

COMPARISON OF TRANSORAL LASER AND OPEN PARTIAL LARYNGECTOMY FOR T1 AND T2 GLOTTIC CANCER: A REVIEW OF LITERATURE

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Abstract

T1–T2 glottic carcinomas may be treated with conservative surgery or radiotherapy. The goals of treatment are cure and laryngeal voice preservation. The aim of the current study was to review the literature and discuss the optimal management of T1 and T2 glottic carcinoma. Literature review indicated that the local control, laryngeal preservation, and survival rates of patients were similar after transoral laser resection and open partial laryngectomy. Voice quality depended on the extent of resection for patients undergoing surgery; results for patients undergoing laser resection for limited lesions showed better Voice Handicap Index scores, whereas open partial laryngectomy yielded poorer results. The cost of treatment was more for open partial laryngectomy. Patients with well defined lesions suitable for transoral laser excision with a good functional outcome were treated with laser. Open partial laryngectomy was reserved for patients with locally recurrent tumors.

This review has been conducted by analyzing the Data which has been displayed in Pubmed literature in the last 25 years on the topics of Transoral Laser and Open partial Laryngectomy in the management of T1 and T2 glottic cancer. The various original articles and review articles were analyzed and compared and a conclusion derived.

Keywords: transoral laser, open partial laryngectomy, cordectomy, voice

1. Introduction

In India, at 30-69 years, the three most common fatal cancers were oral (including lip and pharynx, 45,800 22.9%), stomach (25,200 12.6%), and lung (including trachea and larynx, 22,900 11.4%) in men. Tobacco-related cancers represented 42.0% (84,000) of male and 18.3% (35,700) of female cancer deaths and there were twice as many deaths from oral cancers as lung cancers.¹

Larynx preservation is an undisputable advance in larynx cancer management. For early diseases, open surgery, transoral laser or irradiation may control the disease and preserve the larynx function. For advanced cases, chemotherapy-based protocols have been validated, but the best protocol is still to be defined.²

In this present review of literature we have considered carcinoma in situ (Tis), non-metastasizing tumours involving one (T1a) or both (T1b) vocal cords as well as unilateral or bilateral glottic carcinomas with infiltration of the supra- and/or subglottis with or without preservation of vocal cord mobility (T2)

2. Management of T1 and T2 Glottic cancer

Management of patients with T1 – T2 N0 disease may vary from transoral laser excision, open

partial laryngectomy and chemoradiotherapy but the goals of treatment are cure and laryngeal voice preservation.

It is seen that in more than 95% of patients who have disease recurrences will do so within 5 years of treatment, so outcomes reported at 5 years accurately reflect the efficacy of therapy.³ Endpoints of interest include local control, ultimate local control (including successful salvage treatment after a local tumour recurrence), absolute survival, cause-specific survival, and complications.

Cause-specific survival, in which deaths due to malignancy and those secondary to complications are coded as treatment failures, is a more accurate reflection of treatment efficacy compared with absolute survival. Although voice quality after treatment is of interest, it varies with extent of resection (for patients treated surgically), and data pertaining to this outcome are relatively limited.⁴ Cost is also important and varies depending on the methods of reimbursement. Data pertaining to this endpoint are even more limited.

2.1 Local Control

2.1.1 Transoral laser excision (Table 1): In transoral laser excision, the lesions are removed with a clear margin of approximately 1–3 mm.

The thermal damage zone does not interfere with assessment for histological clearance. The CO₂ laser is the laser of choice.

There is very little postoperative oedema. Postoperative voice function is mainly influenced by the amount of tissue resected. Morbidity associated with transoral laser microsurgery of early glottic cancer is low. A tracheostomy is never required and complications are rare, enabling the surgery to be performed on an outpatient basis.

Laser ablation in the vicinity of the cartilage, or even on the cartilage, does not cause perichondritis or necrosis, resulting from thermal effects. In addition, there is also a perceived benefit: small blood vessels and lymphatics are sealed off, thus minimizing any metastatic spread during surgery.

A classification of laryngeal endoscopic cordectomies was first proposed by European laryngology society in 2000. The classification described 8 types of cordectomies, as follows:^{5,6}

- Type I: Subepithelial cordectomy, which is the resection of vocal cord epithelium passing through the superficial layer of lamina propria.
- Type II: Subligamental cordectomy, which is resection of epithelium, or Reinke's space and vocal ligament.
- Type III: Transmuscular cordectomy, which proceeds through vocalis muscle.
- Type IV: Total cordectomy, which extends from vocal process to the anterior commissure.
- Type Va: Extended cordectomy encompassing the contralateral vocal fold.
- Type Vb: Extended cordectomy encompassing the arytenoids.
- Type Vc: Extended cordectomy encompassing the ventricular fold.
- Type Vd: Extended cordectomy encompassing the subglottis.

This classification did not propose any specific management for the lesions arising from the anterior commissure, which are being included among the indications for type Va cordectomy. To solve this problem, new cordectomy, encompassing the anterior commissure and anterior part of vocal cord, was proposed by European laryngology society working committee on nomenclature. This is classified as type VI which includes resection of the anterior commissure with bilateral anterior cordectomy; may include the subglottic mucosa and the cricothyroid membrane. Type VI is indicated for cancer originating in the anterior commissure

involving one or both the vocal cords, without infiltrating the thyroid cartilage.⁵

Laser-assisted microsurgery for laryngeal malignancy is *not* contraindicated in the older patients. On the contrary, it provides a viable alternative, avoiding a protracted course of radiotherapy which can be challenging because of the patient's failing general health, cardiac or pulmonary condition, etc.

In young patients (under 40 years), radiotherapy is not advised because of the potential for radiation-induced carcinoma in later life. Laser endoscopic surgery is therefore a viable option in this age group.

Steiner in 1993,⁷ reported a series of 240 patients who were treated with trans oral laser for laryngeal cancer from 1979 to 1991. Of these 240 patients, 159 were divided into Tis = 29, T1 = 96, T2 = 34, out of these only 6% developed a local recurrence and one patient required a total laryngectomy. The overall 5-year survival rate (Kaplan-Meier) was 86.5%. The adjusted 5-year survival rate was 100%.

Ambrosio in 2001,⁸ published a case series of 411 patients which were categorized as pT1a = 248, pT1b = 35, pT2a = 128, and local control rates for pT1a = 92%, for pT1b = 80%, and for pT2 (vocal cord mobile) = 84%, laryngectomy was required in 1.2% with pT1a, 5.7% with pT1b, and in 3.7% with pT2 (vocal cord mobile). The 5 year ultimate local control rate was 99% for pT1a, 97% for pT1b, and 96% with pT2 (vocal cord mobile) glottic cancer.

Motta in 2005,⁹ published one of the largest case series of seven hundred nineteen patients (687 men and 32 women; mean age, 60.4 years; range, 33-86 years) with glottic carcinoma (432 T1N0M0, 236 T2N0M0, 51 T3N0M0) underwent CO₂ laser surgery (mean follow-up, 5 years; range, 2-17 years). Statistical comparison was carried out with Wilcoxon test, considering $p < .05$ the minimum significance value. Overall actuarial survival, adjusted actuarial survival, and percentage of patients with no evidence of disease at 5 years were 85%, 97%, and 85%, respectively, in patients with T1a disease; 84%, 96%, and 83% in those with T1b disease; 77%, 86%, and 61% in those with T2 unilateral tumours; 77%, 88%, and 55% in those with T2 bilateral tumours.

König in 2006,³⁶ reviewed 143 patients with an isolated and previously untreated glottic carcinoma classified as Tis = 7, T1 = 91 and T2 = 45, were treated by CO₂ endoscopic laser resection, noted a recurrence of 12.2 % for the group including Tis and T1, and 28.9% in case of

T2 tumours. The overall laryngeal preservation rate was 95% for Tis and T1, and 85% for T2.

With transoral laser, local control rates for T1 and T2 disease range from 77% - 92% and 66% - 88% respectively, ultimate local control after salvage therapy is approximately 97% - 98% and a laryngeal preservation of 90% - 99%. The 5 year disease specific survival is reported to be 90% - 98%.

2.1.2 Open partial laryngectomy (Table 2):

Various open surgical procedures for the treatment of T1 and T2 glottic cancer are open corpectomy through a thyrofixure, open vertical partial laryngectomy, and hemilaryngectomy.

Thomas in 1994,¹⁰ presented a series of 159 patients with glottic cancer between 1976-1986, with a median follow up of 6.6 years. Surgical treatment in this group of 159 patients included 82 frontolateral partial vertical laryngectomies, 61 laryngofissures with corpectomy, 12 hemilaryngectomies, and four anterior commissure procedures. Estimates of survival time beyond the day of surgery, time to first recurrence (local, regional, and distant), and time to first local recurrence were obtained with the Kaplan-Meier product-limit method. Eleven patients experienced recurrent laryngeal cancer. Ten patients underwent laryngectomy for recurrence. One patient underwent an anterior commissure procedure. Three of the 11 patients who underwent re-treatment of the larynx were ultimately salvaged. The probability of survival at 3 and 5 years was 91% and 84%, respectively. The probability of remaining free of local recurrence 3 and 5 years after surgery was 94% and 93%, respectively. Thomas concluded that open laryngeal procedures continue to be excellent treatment for select cases of early glottic carcinoma. They are versatile and efficacious for managing the wide spectrum of larger T1 glottic carcinomas.

Laccourreye in 1994,¹³ in a series of 416 cases, reported that 67 patients staged as T2 received 3 cycles of induction chemotherapy with fluorouracil and cisplatin followed by supraglottic laryngectomy and cricohyoidopiglottopexy. The local control rates were 94% and ultimate local control was achieved in 66 patients (99%), and 65 patients (97%) experienced laryngeal preservation.

Spector in 1999,¹¹ reported 404 patients of T1 glottic cancer with a local control rate of 92% and laryngeal preservation rate of 93% and achieving ultimate local control of 99%. In another study Spector,¹² reported 71 patients of T2 glottic cancer with a local control of 93% and laryngeal

preservation in 93% and ultimate local control of 99%.

For open partial laryngectomy procedures the local control rates range from 86% - 98%, the ultimate local control rates vary from 99% - 100% after salvage therapy and a laryngeal preservation rate of 88% - 100% with a five year disease specific survival rate of 92% - 97% for T1 and T2 stage lesion.

3. Voice outcome

Voice quality encompasses social, psychosocial, mental and physical components. Evaluation of voice quality following laryngeal surgery can be one of the first attempts to assess the functional outcome following successful treatment.

Tolga Kandogan in 2005,³⁷ in a Questionnaire study to assess the outcome of quality of life, and voice handicap index, found that Cricohyoidopexy group have given the lowest scores (57.63) and the Corpectomy group has given the highest scores (67.50) in three questionnaires, representing their quality of life, performances and new voices. These ranges are also consistent with the laryngeal tissue excised during surgery. Although the arytenoidectomy patients had longer oral feeding and decanulation times, there are no statistically significant effects on the quality of life, the functional outcomes, or the quality of voice. This finding further implies that the arytenoid removal does not have an adverse effect on the quality of life, the functional outcomes, or the quality of voice from the patients point of view. Removing the arytenoid only makes the oral feeding and the decanulation times longer in the first weeks after the operation, but after the tissue heals completely and laryngeal reflexes return to normal, larynx begins compensating arytenoids excision and functions satisfactorily.

In all of the patient groups, the quality of voice was found to be sufficient to hold a normal individual conversation. However, the voice was defined by the patients as hoarse and dull. It was rated to be insufficient to make a conversation in a noisy atmosphere, since it cannot be raised satisfactorily.

Rosier *et al.*¹⁴ reported on 18 patients treated at St.- Luc University Hospital (Brussels, Belgium) between 1979 and 1995 for T1N0 glottic carcinoma with transoral laser resection ($n=6$), open partial laryngectomy ($n=5$), or radiotherapy ($n=7$). Perceptual voice ratings were provided by the patients, three non- speech therapists, and two speech therapists. There was a trend toward poorer patient satisfaction after open partial

laryngectomy compared with laser excision or radiotherapy. There was also a nonsignificant trend toward less hoarseness and breathiness after radiotherapy compared with transoral laser excision.

To conclude voice quality is determined by an individual wound healing process, which is associated with varying degrees of granulation tissue and postoperative scarring. Effective postoperative voice therapy is another important factor. The prospects of successful voice rehabilitation depend ultimately on what functionally important structures the surgeon was able to preserve. These prospects are most favourable when the voice can be rehabilitated at the level of glottic phonation.

4. Cost

Gre'goire *et al.*,¹⁵ working at St.-Luc University Hospital, performed a cost-minimization analysis comparing transoral laser resection, open partial laryngectomy, and radiotherapy for T1N0 glottic carcinoma. He found that transoral laser resection and radiotherapy had roughly the same average cost, whereas open partial laryngectomy was approximately twice as expensive. The analysis did not include indirect costs, such as missed work for those who were employed.

Footo *et al.*¹⁶ evaluated a series of patients treated at the Mayo Clinic for Tis–T1 glottic carcinoma. They found that the overall charges and costs were similar for patients treated with radiotherapy compared with transoral resection and both treatments were less expensive than open partial laryngectomy.

5. Survival

Approximately 15–20% of patients die of intercurrent disease within 5 years of treatment. The data regarding survival statistics is insufficient and it can only be assessed from the local control rates at 5 years. The survival rates are roughly comparable among the various treatment modalities, with minor differences likely to reflect selection bias rather than differences in efficacy.

5.1 The Anterior Commissure: This area needs special attention as the absence of perichondrium at the vocal ligament insertion, the extension of the vocal ligament fibers into the thyroid cartilage, and the connections between the intra and extralaryngeal blood vessels and lymphatics were often referred to as possible reasons for recurrences in the anterior commissure.

Primary anterior commissure tumours are rare, but glottic tumours involving the commissure are not

infrequent and overshadow both the possibilities of a cure and the functional sequelae. The involvement is related to a reduction in local control of the illness.^{17, 18, 19}

The high ratio of cures in the initial stages of laryngeal cancer, including most of the tumours affecting the anterior commissure, implies an assessment of results based on survival as well as the impact of functional sequelae.^{20, 21, 22}

Majority of the studies focus on the weak points through which tumours affecting the anterior commissure can extend into other levels of the larynx (supraglottis, subglottis), cartilage or extralaryngeal structures.^{23, 24, 25, 26}

Clinical evaluation of the lesion depending on whether it has an infiltrating or non-infiltrating morphology implies different behaviour. In case of non infiltrating morphology, the tumour is usually limited to the glottic plane, and in tumours with infiltrating morphology the tumour is often deeply invasive, reaching other planes of the larynx and behaving as a true anterior transglottic tumour.²⁷

Resection of the anterior portion of the ventricular bands must be done with caution in view of their importance in the vocal rehabilitation phase. The tumour must be resected with magnification and direct vision. In difficult cases, a biopsy must be made after 6–8 weeks to ensure there is no relapse.

Laccourreye *et al.*²⁹ reported on 416 patients with T1 and T2 glottic carcinoma who underwent open vertical partial laryngectomy. The local recurrence rate in carcinomas with involvement of the anterior commissure was 23%. As an alternative to frontolateral partial resection supracricoid laryngectomy was performed in some centers with the intent to improve the local control rate in anterior commissure carcinomas. Laccourreye *et al.*³⁰ reported on 62 cases of SCPL-CHEP in T1 and T2 glottic carcinomas with anterior commissure involvement. Eighty-one per cent of the patients had undergone neoadjuvant chemotherapy prior to surgery. An excellent 5-year local control rate of 98% could be achieved. No total laryngectomy or permanent tracheotomy had to be carried out for functional reasons. One must take into consideration however, that supra cricoids partial laryngectomy with cricohyoido epiglottopexy with prior chemotherapy is associated with considerable morbidity and can be applied not to every patient. Even though all patients could be decannulated in Laccourreye's series, 17 patients needed postoperative swallowing training, 4 received a temporary and one a permanent feeding tube.

Steiner *et al.*²⁸ analyzed the influence of anterior commissure involvement on local recurrences, laryngeal preservation, and survival in 263 patients with early glottic cancer that underwent transoral laser microsurgery. It was shown that involvement of the anterior commissure affected the local control and organ preservation rates but not the survival rates. The Kaplan-Meier 5-year local control rate of carcinomas with or without involvement of the anterior commissure was 86% vs. 95% for T1a carcinomas, 75% vs. 93% for T1b carcinomas and 78% vs. 83% for T2 (vocal cord mobile) carcinomas. Larynx preservation was possible in 93% vs. 99% of T1a cancer patients, in 88% vs. 94% in T1b cancer patients and 93% vs. 97% in T2 (vocal cord mobile) cancer patients, in the same study Steiner *et al.*²⁸ report local control at T1a with involvement of the AC in 84% and 84% after 3 and 5 years, respectively, with 7% of total laryngectomies. In T1b with involvement of the AC, 81% and 73% after 3 and 5 years, respectively, with 13% of total laryngectomies.

These results could be confirmed by Rodel in a subsequent study encompassing 444 patients.³¹ Similar results were found by Sachse *et al.*³² in a retrospective study.

Chone *et al.*³³ and Peretti *et al.*³⁴ did not find significantly different local control rates in laser microsurgically treated early glottic cancers with or without anterior commissure involvement. Herranz *et al.*³⁵ in a literature review have analyzed and summarized the treatment results in early glottic cancer with involvement of the anterior commissure. They conclude that the three treatment options (surgery open or endoscopic, radiotherapy) have similar outcomes. The choice of treatment should be based on the experience and skill of the treating physician.

In transoral laser microsurgery, good exposure of the tumour and follow-up microlaryngoscopy after 6–8 weeks to have a “second look” operation can be useful to rule out any residual tumour.

Conclusion

In a study conducted by Maurizi *et al* 2005,³⁹ in which he documented 198 patients treated from January 1993 to June 2002, 132 patients were treated by CO2 laser cordectomy were placed in Group1, and 66 patients were treated by open surgery were placed in Group 2. Within Group 1, 16 patients developed local failure, which was retreated in 6 cases with laser surgery; in 9 (6.8%) with total laryngectomy, only 1 case was inoperable. In this group, 10 patients (62.5%)

were salvaged. Within Group 2, 18 patients developed local recurrences, which were retreated, 14 (21.21%) cases with total laryngectomy; the other 4 cases were not suitable for surgery. Of these 18, 8 patients (44.5%) were salvaged.

Results show significant differences between the two groups concerning the specific-disease survival and the salvage ability of local recurrences. In fact, in Group 1 they found a higher salvage rate and a lower incidence of total laryngectomy. As laser therapy leaves the laryngeal cartilaginous framework intact, avoiding the spread of the tumour out of laryngeal organ and resulting in a more favourable oncologic outcome.

Eckel in 2001,³⁸ notified 252 patients with glottic carcinoma of stage 1 and stage 2 treated with Transoral Laser Surgery and reported a recurrence rate of 13.9% (35 patients) and concluded that the results were inferior to that achieved by conventional partial laryngectomy.

Patients categorized as T1N0M0 have tumours ranging from microcancers confined to one vocal cord to larger ones involving the anterior commissure and both vocal cords. The aim of treatment is to cure the cancer and to achieve at the same time the best functional results without any serious complications. For this reason, the treatment of T1-T2 glottic carcinomas has given rise to much controversy in the literature, because they can be successfully treated either by radiation therapy or by external or endoscopic conservative surgery.

Endoscopic CO2 laser surgery can be considered the best surgical approach to T1-T2 glottic cancers, resulting in a progressively decreased popularity of external surgery. In fact, laser resection offers minimized postoperative morbidity, particularly because of better deglutition, and rarely requires tracheotomy. Furthermore, in cases of local recurrences, laser surgery leaves space for further treatments such as adjuvant radiotherapy, laser retreatment, or salvage surgery.

During laser CO2 cordectomy, laryngeal cartilages are left intact; these confine the recurrence within the organ, whereas when cartilages are opened, as in laryngofissure cordectomy, the cancer can easily reach the extralaryngeal tissues through the weak point.

Laser treatment not only allows an excellent plasticity and precision in the management of malignancy but also offers a better local control and survival in comparison with open surgery.

The main contraindication to Laser Cordectomy are:-

1. Lesions with deep involvement of the anterior commissure that are in close proximity to underlying cartilage.
2. Impaired arytenoid mobility as the tumor may invade the cricoarytenoid joint, the posterior cricoarytenoid muscle, or the posterior portion of the cricoid cartilage.

Looking at the above mentioned contradictions and considering the deformed anatomy in patients with large tumors the need for open partial laryngectomy still remains, and moreover in cases with recurrence after treatment with transoral laser or radiotherapy the final resort is open partial laryngectomy or total laryngectomy depending upon the extent.

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Table 1. Local control after Transoral Laser

Author	T staging	No. of Patients	Local control (%)	Larynx preservation (%)
Steiner, ⁷ 1993	pTis – pT2	159	94	99
Ambrosh, ⁸ 2001	T1a	248	92	99
	T1b	35	80	97
	T2 (vocal cord mobile)	128	84	96
Motta, ⁹ 2005	T1a and T1b	432	T1a=85 T1b=83	- -
	T2	236	T2 (unilateral)=61 T2 (bilateral)=55	- -
Konig, ³⁶ 2006	Tis-T1	98	88.8	95
	T2	45	72.1	85

Table2. Local control after Open Partial Laryngectomy

Author	T staging	No. of Patients	Local control	Laryngeal preservation
Thomas, ¹⁰ 1994	Tis –T1	159	93	-
Laccourreya, ¹³ 1994	T2	67	98	97
Spector, ¹¹ 1999	T1	404	92	-
Spector, ¹² 1999	T2	71	93	93