

Functional Outcomes After Transoral CO₂ Laser Surgery for Laryngeal Neoplasms: An Original Clinical Study

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Rezumat

Rezultate funcționale după chirurgia transorală cu laser CO₂ pentru neoplazmele laringiene: studiu clinic original

Introducere: Microchirurgia transorală cu laser CO₂ (TLM) reprezintă o metodă consacrată de tratament cu preservare de organ pentru tumorile laringiene, cu indicații în extindere pentru cazuri selectate local avansate. Scopul acestui studiu a fost evaluarea caracteristicilor pacienților, a abordurilor chirurgicale și a rezultatelor funcționale postoperatorii la pacienții tratați prin TLM.

Material și metodă: A fost efectuată o analiză retrospectivă a 137 de pacienți cu neoplasme laringiene tratați prin chirurgie transorală cu laser CO₂ în perioada 2022-2025. Au fost analizate datele demografice, stadializarea tumorală, factorii de risc identificați și tipurile de intervenții chirurgicale. Rezultatele funcționale au fost evaluate utilizând Voice Handicap Index-10 (VHI-10), Eating Assessment Tool-10 (EAT-10) și Functional Oral Intake Scale (FOIS). Includerea cazurilor T3 selectate s-a realizat pe baza unor criterii clinice și imagistice prestabilite. Au fost utilizate statistici descriptive și testul chi-pătrat, pragul de semnificație statistică fiind stabilit la $p < 0,05$.

Rezultate: Vârsta medie a pacienților a fost de $68,0 \pm 10,3$ ani, cu o ușoară predominanță a sexului masculin (53,3%). Tumorile în stadii precoce și intermediare, clasificate T1–T2, au reprezentat 78,1% dintre cazuri, în timp ce 21,9% au fost reprezentate de tumori T3 selectate. Consumul de tutun a fost raportat la 66,4% dintre pacienți, iar consumul de alcool la 47,4%. Pozitivitatea HPV a fost identificată în 17,5% dintre cazuri. Majoritatea pacienților au fost supuși corpectomiilor ELS tip I–IV. În stadiile tumorale precoce au fost observate rezultate vocale favorabile, în timp ce unele leziuni T3 au fost asociate cu scoruri VHI-10 mai ridicate. Funcția de deglutiție a fost păstrată la majoritatea pacienților; totuși, disfagia semnificativă clinic a fost identificată la 20,0% dintre pacienții cu tumori T3 selectate și la 13,3% dintre pacienții cu tumori supraglotice. Pe parcursul urmăririi, majoritatea pacienților au atins niveluri FOIS de 6-7.

Concluzii: Chirurgia transorală cu laser CO₂ reprezintă o metodă eficientă de tratament

Received: 24.03.2026
Accepted: 25.05.2026

cu preservare de organ pentru neoplasmale laringiene, oferind rezultate funcționale excelente în stadiile precoce și rezultate acceptabile în cazurile T3 atent selectate. Selecția riguroasă a pacienților și utilizarea unei tehnici chirurgicale adecvate sunt esențiale pentru optimizarea rezultatelor.

Cuvinte cheie: microchirurgie transorală laser, cancer laringian, corpectomie, rezultate vocale, funcția de deglutiție

Abstract

Background: Transoral CO₂ laser microsurgery (TLM) is an established organ-preserving treatment for laryngeal tumors, with expanding indications in selected locally advanced cases. This study aimed to evaluate patient characteristics, surgical approaches, and postoperative functional outcomes in patients treated with TLM.

Material and Methods: A retrospective analysis was conducted on 137 patients with laryngeal neoplasms treated with transoral CO₂ laser surgery between 2022-2025. Demographic information, tumor staging, identified risk factors, and surgical interventions were subject to analysis. Functional outcomes were evaluated through the Voice Handicap Index-10 (VHI-10), Eating Assessment Tool-10 (EAT-10), and Functional Oral Intake Scale (FOIS). Inclusion of specific T3 tumors was determined by established clinical and radiological guidelines. Descriptive statistics and chi-square tests were employed, with a significance threshold established at $p < 0.05$.

Results: The mean age was 68.0 ± 10.3 years, with a slight male predominance (53.3%). Early and intermediate tumors, classified as T1-T2, made up 78.1% of the cases. In contrast, the remaining 21.9% of the cases were attributed to selected T3 tumors. Tobacco use was reported in 66.4% of patients and alcohol consumption in 47.4%. HPV positivity was identified in 17.5% of cases. Most patients underwent ELS type I–IV corpectomies. In the early stages of tumor development, positive voice outcomes were observed, whereas higher VHI-10 scores were seen in some T3 lesions. Most patients maintained their swallowing function; however, clinically significant dysphagia was found in 20.0% of the selected T3 tumors and 13.3% of supraglottic tumors. During follow-up, most patients reached FOIS levels of 6–7.

Conclusions: Transoral CO₂ laser surgery is an effective organ-preserving treatment for laryngeal neoplasms, providing excellent functional outcomes in early-stage tumors and acceptable results in selected T3 lesions. Careful patient selection and appropriate surgical technique are essential to optimize outcomes.

Keywords: transoral laser microsurgery, laryngeal cancer, corpectomy, voice outcomes, swallowing function

Introduction

Laryngeal neoplasms represent a significant proportion of head and neck malignancies and continue to pose important challenges in terms of oncologic control and preservation of laryngeal function. In recent decades, treatment strategies have increasingly focused on preserving organs. This shift has been accompanied by a growing emphasis on functional results, particularly voice and swallowing, in addition to survival rates.

Transoral CO₂ laser surgery has become a widely used conservative treatment for early-stage and select intermediate-stage laryngeal tumors. The CO₂ laser's accuracy makes it possible to remove tumors with very little harm to nearby tissues from heat, which helps keep the function of the area. Research indicates that transoral laser treatments yield local control rates for early glottic carcinoma comparable to those achieved with radiation. These methods also have advantages, such as the ability to do the procedure again and the fact that they don't rule out other treatment options if the cancer comes back (1-3). As survival rates have

improved, there has been more interest in how patients do after therapy. The quality of your voice and your capacity to swallow are very important for communication, nutrition, and your overall mental health, as well as for being able to participate in social activities. As a result, validated patient-reported outcome measures, such as the Voice Handicap Index and the Eating Assessment Tool, have become important tools for figuring out how well treatment is working from the patient's point of view (4-6).

In the early stages of the disease, the results of transoral CO₂ laser surgery are generally good. However, these results can be affected by factors such as the stage of the tumor, how much tissue is removed, and whether important parts of the larynx are involved. For more advanced tumors, particularly some T3 lesions, careful selection of patients is essential to maintain a balance between oncologic safety and functional preservation. Several researchers have said that transoral laser techniques may work well for some carefully chosen cases of T3 laryngeal cancers that don't invade cartilage or extend outside the larynx.

This means that more drastic treatments like total laryngectomy aren't necessary (7-9). Nonetheless, the existing data regarding the functionality of this particular group remains sparse and inconsistent.

Transoral CO₂ laser surgery is commonly employed; nevertheless, several research emphasize cancer-related outcomes, whereas the consistent reporting of standardized functional outcomes is very rare. Moreover, comparative data that distinguish by tumor stage and the extent of laser resection are still scarce.

The objective of the present study was to assess functional outcomes following transoral CO₂ laser surgery for laryngeal neoplasms using validated voice and swallowing assessment tools. Secondary objectives included evaluation of functional results according to tumor stage and type of transoral CO₂ laser resection, with particular attention to outcomes in patients with selected T3 tumors managed using an organ-preserving approach.

Material and Methods

Study Design and Patient Population

This retrospective observational study included 137 consecutive patients with primary laryngeal neoplasms who underwent transoral CO₂ laser surgery at a single tertiary referral center between 2022-2025. Clinical data were gathered retrospectively from institutional medical records.

The preoperative assessment comprised clinical examination, flexible and rigid endoscopy, and cross-sectional imaging. The current TNM classification was used to stage the tumors (10).

The study cohort consisted only of patients with primary laryngeal neoplasms who had transoral CO₂ laser surgery. Patients with recurring malignancies, salvage surgeries, or previous radiotherapy were excluded.

Definition of Selected T3 Tumors

Transoral CO₂ laser surgery was only an option for T3 laryngeal tumors if they met certain clinical and radiological selection criteria (*Table 1*). These criteria encompassed restricted involvement of the paraglottic and/or pre-epiglottic space, maintenance of the laryngeal framework, lack of cartilage invasion or extralaryngeal extension on CT and/or MRI, preservation or slight impairment of vocal cord movement, and the absence of necessity for permanent tracheostomy.

According to these standards, 30 patients (21.9% of the study group) were identified as having chosen T3 tumors and were treated with a transoral CO₂ laser method.

Table 1. Definition of selected T3 laryngeal tumors included in the study

Selection criterion	Requirement for inclusion
Tumor extension	Limited paraglottic and/or pre-epiglottic space involvement
Laryngeal framework	Preserved
Cartilage invasion	Absent on CT and/or MRI
Extralaryngeal extension	Absent
Vocal cord mobility	Preserved or mildly impaired
Airway status	No permanent tracheostomy required

Surgical Technique

All patients underwent transoral CO₂ laser surgery under general anesthesia using microscopic visualization. Tracheostomy was not routinely performed as part of the transoral CO₂ laser procedure and was reserved for patients with anticipated or postoperative airway compromise, significant laryngeal edema, or other airway-related concerns. The amount of resection was based on where the tumor was located, how deep it had spread, and how far along it was in the preoperative staging process. The European Laryngological Society (ELS) cordectomy classification was used to sort laser resections (11).

ELS type I-IV cordectomies were performed predominantly in patients with T1 and T2 glottic tumors. Extended ELS type V cordectomies and transoral laser supraglottic laryngectomies were performed in patients with primary supraglottic tumors and in selected T3 laryngeal cancers (n = 30) characterized by limited supraglottic extension, preserved laryngeal framework, and absence of cartilage invasion or extralaryngeal spread on preoperative imaging.

Data Collection

Demographic data, tumor characteristics, smoking and alcohol exposure, HPV status, and type of laser resection were recorded for all patients. HPV status was not available for all patients; cases without documented HPV testing were recorded as HPV status unknown. Baseline patient and tumor characteristics are summarized in *Table 2*, the criteria defining selected T3 tumors in *Table 1*, and the distribution of surgical procedures in *Table 3*.

Functional Outcome Measures

Voice outcomes were assessed using the Voice Handicap Index-10 (VHI-10) (4). Swallowing outcomes were assessed using the Eating Assessment Tool-10 (EAT-10) (5) and the Functional Oral Intake Scale (FOIS) (6).

Table 2. Patient and tumor characteristics of the study cohort (n = 137)

Characteristic	n (%) or mean $\pm$ SD
Total number of patients	137 (100%)
Age, years	
Mean $\pm$ SD	68.0 $\pm$ 10.3
Range	50–85
Sex	
Male	73 (53.3%)
Female	64 (46.7%)
Tumor stage (clinical T stage)	
T1	52 / 137 (38.0%)
T2	55 / 137 (40.1%)
Selected T3	30 / 137 (21.9%)
Smoking status	
Smoker	91 (66.4%)
Non-smoker	46 (33.6%)
Alcohol consumption	
Yes	65 (47.4%)
No	72 (52.6%)
HPV status	
Positive	24 (17.5%)
Negative	80 (58.4%)
Unknown	33 (24.1%)

Timing of Functional Assessment

Functional outcomes (VHI-10, EAT-10, and FOIS) were recorded postoperatively and, when available, preoperatively, during routine clinical follow-up. For the primary analysis, functional outcomes were evaluated at the last available follow-up.

Endpoints

The primary endpoint was postoperative functional status, assessed using VHI-10, EAT-10, and FOIS at last follow-up. Secondary analyses explored functional outcomes stratified by tumor stage (T1, T2, selected T3) and by type of transoral CO₂ laser resection. Clinically significant dysphagia was defined as an EAT-10 score $\geq$ 3.

Statistical Analysis

Descriptive statistics were utilized to encapsulate patient demographics, tumor attributes, surgical

interventions, and functional results. Continuous variables are shown as the mean $\pm$ standard deviation, whereas categorical variables are shown as the number and percentage. We used IBM SPSS Statistics for Windows, version 28.0 (IBM Corp., Armonk, NY, USA) to undertake the statistical analysis.

Results

Patient and Tumor Characteristics

A total of 137 patients with laryngeal neoplasms treated by transoral CO₂ laser surgery during the study period were included in the analysis. Baseline demographic and tumor characteristics are summarized in Table 2.

The mean age of the study population was 68.0 $\pm$ 10.3 years (range, 50–85 years). The sex distribution was relatively balanced, with a slight male predominance (73 males, 53.3%). Most tumors were diagnosed at an early or intermediate stage, with T1 and T2 lesions accounting for 78.1% of cases. Selected T3 tumors represented 21.9% of the cohort.

A history of tobacco use was frequent, reported by 66.4% of patients, while 47.4% reported alcohol consumption. HPV status was available in 75.9% of patients; among these, 24 patients (17.5%) were HPV-positive, whereas HPV status was unknown in 33 cases (24.1%).

Descriptive Graphs

Descriptive graphs illustrating the cohort characteristics reported in Table 2 are presented in Fig. 1 A–F.

Selected T3 Tumors

Thirty patients were selected for transoral CO₂ laser surgery based on specific clinical and radiological criteria. These patients had T3 laryngeal tumors that met the following conditions: limited spread to the paraglottic and/or pre-epiglottic spaces, an intact laryngeal structure, and no signs of cartilage invasion or spread beyond the larynx. All selected T3 cases were managed using a surgical approach that preserved the organ. Table 1 provides a detailed description of the selection criteria.

Type of Transoral CO₂ Laser Surgery

The distribution of surgical procedures is presented in Table 3.

Most patients underwent ELS type I–IV cordec-tomies (78.1%), reflecting the predominance of early-

Table 3. Type of transoral CO₂ laser surgery performed (n = 137)

Type of laser resection	n (%)
ELS corpectomy type I (subepithelial)	18 (13.1%)
ELS corpectomy type II (subligamental)	27 (19.7%)
ELS corpectomy type III (transmuscular)	36 (26.3%)
ELS corpectomy type IV (total corpectomy)	26 (19.0%)
ELS corpectomy type V (extended corpectomy)	15 (10.9%)
Transoral laser supraglottic laryngectomy	15 (10.9%)
Total	137 (100%)

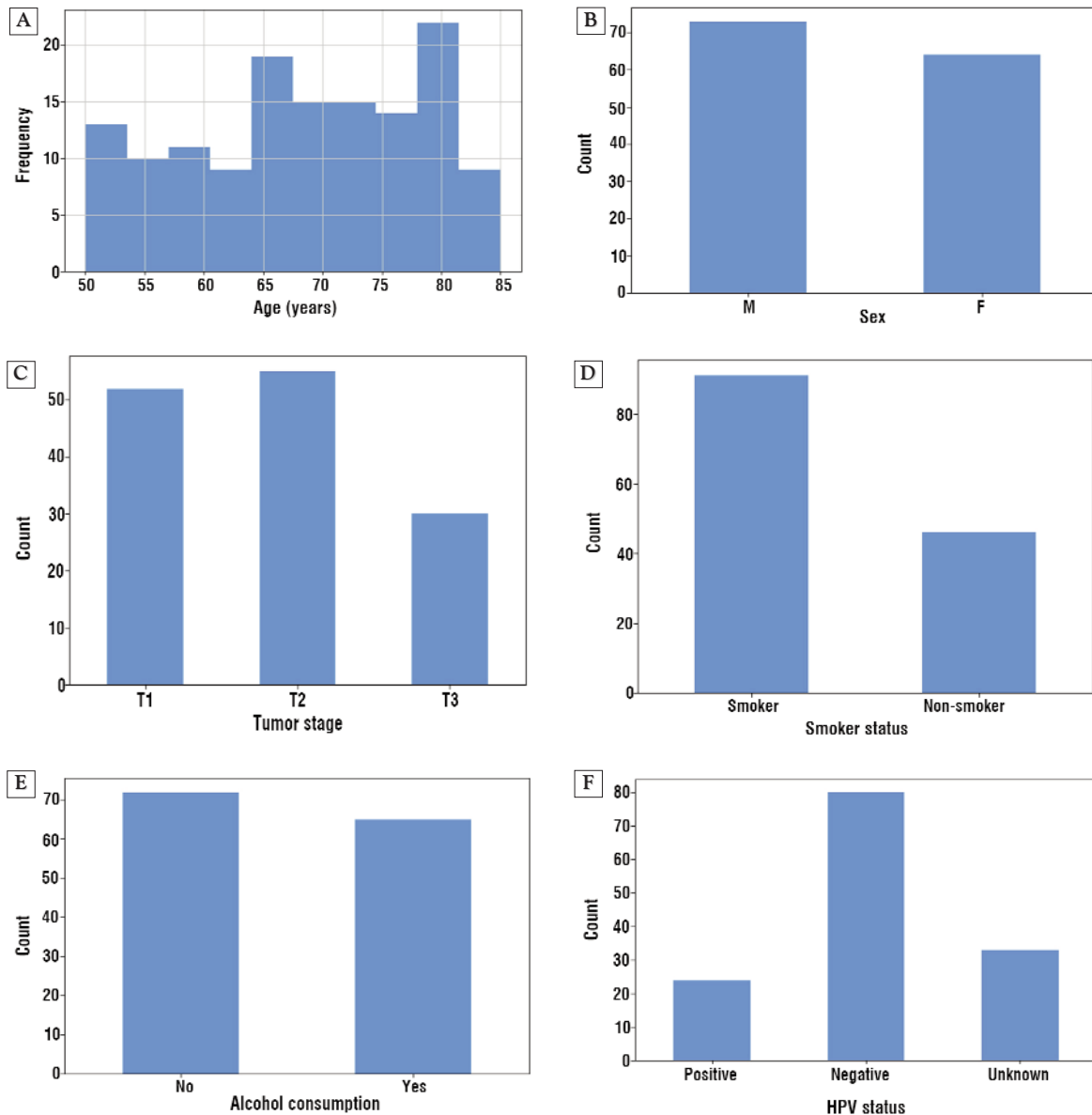


Figure 1. (A) Age distribution; (B) Sex distribution; (C) Tumor stage distribution; (D) Smoking status; (E) Alcohol consumption; (F) HPV status

stage glottic tumors in the cohort. Extended ELS type V cordectomies were performed in 10.9% of cases, primarily for more extensive glottic lesions.

Transoral laser supraglottic laryngectomy was performed in 15 patients (10.9%), including patients with primary supraglottic tumors and selected vocal cord T3 lesions with limited supraglottic extension. No intraoperative conversion to open surgery was required. No patient in the study cohort required temporary or permanent tracheostomy during the postoperative period; therefore, no decannulation

interval was applicable. No patient required surgical re-excision or repeat transoral CO₂ surgery during the study period. Consequently, no post-reintervention analysis of VHI-10 or EAT-10 scores was applicable.

Functional Outcomes by Tumor Stage and Extent of Resection

Postoperative functional outcomes assessed using VHI-10, EAT-10, and FOIS are summarized in Table 4.

Table 4. Postoperative functional outcomes according to tumor stage and tumor site (n = 137)

Group	VHI-10 (last follow-up)	EAT-10 (last follow-up)	EAT-10 ≥ 3 , n (%)	FOIS weeks 1–2	FOIS weeks 3–4	FOIS 1.5–3
T1 (n = 52)	7 (n=47); 8 (n=5)	0 (all patients)	0 (0%)	7	7	7
T2 (n = 55)	13 (n=43); 18 (n=12)	0–1	0 (0%)	6–7	6–7	6–7
Selected T3 (n = 30)	21 (n=17); 22–27 (n=13)	0–3; 3 in 6 patients	6 (20.0%)	4–5	6	6–7
Supraglottic tumors (n = 15)	10 (n=11); 12 (n=4)	1–3	2 (13.3%)	4–5	6	6–7

Voice Outcomes (VHI-10)

Voice outcomes, measured using the Voice Handicap Index-10 (VHI-10), showed that patients with T1 tumors reported only a little voice-related difficulty at their last follow-up appointment. Specifically, 47 patients had VHI-10 scores of 7, and 5 patients had scores of 8.

In the T2 group, the VHI-10 scores were slightly higher. Most patients scored 13 (n = 43) or 18 (n = 12).

In patients with specific T3 tumors, the VHI-10 scores were higher, ranging from 21 to 27.

At the last follow-up, the Voice Handicap Index-10 (VHI-10) scores for patients with supraglottic tumors ranged from 10 to 12.

The distribution of VHI-10 scores across tumor stages and anatomical subsites is illustrated in Fig. 2. As the tumor stage progressed, the median VHI-10 scores showed a consistent increase. The T3 tumors, in particular, showed a wider range of scores.

Swallowing outcomes (EAT-10)

Swallowing function was preserved in all T1 cases (EAT-10 = 0). EAT-10 scores in the T2 group ranged between 0 and 1, with no cases of clinically significant dysphagia. Clinically significant dysphagia (EAT-10 ≥ 3) was present in 6 patients (20.0%) in the selected T3 group.

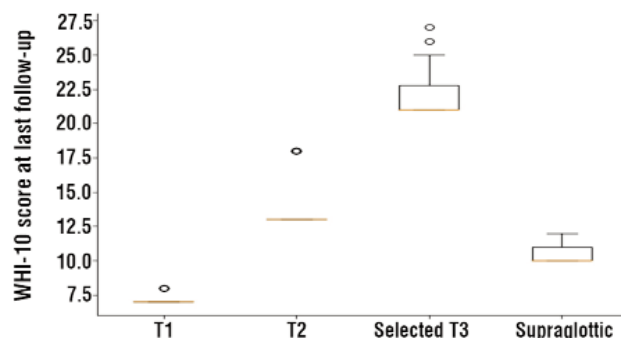
In supraglottic tumors, EAT-10 scores ranged between 1 and 3, with 2 patients (13.3%) demonstrating clinically significant dysphagia. The distribution of post-operative EAT-10 scores across tumor stages is shown in Fig. 3.

Oral Intake Recovery (FOIS)

Oral intake was maintained at FOIS 7 in T1 patients throughout follow-up.

In the T2 group, early postoperative dietary restriction was minimal (FOIS 6–7).

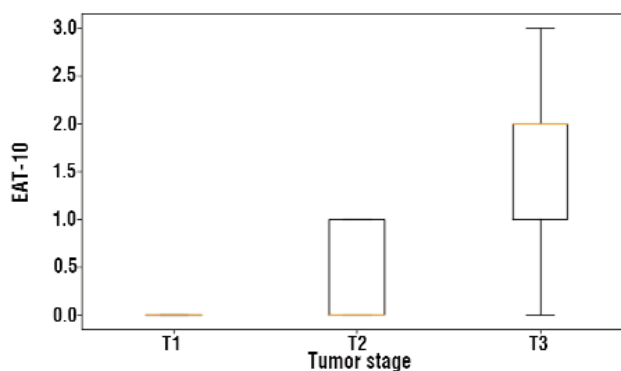
In selected T3 tumors, oral intake was temporarily reduced during the first two postoperative weeks (FOIS 4–5), with progressive recovery to FOIS 6 by weeks 3–4 and FOIS 6–7 at 1.5–3 months.

**Figure 2.** Boxplot of VHI-10 scores by tumor stage and anatomical subsite

A similar recovery pattern was observed in supraglottic tumors. The proportion of patients presenting clinically significant dysphagia (EAT-10 ≥ 3) by tumor stage is presented in Fig. 4.

Chi-square Association Tests

Chi-square tests were used to evaluate associations between categorical variables and tumor stage (T1/T2/T3). Statistical significance was defined as $p < 0.05$.

**Figure 3.** EAT-10 scores by tumor stage

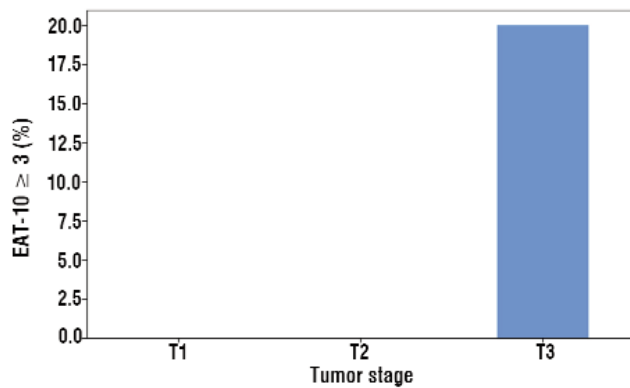


Figure 4. Clinically significant dysphagia according to tumor stage

Sex vs Tumor Stage

Observed counts:

Tumor_Stage	T1	T2	T3
Sex			
F	26	25	13
M	26	30	17

Chi-square (χ^2) = 0.398, p = 0.8194

This association is not statistically significant (p $\geq$ 0.05).

Smoking Status vs Tumor Stage

Tumor_Stage	T1	T2	T3
Smoking_Status			
Non-smoker	12	24	10
Smoker	40	31	20

$\chi^2 = 5.067$, p = 0.079

This association is not statistically significant.

Alcohol Consumption vs Tumor Stage

Observed counts:

Tumor_Stage	T1	T2	T3
Alcohol_Consumption			
No	26	30	16
Yes	26	25	14

$\chi^2 = 0.231$, p = 0.891

This association is not statistically significant (p $\geq$ 0.05).

HPV_Status vs Tumor_Stage

Observed counts:

Tumor_Stage	T1	T2	T3
HPV_Status			
Negative	34	28	18
Positive	7	10	7

Unknown 11 17 5
Chi-square (χ^2) = 3.992, p = 0.4071

This association is not statistically significant (p $\geq$ 0.05).

Discussion

This study examined the functional outcomes after transoral CO₂ laser surgery for laryngeal tumors, involving 137 patients.

Our findings support that transoral laser microsurgery (TLM) provides favorable functional outcomes, particularly in early-stage tumors, while maintaining acceptable results in carefully selected T3 lesions. Our group's demographic characteristics align with the known patterns of laryngeal cancer. The average age and slight male predominance reflect findings from large epidemiological studies. Moreover, the high rate of tobacco use supports its established role as a major risk factor for laryngeal cancer (12,13).

Most cases involved tumors that were found early, which is consistent with current clinical practices.

Transoral laser microsurgery (TLM) is often the first treatment for early glottic carcinoma. Previous studies have shown that TLM provides similar cancer control to radiotherapy for T1-T2 tumors. However, TLM has advantages, such as the ability to repeat treatments and the preservation of other treatment options (1-3,14).

A significant facet of this investigation involves the examination of specific T3 tumors managed via a transoral technique. Contemporary research indicates that, in meticulously chosen instances devoid of cartilage infiltration or extralaryngeal spread, transoral laser microsurgery (TLM) can yield adequate oncological control while maintaining laryngeal functionality (7-9). Our results align with these observations, revealing favorable functional outcomes within this particular cohort.

Voice outcomes were significantly affected by both the tumor stage and the degree of surgical removal. Those with T1 tumors exhibited a negligible perceived voice handicap, aligning with prior research that indicated positive voice outcomes following transoral laser surgery for early-stage glottic carcinoma (15,16). Conversely, patients with T2 tumors presented with somewhat elevated VHI-10 scores, potentially indicative of more extensive resections; nevertheless, the results were still deemed acceptable and comparable to those documented in comparative studies involving radiotherapy (15,17).

As anticipated, the most elevated VHI-10 scores were recorded in specific T3 tumors, which is

consistent with the more extensive resections performed and their subsequent effects on vocal fold function. Despite this, the majority of patients exhibited functional voice outcomes, thereby reinforcing the utility of TLM as an organ-preserving strategy in the management of advanced tumors, provided they are judiciously selected (18).

Swallowing outcomes were generally positive across most patients. Clinically significant dysphagia was absent in those with T1 and T2 tumors; conversely, only a small proportion of patients with specific T3 tumors exhibited swallowing difficulties. These results align with prior research indicating a swift restoration of swallowing function subsequent to transoral procedures, presumably attributable to the preservation of laryngeal framework structures and the avoidance of external incisions (17-20).

Likewise, oral intake demonstrated a gradual recovery across all tumor stages. While some patients experienced transient difficulties following more extensive resections, the majority achieved near-normal FOIS levels within the initial months post-surgery, thereby underscoring the functional benefits associated with minimally invasive transoral approaches.

No statistically significant associations were identified between tumor stage and the analyzed demographic or risk-factor variables. Although factors such as smoking and alcohol consumption are well-established in laryngeal carcinogenesis, their relationship with tumor stage at diagnosis may be influenced by multiple factors, including healthcare access and timing of diagnosis.

It is important to recognize a few restrictions. Selection bias may emerge from the study's retrospective methodology, especially regarding the inclusion of particular T3 tumors. Also, the study's single-center design may restrict the applicability of its findings. Incomplete data makes it hard to fully understand how HPV influences tumor features.

Even with these limitations, this study provides useful information about how well people function after transoral CO₂ laser surgery.

The reliability of the findings is strengthened by the relatively large number of participants and the use of established measures that assess patient-reported outcomes.

Moreover, the incorporation of specific T3 tumors adds to the accumulating evidence advocating for the broadened application of transoral surgical techniques in a carefully curated patient population.

The results of this study support the use of transoral CO₂ laser surgery as a successful treatment that preserves the larynx for laryngeal tumors. This

method provides good results for voice and swallowing, while also ensuring that cancer is effectively treated in carefully selected patients.

Conclusions

Transoral CO₂ laser microsurgery is a viable treatment for laryngeal tumors that preserves the organ, and it often leads to good functional results for most patients.

In this study, patients with early-stage tumors (T1-T2) showed excellent voice and swallowing function after surgery, with only a small impact on their voice and the ability to eat normally.

Although patients with certain T3 tumors presented with higher VHI-10 scores, the majority demonstrated acceptable voice quality and satisfactory swallowing outcomes during the follow-up. Temporary postoperative swallowing difficulties were most frequently observed in patients who underwent more extensive resections, particularly those with selected T3 and supraglottic tumors; however, oral intake generally improved over time in most cases.

These findings support the value of transoral CO₂ laser surgery as a minimally invasive treatment, demonstrating its capacity to preserve laryngeal function while achieving effective cancer control in appropriately selected patients. Moreover, with the application of rigorous selection criteria, transoral laser techniques could present a feasible approach to organ preservation for specific T3 laryngeal tumors, potentially circumventing the necessity for more aggressive interventions such as total laryngectomy (7-9).

Careful patient selection, thorough imaging before surgery, and following established surgical classification systems are essential for ensuring both cancer safety and the best possible functional outcomes. More research, including long-term studies with larger groups of patients, is needed to better understand the long-term functional and cancer-related results of transoral CO₂ laser surgery, especially for patients with certain advanced laryngeal tumors.

Conflicts of Interest

The authors declare no conflict on interest.

Ethical Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Coltea Clinical Hospital.

References

- Steiner W. Results of curative laser microsurgery of laryngeal carcinomas. *American Journal of Otolaryngology*. 1993;14(2):116–121.
- Peretti G, Piazza C, Cocco D, De Benedetto L, Martin E, Nicolai P. Transoral CO₂ laser treatment for Tis–T3 glottic cancer: the University of Brescia experience on 595 patients. *Head & Neck*. 2010;32(8):977–983.
- Remmelts AJ, Hoebels FJP, Klop WMC, Balm AJM. Evaluation of laser surgery and radiotherapy as treatment modalities for early-stage laryngeal carcinoma: tumor outcome and voice quality. *European Archives of Oto-Rhino-Laryngology*. 2013;270(7):207–214.
- Rosen CA, Lee AS, Osborne J, Zullo T, Murry T. Development and validation of the Voice Handicap Index-10. *The Laryngoscope*. 2004;114(9):1549–1556.
- Belafsky PC, Mouadeb DA, Rees CJ, Pryor JC, Postma GN, Allen J, et al. Validity and reliability of the Eating Assessment Tool (EAT-10). *Annals of Otolaryngology & Laryngology*. 2008;117(12):919–924.
- Crary MA, Mann GD, Groher ME. Initial psychometric assessment of a functional oral intake scale for dysphagia in stroke patients. *Archives of Physical Medicine and Rehabilitation*. 2005;86(8):1516–1520.
- Piazza C, Filastro M, Dikkers FG, Nouraei SAR, Puxeddu R, Sittel C, et al. Long-term oncologic results of transoral laser microsurgery for Tis–T3 glottic carcinoma. *Head & Neck*. 2014;36(4):1–9.
- Canis M, Ihler F, Martin A, Wolff HA, Matthias C, Steiner W. Transoral laser microsurgery for T1–T3 laryngeal cancer: oncologic and functional outcomes. *Head & Neck*. 2015;37(1):1–7.
- Piazza C, Paderno A, Grazioli P, Peretti G. Endoscopic management of laryngeal cancer. *Current Opinion in Otolaryngology & Head and Neck Surgery*. 2016;24(2):1–7.
- Brierley JD, Gospodarowicz MK, Wittekind C, editors. *TNM Classification of Malignant Tumours*. 8th ed. Oxford: Wiley-Blackwell; 2017.
- Remacle M, Eckel HE, Antonelli A, Brasnu D, Chevalier D, Friedrich G, et al. Endoscopic cordectomy: a proposal for a classification by the Working Committee, European Laryngological Society. *European Archives of Oto-Rhino-Laryngology*. 2000;257(4):227–231.
- Steuer CE, El-Deiry M, Parks JR, Higgins KA, Saba NF. An update on larynx cancer. *CA: A Cancer Journal for Clinicians*. 2017;67(1):31–50.
- Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: A Cancer Journal for Clinicians*. 2018;68(6):394–424.
- Peretti G, Piazza C, Del Bon F, Mora F, Grazioli P, Barbieri D. Transoral laser microsurgery for early glottic cancer: oncologic outcomes and functional results. *Head & Neck*. 2013;35(3):385–390.
- Greulich MT, Parker NP, Lee P, Merati AL. Voice outcomes following radiation versus laser microsurgery for T1 glottic carcinoma. *Otolaryngology–Head and Neck Surgery*. 2015;152(5):811–819.
- Park JJ, Kim SH, Cho KJ, Choi SH, Kim SY, Nam SY. Voice outcomes after transoral laser microsurgery for early glottic cancer. *Clinical and Experimental Otorhinolaryngology*. 2019;12(3):241–246.
- Ma Y, Mathew A, Ward PD. Long-term voice outcomes after radiation versus transoral laser microsurgery for early glottic cancer. *The Laryngoscope*. 2019;129(3):653–659.
- Vilaseca I, Bernal-Sprekelsen M, Blanch JL. Transoral laser microsurgery for supraglottic carcinoma: oncologic and functional outcomes. *Head & Neck*. 2010;32(3):321–327.
- Motta G, Esposito E, Motta S, Tartaro G, Testa D. Functional results of transoral laser surgery for supraglottic carcinoma. *Head & Neck*. 2008;30(5):620–625.
- Ambrosch P. The role of laser microsurgery in the treatment of laryngeal cancer. *Current Opinion in Otolaryngology & Head and Neck Surgery*. 2007;15(2):82–88.