TRANSORAL LASER MICROSDURGERY FOR T3 LARYNGEAL TUMORS: PROGNOSTIC FACTORS

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Abstract: Background. The objective of this study was to evaluate the outcomes of transoral laser microsurgery (TLM) in T3 laryngeal carcinomas and to identify prognostic factors for survival and laryngeal preservation.

Methods. This study aimed to provide a retrospective analysis of 147 consecutive patients, evaluating their overall survival, disease-specific survival, laryngectomy-free survival, and function preservation rate.

Results. Five-year overall, disease-specific, and laryngectomy-free survivals were 53.1%, 70.2%, and 62.3%, respectively. Disease-specific survival differed between glottic and supraglottic tumors (86.3% vs 61.8%; \( p = .015 \)). Function preservation was 65.5% in supraglottic and 49.1% in glottic tumors (\( p = .002 \)). Disease-specific survival was not related to pre-epiglottic involvement, cord fixation, or focal cartilage infiltration (\( p > .05 \)). Vocal cord fixation and cartilage infiltration were independent negative prognostic factors for organ preservation (odds ratio [OR] = 0.184; 95% confidence interval [CI] = 0.082-0.411; \( p = .000 \) and OR = 0.331; 95% CI = 0.139-0.789; \( p = .013 \), respectively).

Conclusion. Our conclusion is that TLM is a good alternative in a large number of T3 laryngeal tumors, with adequate survival and organ preservation rates above 60%.

Keywords: advanced laryngeal cancer; CO2 laser; transoral laser microsurgery; organ preservation

Resection of laryngeal tumors of the upper airways by means of transoral laser microsurgery (TLM) has progressively replaced external partial surgery in many otolaryngology departments. The first and largest experience with TLM in early and advanced tumors treated was published by Steiner et al.1-3 from Göttingen, Germany. During the past decades, they have standardized this type of surgery and widespread the rationale and outcomes for transoral resections in a large number of publications.

Currently, TLM is the first treatment option for early laryngeal tumors in many European centers. The good oncologic and functional outcomes, especially in those cases of limited disease, have lead many surgeons to progressively increase the indications for this type of surgery.4,5 More recently, other medical centers have expanded the use of TLM for advanced-staged disease,6-12 re-asserting the outcomes noted in Steiner’s publications. However, a large number of patients included in these studies had an advanced stage of disease, but not
always a locally advanced tumor in the primary site, thus its usefulness as a curative treatment in locally-advanced tumors remains controversial.

The aim of our study was to evaluate the outcome of TLM as a standard treatment of locally-advanced tumors of the larynx, and to assess the influence of aspects such as tumor location, stage of disease, vocal cord mobility impairment, pre-epiglottic space involvement, or presence of focal infiltration of the cartilage on the functional and oncologic outcomes.

MATERIALS AND METHODS

In 1998, TLM was considered the surgical standard of treatment for patients with T1 to T3 laryngeal carcinomas at our academic tertiary referral center. Since then, more than 800 patients have been treated with curative intention, and data regarding oncologic and functional aspects have been prospectively introduced and updated weekly in our SPSS database.

The sample analyzed in the present study includes 147 consecutive patients treated with TLM for a T3 squamous cell carcinoma of the larynx from February 1998 to August 2008. Exclusion criteria for TLM in our protocol are inadequate access or exposure of the tumor, and tumors crossing the midline of the posterior commissure. Patients treated with palliative intention because of distant metastases or concomitant second primaries have not been included in the present analysis. No age limit or absolute performance status was considered for surgery. Tumors were initially classified according to the 1997 American Joint Committee on Cancer (AJCC) TNM staging system, and re-staged afterward according to the 2002 TNM version.13

A Sharplan CO2 laser equipment (40w) with the 712 Acuspot micromanipulator (Sharplan, Tel Aviv, Israel) was used for the TLM. Transoral removal of the tumor was accomplished in the beginning following the technique described by Steiner and Ambrosch.14 In 2000, the AcuBlade system (Lumenis, Santa Clara, CA), a new scanner application, was incorporated at our department, and tissue ablation with the scanner, in order to grossly reduce the tumor specimen, was added to the initial concept of blockwise resection only, especially in large and bulky tumors growing in the anterior commissure. With increasing experience, the duration of the surgery, the number of frozen sections, and also the number of staged neck dissections were considerably reduced.

Laryngeal surgery was followed by modified, radical, or selective neck dissection when needed. Dissections were performed on demand, including levels II, III, IV, and V for positive necks and II–III for N0 necks. According to the pathologic findings, postoperative margins were classified in 3 categories: affected, uncertain, and negative. An affected margin showed marked tumor infiltration. An uncertain margin was defined when the sample was insufficient, when it showed carbonization impeding accurate evaluation, or when tumor cells were less than 2 mm.15 When margins were positive, a transoral laser surgery was proposed to enlarge the resection. Adjuvant radiotherapy to the primary site was not considered initially in our protocol. Only in a few cases of uncertain margins with no possibilities of enlargement (or in which resection would lead to a total laryngectomy), and positive neck nodes (starting from pN2 or with extracapsular spread), radiation to the primary site was also considered.

Statistical Analysis. Data are presented as mean ± SD. The relation between qualitative variables was analyzed with the Pearson chi-square test. The variables that were significant in the univariate analysis were introduced into a logistic regression model (Backstep Wald method) to determine independent risk factors. The dichotomized variables such as tumor relapse, organ preservation, and function preservation were used as dependent variables, and the likelihood ratio test (p < .05 for entry, p > .10 for removal) for model comparison was used to select variables.

Rates of overall survival, disease-specific survival, laryngectomy-free survival, and function preservation were estimated by means of the Kaplan–Meier method. Overall survival was assessed from the date of surgery to the date of death (regardless of the cause) or the date of the last consultation for censored observations. To calculate the rate of disease-specific survival, only deaths related to tumor or complication of the treatment were considered. The endpoint for larynx preservation was the date of total laryngectomy. The endpoint for function preservation was the date of total laryngectomy, permanent
tracheotomy, or definitive gastrostomy tube. Comparisons in survival rates between groups were assessed with the Log-rank test.

Data were analyzed using SPSS for windows version 14.0. A \( p \) value of .05 was defined as statistically significant.

**RESULTS**

The sample comprised 142 men (96.6%) and 5 women (3.4%), with a mean follow-up of 73.7 ± 38.6 months (range, 3–130). The mean age of the patients at the time of surgery was 62.9 ± 11.1 (range, 20–95). In 143 patients (97.3%), TLM was the first treatment option, in 1 patient (0.7%) TLM treatment was used after radiation therapy failure, and in 3 patients (2%) TLM was indicated for previous surgical relapse.

According to the surgeon’s report, access to the tumor was good in 119 patients (81%) and difficult in 28 (19%). At the end of the surgery, the resection was considered complete in 121 patients (82.3%) and “uncertain” in 27 (17.7%). The definitive pathology analysis of the margins was negative for the presence of the tumor in 86 patients (58.5%), uncertain in 38 (25.9%), and positive in 23 (15.6%).

Disease in all patients was postoperatively staged as pT3 according to 2002 TNM classification. In 84 patients (57.1%), the pre-epiglottic space was involved (86.7% of supraglottic vs 2.3% of glottic); in 36 patients (24.5%), focal infiltration of the thyroid cartilage was found during the surgery (9% of supraglottic vs 52.3% of glottic); and in 46 patients (31.3%), the vocal cord was fixed (15.6% of supraglottic vs 58.8% of glottic). Nineteen patients (12.9%) had more criteria than 1 to be staged as pT3.

Transoral laser resection was followed by neck dissection in 97 patients (66.4%). In 34 patients (23.3%), neck dissection was performed unilaterally, and in 63 (42.8%) bilaterally. In 1 patient, the staged neck dissection was not accomplished because the patient died of a tumor complication. The number of patients with pathologically confirmed positive nodes in our sample was 54 (36.7%). Data regarding tumor location, node involvement, and stage of disease are expressed in Table 1.

One hundred nine patients never received postoperative radiation therapy. In 25 patients (17%), adjuvant radiation was indicated in the neck and in the primary tumor site, and in 12 patients (8.2%) adjuvant radiation was applied only to the neck.

**Complications.** Thirty-seven patients (25.2%) experienced any type of complication related to the surgical treatment, 20 (13.6%) of them requiring surgery or admission in the intensive care unit. The most threatening complication was tumor site bleeding (\( n = 20, 13.6% \)), followed by pneumonia (\( n = 8, 5.4% \)), and dyspnea (\( n = 1, 0.7% \)). Other complications included slight emphysema (\( n = 4, 2.7% \)), or local infection (\( n = 4, 2.7% \)). Complications were resolved without residual sequelae in 142 patients (96.6%), 4 patients (2.7%) presented with minor sequelae (abnormal scarring, or reduction in pulmonary function), and 1 patient (0.7%) died of massive bleeding a few days after surgery of a supraglottic tumor.

**Oncologic Outcomes.** During the follow-up period, 55 patients (37.4%) presented with a local recurrence, which was treated by means of laser surgery in 5 patients (9.1%), partial external surgery in 5 (9.1%), and total laryngectomy in 45 (81.8%). One patient (1.8%) was considered palliative because of concomitant locoregional and distant disease.

In the univariate analysis, the probability of tumor relapse was related to the status of the margins (\( p = .002 \)), the absence of pre-epiglottic involvement (\( p = .001 \)), the location of the tumor (\( p = .005 \)), the presence of vocal cord fixation (\( p = .02 \)), and focal cartilage infiltration (\( p = .03 \)), but not to tumor exposure (\( p = .052 \)). In the multivariate analysis, the presence of vocal cord fixation (odds ratio [OR] = 2.586; 95% confidence interval [CI] = 1.225–5.457; \( p = .013 \)), and the presence of focal cartilage infiltration

| Table 1. Characteristics of the sample according to location, node involvement and stage. |
|-----------------------------------------------|-----------------|-------------------|
| Stage III                                      | Supraglottic    | Glottic           | Total            |
| T3N0                                          | 47 (49)         | 46 (90.2)         | 117 (78.9)       |
| T3N1                                          | 19 (19.8)       | 5 (9.8)           | 29 (20.4)        |
| Stage IVA                                      |                |                   |                 |
| T3N2b                                         | 11 (11.5)       | –                 | 20 (13.6)        |
| T3N2c                                         | 18 (18.8)       | –                 | 36 (24.5)        |
| Stage IVB                                     |                | 1 (0.7)           | 29 (19.7)        |
| T3N3                                          | 1 (1)           | –                 | 1 (0.7)          |
| Totals                                        | 96 (65.3)       | 51 (34.7)         | 147 (100)        |

Table 1. Characteristics of the sample according to location, node involvement and stage.
were independent significant factors influencing the rate of recurrence.

Five-year overall and disease-specific survival rates were 53.1% and 70.2% in our sample (Figure 1). Disease-specific survival differed significantly according to tumor location: 86.3% for glottic tumors compared with 61.8% for supraglottic; \( p = .015 \). No significant differences in disease-specific survival were found related to the presence or not of vocal cord fixation (71.6% vs. 69.9%; \( p = .840 \)), pre-epiglottic involvement (64.3% vs. 79.7%; \( p = .23 \)), or focal cartilage infiltration (80.6% vs. 69%; \( p = .18 \)).

**Functional Outcome.** The Kaplan–Meier 5-year laryngectomy-free survival and function preservation survival rates were 62.3% and 57% in our sample (Figure 2). The percentage of patients with a 5-year preserved larynx was higher in supraglottic tumors compared with glottic (76.6% vs. 58.9%; \( p = .003 \)). Similar results were observed for function preservation rates between supraglottic and glottic tumors (74.5% vs. 51%; \( p = .004 \)). Laryngectomy-free survival according to the presence of pre-epiglottic involvement, vocal cord fixation, and cartilage infiltration are expressed in Figure 3A–C.
In the multivariate analysis, the presence of vocal cord fixation was an independent negative factor for organ and function preservation. Patients with a fixed vocal cord had less possibilities of organ preservation (OR = 0.184; 95% CI = 0.082–0.411; p = .000) and of function preservation (OR = 0.198; 95% CI, 0.090–0.435; p = .000) compared with those without cord fixation. Also, the presence of focal cartilage infiltration during the surgery was a negative independent factor for organ and function preservation (OR = 0.331; 95% CI = 0.139–0.789; p = .013, and OR = 0.395; 95% CI = 0.169–0.923; p = .032, respectively).

Data summarizing oncologic and functional outcomes according to location are expressed in Table 2.

**DISCUSSION**

After the landmark trial of the Department of Veterans Affairs (VA) Laryngeal Cancer Group, in which induction chemotherapy followed by radiotherapy was compared with surgery plus adjuvant radiotherapy (VA study\textsuperscript{16}), the presence of a wider variation in patterns of care for advanced laryngeal cancer has become a reality. As a result of the VA report, the organ preservation concept has progressively been incorporated as a fundamental endpoint in the treatment of laryngeal cancer.

Multiple randomized studies using different regimens of chemotherapy in combination with different radiation schedules have been conducted, aiming to preserve the larynx without jeopardizing survival. In 2003, the Radiation Therapy Oncology Group (RTOG) and the Head and Neck Intergroup published the preliminary results of a randomized trial (RTOG 99-11) investigating 3 radiation-based treatments: induction chemotherapy plus radiation, concomitant chemoradiation, and radiotherapy alone.\textsuperscript{17} At 2 and 1/2 years, concurrent therapy was superior to sequential therapy and to radiotherapy alone in terms of local control and laryngectomy preservation. The authors concluded that concurrent chemoradiation should be considered the standard of care. However, the long-term results of RTOG 99-11 resulted in no differences in 5-year overall survival between groups, because patients in the concurrent arm were dying of chronic toxicities.\textsuperscript{18}

Currently, there is still no definitive consensus regarding optimal therapy for advanced head and neck tumors in the medical literature, and a division appears between those that advocate for chemoradiation preservation strategies with surgery for salvage, and those who still consider primary surgery plus adjuvant radiation the treatment of choice. In fact, a recent...
study published by Hoffman et al.\textsuperscript{19} advises that with the increased use of chemoradiation, a decline in the 5-year survival occurred among advanced laryngeal cancers staged as T3N0M0. Thus, the management of laryngeal cancer with a primary surgical approach remains valid.

Total laryngectomy ± adjuvant radiotherapy has been considered the standard treatment of T3 laryngeal tumors in many centers, and may still be considered the gold standard regarding oncologic outcomes. However, the presence of a permanent stoma is a handicap for the patient, with its impact on communication skills and deterioration of quality of life. In Europe, open supraglottic laryngectomies and supracricoid laryngectomies have been used to surgically treat early, but also locally advanced tumors of the larynx. The local control rates go from 70% to 90% in T3 tumors treated with supraglottic laryngectomies\textsuperscript{20–25} and from 93% to 100% in much selected T3 tumors treated with supracricoid partial laryngectomies.\textsuperscript{24–26}

The role of supracricoid laryngectomies to treat intermediate laryngeal tumors is progressively being recognized, especially for glottic tumors. However, as these external approaches aim at the functional recovery of the preserved larynx, indications are limited by the age of the patient and by the pulmonary performance. Dufour et al.\textsuperscript{27} have also published high local control rates for more advanced T3 endolaryngeal carcinomas treated with supracricoid laryngectomies, but most of the patients included in the sample received neoadjuvant chemotherapy with cisplatin and fluorouracil. Only those with clinical response in terms of remobilization of the fixed arytenoid were considered for partial surgery, with 20% of the patients receiving additional postoperative radiation because of close margins or positive nodes. Unfortunately, no data regarding complications or the number of patients with definitive tracheotomy or gastrostomy has been provided.

More recently, partial surgery has evolved toward endoscopic resections, and TLM has progressively expanded its indications based on Steiner’s experience.\textsuperscript{10–12} Compared with partial external surgeries, TLM has demonstrated a reduced morbidity and a shorter recovery time, with the possibility of avoiding tracheotomy and even the feeding tube in a large number of patients.\textsuperscript{28} In addition, the age limit for TLM goes beyond the age limit of external partial surgery, increasing the number of patients that can be treated with primarily surgical preservation strategies. As a matter of fact, TLM has been considered an emerging strategy in the treatment of laryngeal cancer,\textsuperscript{29,30} but experience with TLM in locally advanced tumors is still limited, thus its usefulness in advanced tumors remains controversial.

In 2007, Hinni et al.\textsuperscript{10} published a multicenter study to assess the results of TLM in advanced resectable laryngeal cancer concluding that TLM was totally comparable to radiation-based preservation strategies, and also to external laryngectomies. The results obtained in the present study are in agreement with Hinni et al.\textsuperscript{10} and also with other authors assessing TLM for advanced carcinomas.\textsuperscript{11,12} The 5-year disease-specific survival in our sample was 86% for glottic and 61% for supraglottic tumors, confirming that TLM may be a choice of treatment for locally advanced laryngeal carcinomas.

The 5-year long-term overall survival obtained with TLM in our sample (53.1%) compares to the updated data of the 3 arms of treatment reported by the Intergroup RTOG 91-11\textsuperscript{18}: chemoradiation (54.6%), induction plus radiation (59.2%), and radiation alone (53.5%), but also to the 55% published in the multicenter TLM study of Hinni et al.\textsuperscript{10} Five-year laryngeal preservation and function preservation rates were 62.3% and 57% in our patients, these results being lower than those published by Hinni et al\textsuperscript{10} (86%), or with concomitant chemoradiation (88%). The reduction in the preservation rate of our study could be explained by the characteristics of the patients: all patients included in our sample presented locally

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<thead>
<tr>
<th>Overall survival, 5 y</th>
<th>Disease-specific survival, 5 y</th>
<th>Laryngectomy-free survival, 5 y</th>
<th>Local control with initial treatment, %</th>
<th>Local control after salvage surgery, %</th>
</tr>
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<tbody>
<tr>
<td>Supraglottic</td>
<td>45.8%</td>
<td>61.8%</td>
<td>76.6%</td>
<td>69.8%</td>
</tr>
<tr>
<td>Glottic</td>
<td>73.1%</td>
<td>86.3%</td>
<td>51%</td>
<td>47.1%</td>
</tr>
<tr>
<td>All locations</td>
<td>53.1%</td>
<td>70.2%</td>
<td>62.3%</td>
<td>61.9%</td>
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advanced tumors staged as pT3 according to 2002 AJCC, whereas in the multi-institutional TLM study, the 1992 version of TNM classification was used, 9% of the patients were staged as T2, and 10% of patients with preserved larynx were tracheotomy-dependent or feeding-tube dependent. The same situation applies to the RTOG 91-11 study. We can easily find differences in the selection criteria, with 12% of the patients staged as T2 in the chemoradiation group, or the presence of only 1 patient staged as N3 in our sample. Moreover, no clear data regarding the number of patients with long-term preserved larynx and also preserved function without tracheotomy or gastrostomy have been provided in the RTOG protocol.

We focused our analysis on T3 laryngeal tumors because in the daily practice these are the patients that we consider controversial in terms of treatment decision. For T2 tumors, good oncologic and functional outcomes have been reported either with primary surgery or organ preservation protocols, and the selection usually depends on personal preferences, experience, facilities, and cost of the procedures. In our experience, it is in T3 tumors that doubts arise regarding the best treatment procedure. Moreover, we wanted to know the impact of the 3 different pT3 subcategories on survival and functional outcomes as a better way to select patients for TLM.

The results obtained in our study demonstrate that the subcategory “involvement of pre-epiglottic space” is the best predictive factor for larynx preservation with TLM for T3 laryngeal cancer, being the “presence of vocal cord fixation” (primary glottic or supraglottic tumor) the worst scenario for tumor relapse and organ preservation. In fact, only 1 of 3 patients with a fixed vocal cord was able to preserve the larynx in our sample, compared with 3 of 4 patients with pre-epiglottic infiltration.

The T3 category of laryngeal carcinoma includes lesions that are completely different in terms of local extension. In the case of vocal cord fixation, the diagnostic difficulties rely on the evaluation of the cause of the impaired mobility (muscle infiltration, paraglottic space involvement, and cricoarytenoid joint involvement). As a matter of fact, a complete or near complete resection of the arytenoid has to be done together with the paraglottic space to avoid recurrence, with the consequent risk of temporary postoperative aspiration. In the case of thyroid cartilage infiltration, the possibility of tumor dissemination through the bone marrow of the ossified thyroid cartilage has been mentioned previously, and the surgeon has no way to support the resection based on frozen sections. Large excisions of cartilage may be accomplished with the laser and are, therefore, recommended. Larger excisions, however, may also increase the presence of a chronic inflammation at the operative site and the formation of postoperative granulation tissue sometimes impairing the endoscopic follow-up, not to mention the possibility of extralaryngeal soft tissue spread in case of tumor relapse when wide areas of cartilage have been removed. On the other hand, when the pre-epiglottic space is involved, it can be easily exposed and completely removed with the help of different instruments, and wider margins may be achieved with little postoperative functional impact.

Despite good oncologic results, other critical points are to be considered in TLM, such as when tumor exposure is difficult during the resection, the risk of complications, limitations in the intraoperative assessment of the specimens, and also a reduced local control. According to our experience, technical resection difficulties and complication rates may be reduced with adequate instrumentation and increasing experience. In our sample of pT3 tumors, 13.6% of patients presented with major complications after TLM, with postoperative bleeding being the most life threatening. The risk of postoperative bleeding after TLM has been reported to be between 3% and 6% in a series that included early and advanced tumors. In locally advanced tumors (T3–T4), a higher risk of complications has been reported, especially in those located in supraglottic and piriform sinus. The mortality rate ranges from 0% to 3%, including deaths that occurred within 30 days of surgery, that are most likely associated with medical comorbidities than to TLM. The 0.7% mortality rate in our sample is thus in accordance with previous reports, and supports the idea that TLM is totally comparable to other surgeries in terms of safety, even in the absence of postoperative prophylactic tracheotomy.

Regarding organ preservation protocols, a detailed analysis of randomized studies that compare chemoradiation with radiation alone show a higher acute toxicity rate with the chemoradiation regimens, with a 13% to 30%
increase in severe mucositis (grade 3–4), 30% to 40% increase in leukopenia (grade 3–4), and 2% increase in early deaths secondary to acute toxicity.35–38

A critical point in our sample is the high rate of tumor relapse. One of 3 patients presented with persistence or tumor relapse during the follow-up, and most of them had to be salvaged with total laryngectomy. Local recurrence rates between 14% to 33.3% have been published for supraglottic tumors treated by means of TLM,6,7,32 these results being similar to those obtained with surgical external approaches for T3 cancer.20–22 The possibility of tumor relapse has significantly been related to the presence of vocal cord fixation or focal erosion of the thyroid cartilage in our sample. This may suggest that the subcategory of patients staged as pT3, because of pre-epiglottic involvement, are more suitable for TLM than others. In the case of T3 tumors with cord fixation, reported local control rates with open partial laryngectomies in the literature are similar to those obtained with the transoral approach. In contrast, for pT3 cases with focal cartilage infiltration, supracricoid laryngectomies have demonstrated higher local control and function preservation rates. Unfortunately, in our experience, an accurate diagnosis of cartilage erosion is not that easy with the conventional preoperative workup (endoscopic examination + CT scan), and in a remarkable number of patients the focal infiltration of the cartilage is an intraoperative finding. Not to mention that this finding has not been confirmed by histopathology in most of our patients, thus the limitation of using this variable as a prognostic factor should be considered.

Although the local control rate of our patients is inferior to that obtained with partial supracricoid laryngectomies +/- adjuvant treatment,21–24,35 it compares adequately to results after chemoradiation,17 being superior to those published for radiotherapy alone.39 The reduced local control of our patients may reduce the preservation rates, but does not seem to jeopardize the long-term survival of our patients with oncologic outcomes totally comparable to the literature.19 Moreover, when a salvage surgery is necessary, the absence of previous chemoradiation in the larynx field simplifies the surgery, reducing the risk of pharyngocutaneous fistulae, the need for locoregional or microvascular flaps, and in consequence, the cost of the procedure. In addition, the use of laser surgery as a first-line treatment in patients with advanced tumors allows us to reserve radiotherapy to treat a recurrence or a second primary tumor.

A strength in our study is that this is the first report focused specifically on the prognostic factors for survival and organ-preservation in pT3 laryngeal cancer treated with TLM. However, we believe that a few questions are still unanswered. In the 2002 TNM classification, glottic tumors involving the paraglottic space are classified as T3, but the definition of paraglottic space is not well defined. In addition, TNM classification does not consider tumor volume or does not differentiate between limited or deep infiltration of the pre-epiglottic space. It might be interesting to study the volume of tumors objectively in order to establish a prognostic difference between limited and massive involvement of pre-epiglottic space.

All patients have been evaluated and treated in the same institution according to the standard protocol of our department. For the present analysis, patients with advanced stage of disease, but not locally advanced cancer of the larynx, have been excluded in order to homogenize the sample. The results obtained in our study suggest that TLM may be a good alternative for selected pT3 laryngeal tumors, with results comparable to other organ-preservation strategies. From the functional point of view, more than 50% of the patients were able to preserve the larynx and the function in our sample without jeopardizing the survival. The higher organ-preservation rate was observed in the category of patients with pre-epiglottic involvement (76%), followed by those with focal infiltration of the cartilage (52%), and finally those with fixed vocal cord (40%).

The lack of randomization of TLM with other surgically preservation alternatives or chemoradiation-based protocols constitutes a limitation of our study. In addition, objective data regarding quality of life is missing, and in the absence of such definitive data results should be evaluated with caution. Prospective data regarding preoperative and postoperative quality of life of our patients has been prospectively collected since 2004 at our institution, and will be analyzed in the near future. Unfortunately, the number of patients treated annually in our center is not sufficient to conduct a randomized protocol to answer which is the best preservation strategy for T3 laryngeal cancer in a reasonable
period of time. Larger multi-institutional protocols including surgical strategies versus treatments based on combined chemoradiation are necessary to confirm the usefulness of TLM in the treatment of T3 laryngeal cancer.

In conclusion, the results obtained in our study suggest that TLM seems to be a good organ preservation alternative in a large number of T3 laryngeal tumors, with survival rates comparable to those obtained by other surgical and nonsurgical strategies, and organ preservation above 60%.

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