 for Windows (SPSS, Chicago, IL) was used for the analysis. A p value of $< .05$ was considered statistically significant.

RESULTS

Overall survival was 66.9%, 5-year disease-specific survival was 91.7% and local disease control was 91.5% for all patients in the study sample. The 2 different surgical procedures used and the outcomes for all the study patients are presented in Table 1. Overall survival was 64.5% for patients undergoing transoral laser resections and 69.5% for those having partial laryngectomies ($p = .717$). Five-year disease-specific survival was 90.8% for the transoral laser resection group and 92.6% for the partial laryngectomy group ($p = .703$; Figure 1). Local disease control was 89.4% for transoral laser resections and 93.9% for partial laryngectomies ($p = .181$; Figure 2). Differences between the 2 surgical approaches were, therefore, not statistically significant.

Anterior commissure involvement was detected in 163 of 271 cases. The disease-specific survival was 90.2% in the group with anterior commissure involvement and 93.7% in the 108 cases without ($p = .564$).
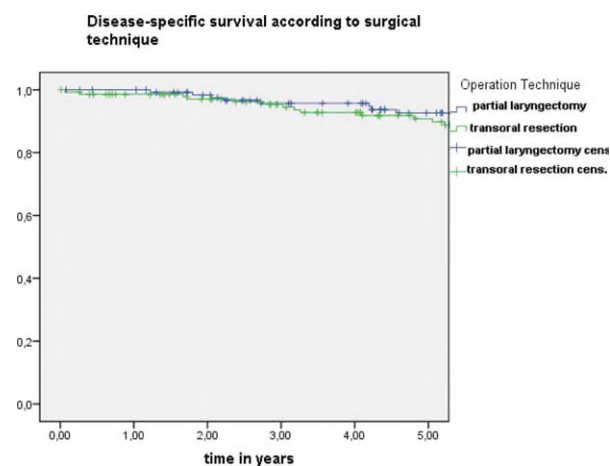

FIGURE 1. Kaplan–Meier analysis of the disease-specific survival according to surgical technique. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]
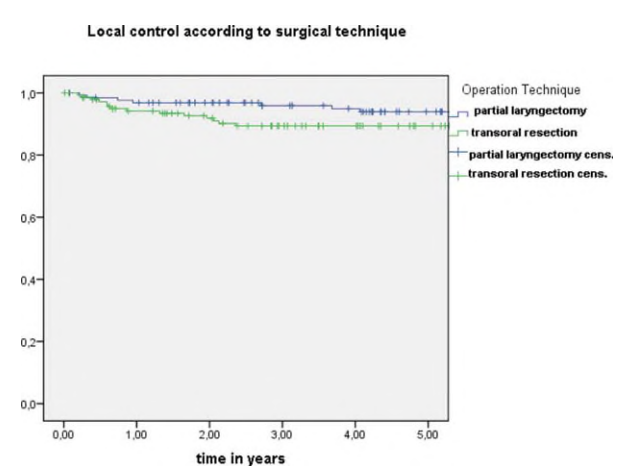

FIGURE 2. Kaplan–Meier analysis of the local control according to surgical technique. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]
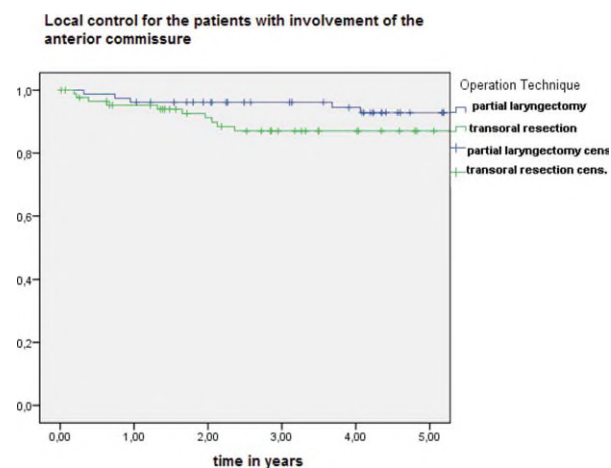
FIGURE 3. Kaplan–Meier analysis of local control according to surgical technique for the patients with involvement of the anterior commissure. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]
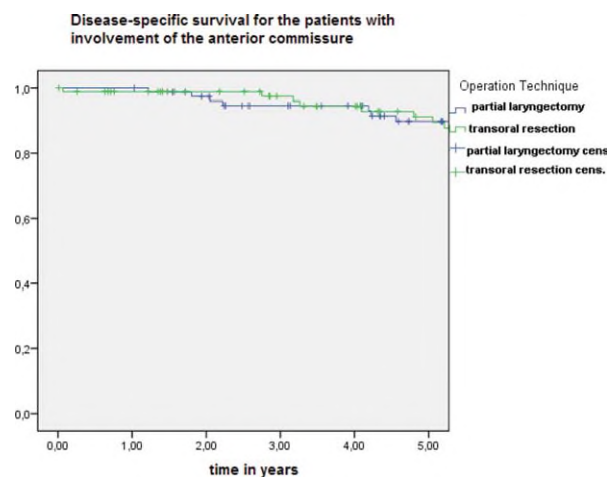

FIGURE 4. Kaplan–Meier analysis of disease-specific survival according to surgical technique for the patients with involvement of the anterior commissure. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

The local control rates were 89.8% and 94.1%, respectively ($p = .33$).

Of these 163 cases, 77 patients (47.2%) underwent an open surgical procedure and 86 patients (52.7%) had transoral laser resection. The 2 surgical approaches were compared for the local control rate and disease-specific survival. The local control rate was 87.0% for transoral laser resections and 92.8% for open partial laryngectomies (Figure 3). The disease-specific survivals were 91.0% and 89.5%, respectively (Figure 4). The differences were not statistically significant ($p = .141$ for local disease control and $p = .585$ for disease-specific survival) in this subgroup of patients.

Major complications in this series included postoperative bleeding, aspiration, fistula formation, stenosis, and wound healing disorders. Specific types and incidence of complications, according to surgical procedure, are presented in Table 2. There was no significant difference between the 2 surgical approaches ($p = .271$). The incidence and type of tracheostomy, according to surgical technique, are presented in Table 3. A significantly lower need for a tracheostomy was found with transoral laser microsurgery than with partial laryngectomy techniques ($p < .001$).

DISCUSSION

When reviewing the literature on different surgical modalities for T2 vocal cord carcinoma, it is immediately obvious that the number of cases investigated is often very small compared with the literature concerning T1 and T3 glottic tumors. A T1 or a T3 glottic carcinoma can be recognized without difficulty and is much easier to classify than a T2 tumor. T2 glottic squamous cell carcinomas compose a very heterogeneous group of lesions in terms of superficial and deep extension. Some cases may show no supraglottic or subglottic tumor extension but have impaired vocal cord mobility while other lesions show considerable supraglottic and/or subglottic extension with normal vocal cord mobility.[9] As a result, they differ greatly in treatment indications and prognosis. In their proposal for revising the TNM classification, Glanz et al[10] state that the glottic carcinomas with impaired vocal cord mobility should be placed in the T3 category, along with tumors with vocal cord fixation. In the past 30 years, various reports in the medical literature have documented the oncologic results achieved with fronto-lateral partial laryngectomy alone for selected T2 squamous cell carcinoma of the glottis. Miscellaneous anatomic factors, such as invasion of the anterior commissure, infraglottic extent of tumor, impaired motion of the true vocal cord, and tumor volume have frequently been suggested as potential adverse prognosis factors in terms of local control.[11–13] Laccoureye et al[14] demonstrated that local recurrence after vertical partial laryngectomy significantly alters survival in patients with T2 glottic carcinoma. This fact is, in complete contradiction to the basic concept, that when conservative surgery in patients with selected "early"

Table 2. Specific types and incidence of complications according to surgical procedure.

Surgical technique	Total no. (incidence) of complications	Bleeding	Aspiration	Fistula or stenosis	Wound healing disorder
Transoral microsurgery	3	2	0	0	1
Partial laryngectomy	7	1	1	1	4

Table 3. Incidence and type of tracheotomies according to surgical technique.

Surgical technique	No. of transient tracheotomies	No. of permanent tracheotomies	Total
Transoral microsurgery	1	2	3
Partial laryngectomy	23	9	32
Total	34	11	45

(stage I–II) invasive squamous cell carcinomas of the glottis fails, salvage treatment then results in eradication of the disease with good survival but at the expense of the loss of the larynx. The relatively small number of reports on T2 glottic carcinomas in the recent literature, the further need for thorough examination of the anterior commissure involvement as a prognostic factor, and the controversy about the effect of local recurrence on survival, as discussed above, are the main purposes for the present study.

The success of any organ-preservation treatment modality rests on achieving a balance between effective locoregional cancer control and maximal functional outcome. Organ-preservation laryngeal surgery has been defined as "a combination of procedures that remove a portion of larynx while maintaining the physiological functions of speech, swallowing, and respiration without compromising local control and cure rates or the need for a permanent tracheostoma."[15] While considering organ preservation, it is important to realize that maintenance of the local anatomy may not translate into a good functional outcome.[2] Besides the rate of cure, treatment for early glottic carcinoma has to consider the percentage of larynx preservation, subsequent voice quality, minimizing the risk of serious complications, and the costs of treatment. The therapeutic options include transoral laser microsurgery, open partial laryngectomy, and primary radiotherapy.[16] The choice of 1 or other option depends on the localization and extent of the tumor, the experience of the therapeutic center, the patient's medical condition (age, general health), and the patient's preferences (daily voice requirements).[17]

Laser endoscopic resection of early glottic tumors has become popular due to the favorable oncologic and functional results. Excision by laser does not exclude other treatments if there are local recurrences.[18] Transoral laser resection offers easy access to the tumor site and the possibility of repeated resection whenever dictated by pathology,[19] increased precision, and an intrinsic hemostatic effect.[20] This method confers several other advantages, such as removing the needs for extensive reconstruction and tracheostomy.[21] On the other hand, the safe use of CO_2 lasers requires increased awareness and training of the surgeon and operating room personnel.[7] Combustion of endotracheal tubes was reported soon after the introduction of laser CO_2 in endolaryngeal microsurgery.[22,23] This intraoperative complication could be prevented by the use of laser-resistant endotracheal tubes. Unfortunately, however, transoral laser surgery may pose serious problems for pathologists having to assess the status of tumor resection margins.[5,24]

The inability to expose the lesion with direct laryngoscopy precludes endoscopic management of T2 glottic carcinoma and favors open partial laryngectomy.[25] The description of the modern technique is attributed to Som (1951).[26] Open procedures have also been advocated for the treatment of early glottic cancer with anterior commissure involvement because of the better exposure of this anatomic region. Some authors assume the anterior commissure represents a weak point with regard to tumor spread because it is here that Broyles' ligament inserts into the thyroid cartilage, thereby inducing susceptibility to tumor invasion. The lack of perichondrium at the point where the ligament adheres to the cartilage is responsible for this weakness with respect to tumor spread.[27,28] Moreover, some investigators believe anterior commissure involvement to be a contraindication to laser surgery because of a high recurrence rate.[29] One reason may be that endoscopic exposure of the tumor is more difficult in such cases and requires both advanced surgical training and great experience.[30] On the other hand, conventional open partial procedures carry certain disadvantages, including longer hospitalization, higher tracheostomy rates, and the need for a feeding tube in many cases.[30] Surgery results in a considerable laryngeal defect, and this has to be reconstructed immediately to restore the voice and to prevent a fistula. The optimal entry point into the laryngeal lumen has to be selected using landmarks determined before surgery and the tumor is not in view until the larynx has been opened.[31]

One of the reasons prompting our study was the need to compare the effectiveness of the different surgical approaches, as there are only a few reports on T2 glottic carcinomas. We, therefore, retrospectively determined the oncologic outcomes of different surgical approaches to T2 N0 glottic cancer and of different tumor locations (anterior commissure involved or not), in patients treated in our department. Despite any of the differences noted, the high disease-specific survival and local control rates confirm that laryngeal preservation surgery can effectively provide a cure for stage II glottic cancer, irrespective of the technique used. As previously mentioned, the incidence of major complications was similar for the 2 techniques ($p = .271$). Therefore, oncologic effectiveness could not be used as an argument for or against a particular surgical technique, but randomized prospective studies are still needed to objectively compare all available treatment modalities.

In our patient series, we did not find a statistical significant difference in the oncologic outcomes between patients with and without involvement of the anterior commissure. Our results show that

involvement of this anatomic region does not necessarily suggest an adverse prognostic factor in terms of disease outcome. Moreover, no difference between the 2 surgical procedures was found for these parameters in patients with anterior commissure involvement. In our view, the transoral approach can be used without reservation in these cases, provided that the tumor can be exposed completely.

On the other hand, the difference in the requirement for tracheostomy in transoral procedures compared with open surgical techniques reached statistical significance ($p < .001$). In the first group, only 2 permanent tracheostomies (2 of 143; 1.4%) were needed because of persistent aspiration, and 1 temporary tracheostomy for acute postoperative dyspnea. The low tracheostomy rate counts as 1 of the most important advantages of the transoral approach (in terms of better perioperative and postoperative quality of life) and is consistent with the existing literature.[32–34]

Early glottic carcinomas are characterized by an excellent prognosis in terms of overall survival, disease-specific survival, and local recurrence control. The choice of treatment for T2 glottic carcinomas is the 1 that seems best for the tumor, the patient, and the surgeon. Appropriate prospective randomized controlled studies are still needed to objectively compare all available treatment modalities for early glottic cancer. According to our statistical analysis, transoral surgery is the treatment of choice for T2 glottic cancer, even in patients with tumor invading the anterior commissure. It offers a sound oncologic outcome, favorable functional results, a significantly lower rate of (permanent or temporary) tracheostomy in comparison with the open procedures, and the significant possibility for repeated resection when needed. However, it should be emphasized that reliable endoscopic resection requires a thorough analysis of tumor extension and infiltration. In our view, open partial laryngectomy in T2 glottic tumors should be reserved for those cases where the lesion cannot be adequately exposed at the time of direct microlaryngoscopy.

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