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Original Research Article

T1 and T2 glottic squamous cell carcinoma: endoscopic laser surgery versus radiotherapy experience in a cancer center in Mexico

Kuauhyama Luna-Ortiz[1]*, Veronica Villavicencio-Valencia[1], Zelik Luna-Peteuil[2], Dorian Y. Garcia-Ortega[3], Saul Favila-Lira[4], Diana Villavicencio-Valencia[1], Philippe Pasche[5]

[1]Department of Head and Neck Surgery Instituto Nacional de Cancerología
[2]Universitatea de Medicinâ și Farmacie Grigore T. Popa Iași
[3]Department of Surgical Oncology Instituto Nacional de Cancerología
[4]National Autonomous University of Mexico
[5]ORL and Cervocofacial surgery, Hirslanden Clinic, Lausanne

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***Correspondence:**
Dr. Kuauhyama Luna-Ortiz,
E-mail: kuauhyama@yahoo.com.mx

ABSTRACT

Background: Radiotherapy and endoscopic laser surgery (ELS) has been considered the primary treatment for laryngeal cancer. This study aims to compare ESL and radiotherapy in terms of organ preservation, disease-free survival, overall survival and cancer-specific survival.
Methods: A retrospective study using database of T1-T2 glottic cancer treated with radiotherapy and ELS. Disease-free survival, overall survival and cancer specific survival (CSS) for both groups according to Kaplan-Meier.
Results: 108 patients received radiotherapy and 98 patients underwent ELS were analyzed. Organ preservation rate was higher in the ELS group (88.8% vs 84.3%) p=NS. The percentage of patients alive without disease was higher in the ELS group (85.7% vs 58.3%) (p<0.00). The five-year general OS rates were 93% and 91% in the ELS and radiotherapy group, respectively; while the ten-year OS rates were 93% and 63%, respectively. The five-year and ten-year OS rates for T1 and T2 (p=NS). Five-year CSS in the ELS and radiotherapy group was, respectively, 86% and 85%, whereas ten-year CSS was 83% and 50%, respectively (p=NS). A sub analysis of recurrent cases was performed for both groups. Organ preservation was achieved in 71.1% of cases in the ELS group compared with 58% in the radiotherapy group (p=0.23).
Conclusions: T1 tumors should be exclusively treated with ELS or open surgery, diagnosis and treatment can be combined in a single surgical procedure. Before administering radiotherapy, a diagnosis is needed. T2 tumors should be properly selected for their management and many approaches are available. Organ preservation is similar for both groups.

Keywords: Early laryngeal cancer, Endoscopic, Laser, Microlaryngoscopy, Organ preservation, Recurrence, Radiotherapy, Survival, Surgery, Transoral approach

INTRODUCTION

The incidence of laryngeal cancer has decreased by 2.4% annually over the past decade due to anti-tobacco policies.[1] Radiotherapy has traditionally been the standard treatment for early-stage tumors (T1, T2); however, surgical procedures that preserve the organ, such as ELS, are now considered the best option. Since 2006, ELS has been replacing radiotherapy as the preferred treatment for T1-T2 laryngeal cancer in the Americas.[2] In Europe, especially in Germany, endoscopic surgery remains the most common treatment. Both treatments have shown survival rates ranging from 80%

to 90%.[2,3] In early stages, it is important to consider not only survival but also voice quality, swallowing, overall quality of life and available options in case of recurrence. Radical surgery like total laryngectomy may be necessary but eliminates the possibility of organ preservation. These treatments are not interchangeable; each has its own advantages. Radiotherapy involves modern and costly equipment, while ELS requires less expensive equipment but highly trained personnel skilled in open partial laryngectomies.[4] This study aims to compare ELS and radiotherapy regarding organ preservation, disease-free survival and overall survival in a cancer center in Mexico.

METHODS

This retrospective study focused on patients with early-stage glottic cancer (T1-T2 N0M0). It was reviewed, approved and registered (#2025/148) by the Institutional Review Board and written informed consent was obtained from all patients. Two groups treated during different periods were examined: a radiotherapy group from 1990 to 2005 and an ESL group from 2005 to 2022at the Instituto Nacional de Cancerologia (Mexico). Biopsies were taken from all patients in the radiotherapy group, either in the doctor's office or operating room under general anesthesia, with prophylactic radiation administered to the neck.

Patients in the ESL group received clinical diagnosis in the doctor's office and underwent outpatient surgery. In cases of clinical suspicion, they underwent neck ultrasound and fine-needle aspiration biopsy. Endoscopic biopsy under general anesthesia was performed in all patients with suspected recurrence. Follow-up visits were scheduled every 3 months during the first year, every 4 months in the second year, every 6 months until the fifth year and annually thereafter.

All patients were evaluated by fiberoptic laryngoscopy. All patients treated with Radiotherapy and ESL group at our hospital were included. Criteria exclusion were those patients treated in another institution or by other surgical team.

Statistical analysis

Age, sex, symptoms, tumor location, T stage, clinical stage, persistence, relapse, treatment, organ preservation after relapse and status were compared in both groups. Disease-free survival (DFS), overall survival (OS) and CSS were estimated for both groups using Kaplan-Meier curves.

RESULTS

Patients

Two groups of patients were included in the analysis: the radiotherapy group (108 patients) and the ELS group (98 patients). The radiotherapy group received treatment for 6 weeks, while patients in the ELS group were discharged on the same day of surgery and ate a standard diet.

Clinical characteristics

Table 1 shows the clinical characteristics, including sex, associated diseases and symptoms. Dysphonia was more frequent in the ELS group, but it was accompanied by dyspnea and dysphagia in the radiotherapy group (p=0.04).

Regarding staging, T1b was twice as common in the radiotherapy group (p=0.01), however, no significant difference was seen in clinical stage (p=0.17) or local recurrence (38.8% in the ELS group and 35.2% in the radiotherapy group, p=0.59). Although the organ preservation rate was higher in the ELS group (88.8% vs 84.3%), this difference was not statistically significant (p=0.34). The percentage of patients alive without disease was higher in the ELS group than in the radiotherapy group (85.7% vs 58.3%, p<0.00).

Survival

Five-year disease-free survival (DFS) in the ELS and radiotherapy groups was, respectively, 57% and 66%. Ten-year DFS was 53% in both groups (p=NS). Five- and ten-year DFS for T1 and T2 showed no significant differences between the two groups (p=NS) (Figure 1).

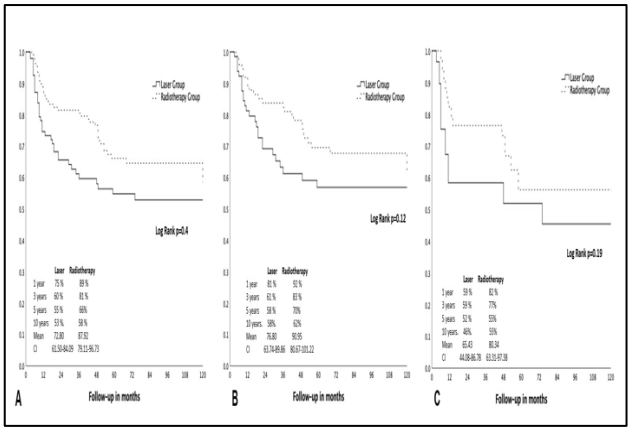

Figure 1 (A-C): General disease-free survival at 5- and 10-years comparisons between ELS vs RT, T1 DFS at 5- and 10-years comparisons between ELS vs RT, T2 DFS at 5- and 10-years comparisons between ELS vs RT.

Five-year OS in the ELS and radiotherapy groups was, respectively, 93% and 91%, while ten-year OS was 93% and 63%, respectively. Five- and ten-year OS for T1 and T2 showed no significant differences between groups (p=NS) (Figure 2). Five-year (CSS) in the ELS and radiotherapy groups was, respectively, 86% and 85%, while ten-year CSS was 83% and 50%, respectively (p=NS) (Figure 3).

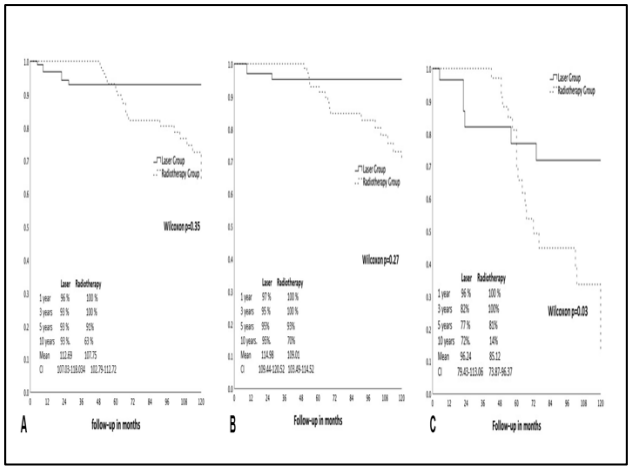

Figure 2 (A-C): General overall survival (OS) at 5- and 10-years comparisons between ELS vs RT, T1 OS at 5- and 10-years comparisons between ELS vs RT, T2 OS at 5- and 10-years comparisons between ELS vs RT.

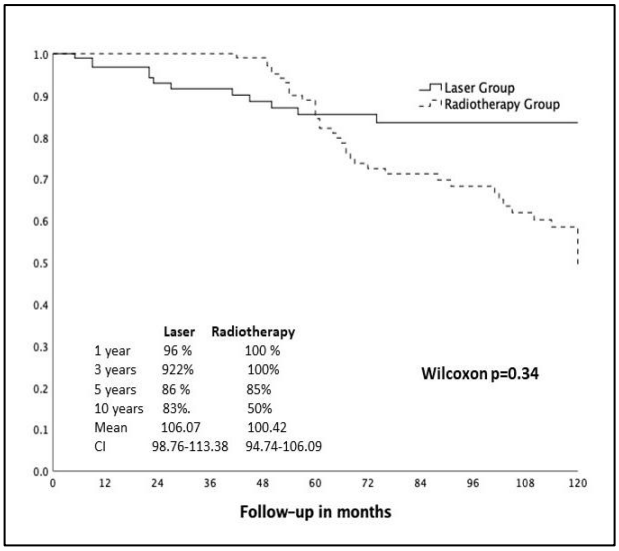

Figure 3: Cancer specific survival comparisons between ELS vs RT at 5 and 10 years.

Subnalysis in both groups

A sub analysis of recurrent cases was conducted for both groups (Table 2). We found that among patients with T1 glottic cancer, recurrence occurred in 25 patients (65.8%) in each group. However, when T1 was further divided, there was a higher number of T1b cases in the radiotherapy group (16 patients, 42.1%, p<0.058). Although the number of T2 cases was the same in both groups (13 patients), 55.3% of patients in the ELS group experienced primary site recurrence, while 44.7% developed a second primary cancer.

Local recurrences occurred in 90.9% of patients in the ELS group, compared to 63% in the radiotherapy group. Regional recurrences were seen in 9.1% of patients in the ELS group versus 23.7% in the radiotherapy group. A significant difference was noted in distant recurrence, with 0% in the ELS group and 13.2% in the radiotherapy group (p=0.005) (Table 2).

However, 57.9% of patients in the ELS group required a first reoperation (second-look surgery), 34.2% needed a second reoperation and 7.9% underwent a third reoperation. Organ preservation was achieved in 71.1% of cases in the ELS group compared to 58% in the radiotherapy group (p=0.23) (Table 2).

Table 1: Clinical characteristics of both groups.

	Laser (n=98)	Radiotherapy (n=108)	P value
Age in years	63.97	62.59	0.37
	Min-Max 30-91	Min-Max 32-88	
	Mean 63.78	Mean 62.59	
	standard deviation 12.06	standard deviation 13.04	
Sex	**N (%)**	**N (%)**	
Male	91 (92.9)	98 (90.7)	0.58
Female	7 (7.1)	10 (9.3)	
Symptoms			
Dysphonia	97 (99.0)	99 (91.7)	0.04
Dysphonia+dyspnea	1 (1.0)	4 (3.7)	
Dysphagia	0 (0)	5 (4.6)	
Concomitant disease			
None	63 (64.3)	76 (70.4)	0.48
Mellitus diabetes	8 (8.2)	4 (3.7)	
Arterial hypertension	17 (17.3)	19 (17.6)	
Dyslipidemia	1 (1.0)	0 (0.0)	
Diabetes+hypertension	7 (7.1)	9 (8.3)	
Hypertension+dyslipidemia	1 (1.0)	0 (0.0)	
Obesity	1 (1.0)	0 (0.0)	

Continued.

	Laser (n=98)	Radiotherapy (n=108)	P value
T stage			
Tis	3 (3.1)	0 (0.0)	
T1a	50 (51.0)	39 (36.1)	0.01
T1b	16 (16.3)	35 (32.4)	
T2	29 (29.6)	34 (31.5)	
Clinical stage			
0	3 (3.1)	0 (0.0)	0.17
I	67 (68.4)	74 (68.5)	
II	28 (28.6)	34 (31.5)	
Recurrence			
Yes	38 (38.8)	38 (35.2)	0.59
No	60 (61.2)	70 (64.8)	
Status			
Alive without disease	84 (85.7)	63 (58.3)	
Alive with disease	7 (7.1)	25 (23.1)	<0.000
Dead without disease	1 (1.0)	5 (4.6)	
Dead with disease	6 (6.1)	15 (13.9)	
Status			
Alive	84 (85.7)	63 (58.3)	<0.000
Dead	14 (14.3)	45 (41.7)	
Functional status of larynx			
Organ preservation	87 (88.8)	91 (84.3)	0.34
Total laryngectomy	11 (11.2)	17 (15.7)	

Table 2: Recurrence, characteristics and treatment of both groups.

	Laser (n=38)	Radiotherapy (n=38)	P value
	N (%)	N (%)	
T			
Tis	2 (5.3)	0 (0.0)	
T1a	16 (42.1)	9 (23.7)	0.058
T1b	7 (18.4)	16 (42.1)	
T2	13 (34.2)	13 (34.2)	
Clinical stage			
0	2 (5.3)	0 (0.0)	0.353
I	23 (60.5)	25 (65.8)	
II	13 (34.2)	13 (34.2)	
Number of recurrences			
1	22 (57.9)	38 (100)	
2	13 (34.2)	0 (0.0)	<0.0001
3	3 (7.9)	0 (0.0)	
Site of recurrence			
Same site	21 (55.3)	38	
Second primary	17 (44.7)	No data	
Site of recurrence			
Local	36 (90.9)	24 (63.2)	0.005
Regional	2 (9.1)	9 (23.7)	
Distant	0 (0.0)	5 (13.2)	
Distant recurrence			
None	38 (100)	33 (86.8)	
Lung	0 (0.0)	2 (5.3)	0.18
Liver	0 (0.0)	1 (2.6)	
Brain	0 (0.0)	1 (2.6)	
Lung+liver	0 (0.0)	1 (2.6)	

Continued.

	Laser (n=38)	Radiotherapy (n=38)	P value
Functional status of the larynx			
Organ preservation	27 (71.1)	22 (58)	0.23
Total laryngectomy	11 (28.9)	16 (42)	
Status			
Alive without disease	30 (78.9)	10 (26.3)	
Alive with disease	4 (10.5)	16 (42.1)	<0.000
Dead without disease	1 (2.6)	1 (2.6)	
Dead with disease	3 (7.9)	11 (28.9)	
Status			
Alive	30 (78.9)	10 (26.3)	<0.000
Dead	8 (21.1)	28 (73.7)	
Treatment for recurrence			
None	0 (0.0)	1 (2.63)	
Surgery	30 (79)	24 (63.15)	
Radiotherapy	0 (0.0)	3 (7.9)	0.02
Chemotherapy	0 (0.0)	5 (13.15)	
Palliative care	0 (0.0)	1 (2.63)	
Combined treatment	8 (21)	4 (10.52)	
Treatment for recurrence			
None	0 (0.0)	1 (2.63)	
Laser	21 (55.26)	0 (0.0)	
Local surgery	0 (0.0)	2 (5.26)	
Laryngectomy	5 (13.15)	17 (44.73)	
Laryngectomy+modified radical neck dissection	4 (10.52)	0 (0.0)	
Chemotherapy	0 (0.0)	5 (13.15)	
Chemotherapy+modified radical neck dissection	0 (0.0)	2 (5.26)	
Radiotherapy	0 (0.0)	3 (7.9)	<0.00001
Chemotherapy+local surgery	0 (0.0)	1 (2.63)	
Laser+radiotherapy	2 (5.26)	0 (0.0)	
Palliative care	0 (0.0)	1 (2.63)	
Chemo-radiotherapy	1 (2.63)	1 (2.63)	
Supracricoid laryngectomy+cricohyoidoepiglottopexy	2 (5.26)	1 (2.63)	
Laser +modified radical neck dissection	1 (2.63)	0 (0.0)	
Chemo-radiotherapy+ laser	2 (5.26)	0 (0.0)	
Modified radical neck dissection	0 (0)	4 (10.52)	

Table 3: Comparison between different series of early stages laryngeal cancer treated with laser vs radiotherapy.

	DFS laser	DFS RT	OS Laser	OS RT	DSS Laser	DSS RT
De Santis et al[12]	60% at 5 ys	67.2% at 5 ys			93.3% at 5 ys	90.8% at 5 ys
Shen et al[13]	93.1% at 3 ys	95.3% at 3 ys	95.4% at 3 ys	93.3% at 3 ys		
Shelan et al[9]	73% at 5ys	79% at 5ys	97% at 5ys 90% at 10 ys	91% at 5ys 84% at 10 ys	88% at 5ys	98% at 5ys.
Lois-Ortega et al[11]	70% at 5 ys 29.7% at 10 ys	52.4% at 5 yrs. 19.2 at 10 ys.	88.8 at 5ys. 47.2% at 10 ys.	76.3% at 5 yrs. 43.5% at 10 ys.	91.7% at 10ys.	50% at 10ys
Bron et al[10]	87% at 5 ys	66% at 5 years			90% at 5 ys	88% at 5 ys
Present series	55% at 5 ys 53% at 10 ys	66% at 5 ys 58% at 10 ys	93% at 5ys 93% at 10 ys	91% at 5 ys 63% at 10 ys	86% at 5 ys 83% ay 10 ys	85% at 5 ys 50% at 10 ys

DISCUSSION

In this retrospective study, we compared two treatments for patients with T1-T2 (N0) glottic cancer. Authors addressed a clinical question outlined in the ASCO larynx-preservation guideline: what is the larynx-preservation treatment options for limited-stage (T1, T2) primary site disease that do not threaten survival and what considerations should be made when choosing among them? Steiner et al made significant contributions in bridging the gap between the diagnosis and treatment of early-stage glottic cancer in Germany.[2,5] Both treatments produce similar results in controlling the disease. However, authors believe that the current management of T1 tumors and most T2 tumors should not include radiotherapy as the primary treatment for early glottic cancer. These tumors can be diagnosed and treated in the same surgical procedure, reserving radiotherapy for cases of recurrence. questioned in which situations radiotherapy is indicated, given that histological confirmation is needed for it. If tumors can be diagnosed and treated simultaneously, radiotherapy will not be effectively indicated in early stages, especially T1. In a meta-analysis by Huang et al the authors found that, for T1a tumors, laser treatments were linked to better survival rates than radiotherapy.[6] This finding further supports the benefits of treating the tumor in a single session and keeping all treatment options open in case of recurrence, as if the patient had never been treated.

The ASCO larynx-preservation guideline supports this idea and highlights the need for patients to be treated with a single approach.[2] In Mexico, patients are still diagnosed by biopsy and many are treated during the same procedure. However, questions remain about whether this is enough, so doctors often give radiotherapy even when there's no visible lesion. Authors believe radiotherapy is often an example of overtreatment and the best treatment would be a new surgery with wide margins using ELS and CO2 laser. Still, most studies, including this one, compare non-randomized historical controls.

Voice quality has often been cited as an argument in favor of radiotherapy; however, no randomized controlled trials have specifically evaluated its impact. Since pre- and postoperative phoniatric assessments are not routinely performed on all patients, deterioration in voice quality may go unnoticed. Nevertheless, the more extensive the injury, the more noticeable the tissue loss tends to be.[7]

In some cases, suspension microlaryngoscopy cannot be performed due to challenging laryngeal exposure. This affects about 10% of our cases. The patients are informed about this potential. When faced with such situations, authors perform a cordectomy or vertical partial hemilaryngectomy with reconstruction using false cord imbrication under anesthesia. Patients are discharged the next day.[8] Authors did not further categorize T2 tumors into T2a and T2b. This distinction is frequently reported in the literature because T2b tumors are linked to a poorer prognosis. In such cases, treatments like chemoradiotherapy or partial laryngectomies such as supracricoid laryngectomy may be considered.[2] Warner et al supported this view in their systematic review, noting that T2 tumors achieved similar five-year local control rates with endoscopic laser surgery; however, T2b tumors showed a higher recurrence rate than T2a tumors.[9] In their systematic review, Vaculik et al suggested that transoral laser microsurgery provides better outcomes compared to other options in terms of overall survival (OS), CSS and laryngeal preservation.[10] Conversely, our review found similar OS, CSS and laryngeal preservation rates between the two groups. As Hendriksma et al noted, radiotherapy studies often lack details about anterior commissure involvement an omission that also applies to our series, partly because it is retrospective and covers two different treatment periods, which we recognize as a study limitation.[11] More recent evidence, such as the work by Seno et al suggests that hyperfractionated radiotherapy works well for T1 disease with anterior commissure involvement but is not enough for T2 disease.[4]

Even though authors observed that ELS had higher organ preservation rates (88.8%) compared to radiotherapy (84.3%), the difference was not statistically significant (p=0.34), possibly due to our sample size. Strong and Jako et al were the first to perform ELS in America.[12] It was not until 2006 that Forastiere et al began choosing ELS over radiotherapy.[2] ELS, radiotherapy and open partial laryngectomy have all demonstrated survival rates ranging from 80% to 90% in patients with T1-T2 glottic cancer.[2] Open partial laryngectomy serves as an alternative for patients unable to undergo laser resection.

Another benefit of ELS is that recurrent patients can undergo a second ELS or other treatment options, such as laryngofissure cordectomy, supracricoid laryngectomy or even radiotherapy for organ preservation. However, conservative surgery is rarely offered to radiotherapy patients and only 50 to 75% of them achieve organ preservation, with most requiring total laryngectomy, as noted by Forastiere et al.[2,13] In the subgroup of patients with recurrence in the ELS group (Table 2), most had undergone two or more laser resections, leading to a 71.1% organ preservation rate, compared to 58% in the radiotherapy group (p=0.23). Although this difference is not statistically significant, possibly due to the sample size, it suggests a trend favoring ELS. Additionally, we found that ELS provides the advantage of shorter hospital stays, with patients being discharged a few hours after surgery and able to resume their standard diet immediately.

In the study, none of the patients in the ELS group received neck treatment. However, the radiotherapy group showed a higher recurrence rate in the neck region (23.7% vs. 9.1%). No patients in the ELS group

developed distant metastasis, while the radiotherapy group had distant metastasis in 13.2% of cases (p=0.005). This might be related to the older age of the radiotherapy group and the higher rate of regional recurrences, which could explain its lower survival rate. Regarding five-year organ preservation, the series showed an overall rate of 88.8% in the ELS group and 84.3% in the radiotherapy group. Authors observed five-year laryngectomy rates of 11.2% in T1 and 15.7% in T2. Similar results were reported by Shelan H et al, who described five-year rates of 8% in stage I and 28% in stage II.[14] All laryngectomies were performed due to recurrence rather than functional deterioration. In another study, Bron et al reported organ preservation in 97% of patients after surgery and in 90.1% of those who received radiotherapy.[15] Their rates are slightly higher than those we found in the present study; however, their surgery group included open surgeries as well and 90% of their cases involved T1 tumors. Likewise, the findings regarding open surgery for organ preservation agree with those reported by Bron et al.[15] In the series, we found 17 cases (44.7%) of second primary cancers at different sites from the initial tumor location. In contrast, Shelan et al reported a lower incidence of second primary cancers at 12%.[14]

The five-year DFS in the ELS and radiotherapy groups was, respectively, 57% and 66%. The ten-year DFS was 53% in both groups (p=NS). The five-year and ten-year DFS for T1 and T2 showed no significant differences between the two groups (p=NS) (Figure 1). The five-year OS rates were 93% and 91% in the ELS and radiotherapy group, respectively; while the ten-year OS rates were 93% and 63%, respectively. The five-year and ten-year OS rates for T1 and T2 showed no statistically significant difference (p=NS) (Figure 2). The five-year CSS in the ELS and radiotherapy group was 86% and 85%, respectively. In contrast, the ten-year CSS was 83% and 50%, respectively (p=NS) (Figure 3).

The five-year OS rates were 93% and 91% in the ELS and radiotherapy groups, respectively. Shelan et al and Bron et al reported higher rates (>92%).[14,15] Authors observed that OS declined significantly after 10 years, especially in the radiotherapy group (Figure 2). The five-year CSS was 85% in both groups, which is lower than that reported by Shelan et al (96%) and Bron et al (93%).[8,15] A literature review revealed a wide range of survival rates (30% to 97%) for DFS, OS and CSS (Table 3).[16-18] Our findings agree with those reported by different authors in Table 3.

Recurrence occurred in 25 patients (25.5%) in the laser group and in 25 patients (21%) in the radiotherapy group, rates very similar to those reported by Rydell et al.[19] When there was uncertainty regarding surgical margins, some patients received adjuvant radiotherapy; however, our institutional policy is to observe initially, since laser margins are often close or may appear positive due to thermal artifacts. Furthermore, delaying radiotherapy when ultimately needed does not seem to increase the risk of subsequent laryngectomy.[20] In cases of recurrence, authors recommend repeat laser treatment when organ preservation remains feasible. Radiotherapy was the standard for many decades. However, in many cases, large biopsies were taken and patients underwent radiation due to surgical margins, which could have been considered overtreatment. Nonetheless, this was not confirmed. Additionally, advanced diagnostic methods available at the hospital allowed for better staging in the ELS group. It is also possible that some tumors were under staged during radiotherapy. ELS showed improvements in organ preservation, survival and salvage surgery.

This study may be subject to selection bias, as it was conducted across two different time periods, which could be considered a limitation. Nevertheless, it is important to note that laser surgery represents a practical and cost-effective option in developing countries particularly in settings where limited financial resources restrict access to adequate radiotherapy equipment. This approach allows us to offer patients the possibility of organ preservation.

CONCLUSION

T1 tumors should only be treated with ELS or open surgery. A diagnosis, necessary before radiotherapy, is obtained through ELS or open surgery. Therefore, diagnosis and treatment can be performed in a single surgical procedure. Radiotherapy should be reserved for recurrent cases of T1 tumors.

T2 tumors should be carefully selected for appropriate management and multiple approaches are available. However, ELS is also regarded as one of the best treatment options for resectable tumors. Organ preservation is similar for both groups; however, in cases of recurrence, patients undergoing radiotherapy often must have a total laryngectomy.

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