

Voice outcomes following transoral laser microsurgery for early glottic squamous cell carcinoma

J T KENNEDY, P M PADDLE, B J COOK, P CHAPMAN*, T A ISELI

Abstract

Introduction: Early glottic cancer may be treated with primary radiotherapy or transoral laser microsurgery with comparable survival. The choice of therapy therefore depends on patient preference after discussion of risks, benefits and alternatives.

Materials and methods: All previously untreated patients undergoing transoral laser microsurgery for T₁ or T₂ glottic cancer at St Vincent's Hospital between July 1997 and December 2004 had their staging and demographics recorded. Surgery was categorised according to the European Laryngological Society. A voice recording was made pre-operatively then at 12 weeks post-operatively and scored by two independent speech therapists on the Oates Russell Voice Profile – a scale of zero (normal) to five (severe dysphonia). Follow up was for a minimum of two years.

Results and analysis: Fifty-three patients with a mean age of 56 were included. The observed survival was T₁ 89.4 per cent and T₂ 85.3 per cent after a mean follow up of 47 months. Nineteen patients staged T₁ underwent cordectomy. A second procedure was required in 22.2 per cent, however, none required a laryngectomy. Thirty-four patients staged T₂ underwent hemilaryngectomy. A second procedure was required in 41.2 per cent including 8.8 per cent requiring salvage laryngectomy. One patient died with unresectable nodal disease. The mean Oates Russell Voice Profile for T₁ disease was 2.37 and for T₂ 2.68 (range 1 to 4) indicating a mild (2) to moderate (3) degree of voice impairment.

Conclusions: Survival outcomes following transoral laser microsurgery are comparable to treatment with radiotherapy. Voice impairment is usually mild to moderate following transoral laser microsurgery for early glottic cancer but overall may be greater than in radiotherapy patients. The repeatability of transoral laser microsurgery may result in a lower laryngectomy rate compared with published series using radiotherapy.

Key words: Laser Surgery; Larynx Neoplasms; Voice

Introduction

There were 584 new laryngeal cancers and 247 laryngeal cancer deaths in Australia in 2001.¹ Early laryngeal squamous cell carcinoma (SCC) may be treated with surgery, open laryngeal conservation surgery or transoral laser microsurgery or definitive radiotherapy. A review of over 17 000 laryngeal cancers treated in the United States between 1986 and 1992 showed that most (54 per cent) stage I glottic cancers received initial definitive treatment with radiotherapy. The five-year relative survival rate was comparable between radiotherapy (73 per cent) and surgery (81 per cent). The five-year survival rate for stage II glottic cancer treated initially with surgery alone was 57 per cent where radiation had a five-year survival of 69 per cent (and 70 per cent for the combination).

However, the lower surgical survival rate may reflect a selection bias as cancers staged T₂ on the basis of impaired fold mobility are treated preferentially with surgery in many centres and have a poorer prognosis.² A recent meta-analysis concluded that 'there is no good evidence available from randomised controlled trials to guide treatment choice for patients with early stage glottic cancer'.³

Strong and Jako first described use of the CO₂ laser to endoscopically resect laryngeal cancers.⁴ Strong showed that in up to 20 per cent of cases, no residual SCC remained after the initial diagnostic biopsy often making radiotherapy unnecessary. Steiner showed six local recurrences and only one laryngectomy in 159 patients followed for at least five years using transoral laser microsurgery techniques.⁵ Since then, transoral laser microsurgery

From the Department of Otolaryngology, Head and Neck Surgery and the *Department of Speech Pathology, St Vincent's Hospital, Victoria, Australia.
Accepted for publication: 30 January 2007.

has been widely adopted as an alternative to definitive radiotherapy in the treatment of early laryngeal cancer.⁶

If local control and survival are comparable the choice between surgery and radiotherapy for early laryngeal cancer is determined by patient preference after discussion of risks, benefits and likely functional outcomes. Steiner showed that most transoral laser microsurgery cases could be done as day cases with modest pain for a few days. Patients must be warned that approximately one-third of patients require a second procedure, often to biopsy suspicious granulation tissue. Most radiation protocols take six weeks, cause painful mucositis lasting a further two to four weeks and carry the small but real risk of causing a radiation induced tumour (estimated at 1/300).⁷

Materials and methods

Transoral laser microsurgery became a treatment option at St Vincent's Hospital in 1997. All patients with early (T₁/T₂) glottic cancer electing to undergo transoral laser microsurgery between July 1997 and December 2004 had their patient demographics and tumour maps recorded. Patients who had a second primary tumour or who had received previous treatment (other than a biopsy) were excluded.

Details of the surgery were prospectively recorded as cordectomy (level I-IV according to depth of invasion), vertical hemilaryngectomy or extended hemilaryngectomy as defined by the European Laryngological Society.⁸

All patients who elected to receive transoral laser microsurgery had a voice recording taken pre-operatively and 12 weeks post-operatively. The voice recordings were independently analysed by two independent speech therapists against the Oates Russell Voice Profile.⁹ This gives a grade of 0 (normal) to 5 (severe dysphonia).

Patients were reviewed six weekly for the first six months then three monthly for two years then four to six monthly until five years. All patients were followed for a minimum of two years.

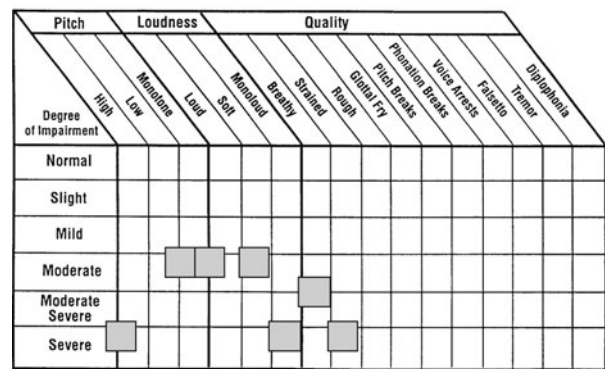
Results and analysis

There were 53 patients who underwent transoral laser microsurgery for early glottic SCC from July 1997 to December 2004. Thirty-six (67.9 per cent) patients were male and 17 (32.1 per cent) were female. The mean age of patients was 56 years (range 37 to 83 years). The mean follow up was 47 months (range 24 to 111 months) excluding two patients who died before 24 months follow up (at nine and 13 months after treatment).

Nineteen patients were staged T₁ and underwent cordectomy (six cordectomy level II, six cordectomy level III and seven patients cordectomy level IV). Fifteen (78.9 per cent) patients staged T₁ underwent a single procedure, three (15.8 per cent) a second procedure to biopsy granulations and one (5.3 per cent) a third procedure after the second biopsy showed SCC in situ. No patients required a

Perceptual Voice Profile

Name : _____ Date : _____
 Clinician : _____ U.R. : _____



From "A Sound Judgement" CD ROM © 1997 J.Oates & A.Russell

FIG. 1
 Typical Oates Russell Voice Profile scoring 2.

laryngectomy for salvage for T₁ cancer. Two patients (10.6 per cent) staged T₁ died in the follow-up time, one of a second primary lung cancer at 45 months following his surgery and the other of acute myocardial infarction at 25 months following his surgery.

The mean Oates Russell Voice Profile following cordectomy was 2.37 (range 1 to 4) indicating a mild (2) to moderate (3) degree of voice impairment. A typical scoring chart for a patient scoring 2 can be seen in Figure 1. The Oates Russell Voice Profiles for different cordectomies (depth of resection) can be seen in Figure 2.

Thirty-four patients were staged T₂. Twenty (58.8 per cent) patients underwent a single transoral laser microsurgery procedure, eight (23.5 per cent) two transoral laser microsurgery procedures, three (8.8 per cent) required three transoral laser microsurgery operations and three (8.8 per cent) required salvage laryngectomy following local recurrence at six, nine and eleven months post initial transoral laser microsurgery. Five patients (14.7 per cent) died during the follow-up period. One patient developed unresectable neck recurrence and died nine months post treatment, one patient died with lung metastases after 31 months. Three patients (8.8 per cent) died

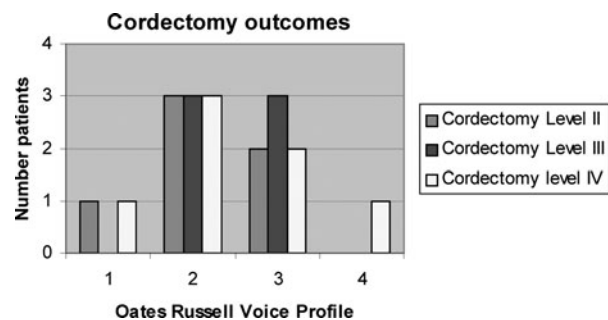


FIG. 2
 Oates Russell Voice Profile for T₁ cancers treated by transoral laser microsurgery cordectomy (level II-IV).

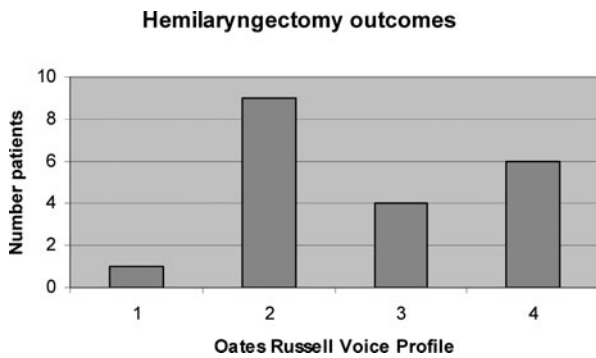


FIG. 3

Oates Russell Voice Profiles for patients undergoing transoral laser microsurgery hemilaryngectomy.

of unrelated causes at 13, 28 and 41 months following treatment.

Twenty-one (61.8 per cent) T₂ staged patients underwent initial transoral laser microsurgery hemilaryngectomy and their Oates Russell Voice Profiles are seen in Figure 3. The mean score for transoral laser microsurgery hemilaryngectomy was 2.75 (range 1 to 4) indicating a moderate (3) impairment. One patient (voice outcome not included in chart) undergoing initial hemilaryngectomy required a total laryngectomy for local recurrence and uses a Blom–Singer prosthesis for voicing.

Thirteen (38.2 per cent) T₂ staged patients underwent initial transoral laser microsurgery extended hemilaryngectomy including resection of the anterior commissure and contralateral vocal cord. The Oates Russell Voice Profiles are seen in Figure 4. The mean score for transoral laser microsurgery extended hemilaryngectomy was 2.56 (range 1 to 4) indicating mild (2) to moderate (3) impairment. Two patients (not included in chart) required total laryngectomy for salvage following local recurrence and both use oesophageal speech.

Discussion

Survival outcomes following transoral laser microsurgery or primary radiotherapy for early glottic cancer are comparable. The absolute survival in this series was excellent: T₁ 89.4 per cent and T₂

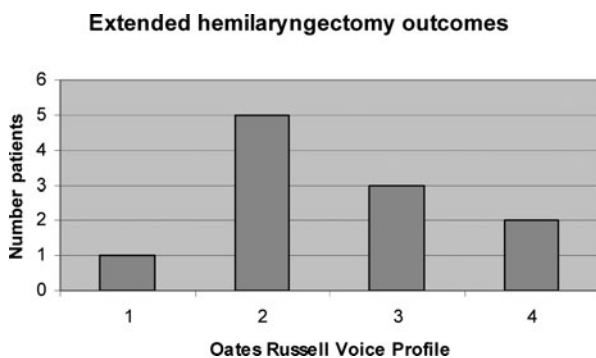


FIG. 4

Oates Russell Voice Profile for transoral laser microsurgery extended hemilaryngectomy.

85.3 per cent after a mean follow up of 47 months. Consequently, voice outcomes and laryngeal preservation are central issues that must be discussed in guiding the treatment choice of patients with early glottic cancer.

This series demonstrates that voice impairment is usually mild to moderate following transoral laser microsurgery for early glottic cancer. Voice impairment is similar for T₁ or T₂ cancers although more extensive resections (deeper cordectomy or hemilaryngectomy) will tend to cause more impairment. The most impaired patients in this series have a moderate to severe impairment with no patients being aphonic.

Cragle and Brandenburg reported that surgical treatment of early glottic cancers may produce a vocal result that is equivalent to that following irradiation.¹⁰ They showed similar voice profiles characterised by decreased maximum phonation times and increased jitter, shimmer, and signal-to-noise ratios in 11 patients treated with transoral laser microsurgery and 20 patients treated with irradiation. Most investigators, however, contend that a better voice more reliably follows treatment with radiotherapy rather than transoral laser microsurgery.^{11–14} Unlike surgery, radiotherapy does not require removal of adjacent healthy tissue to provide a clear margin around a cancer. However, vocal deterioration may result from radiotherapy and may be significant if loss of vocal fold bulk results from tumour necrosis or if fibrosis develops.

This series demonstrates mild or moderate voice impairment and a high degree of laryngeal preservation. Schuller and others used interviews and questionnaires to evaluate 75 patients treated with transoral laser microsurgery for early laryngeal cancers. They found that 88 per cent of the respondents were content with the post-operative voice.¹⁵ The absolute quality of their voice may not be as important a consideration for many patients in selecting treatment as is their general ability to communicate and satisfaction with the treatment modality.

This series shows that total laryngectomy is rarely required for T₁ glottic cancers (0 per cent) and unusual in T₂ cancers (8.8 per cent). Ton-Van *et al.* evaluated 356 patients with early glottic cancer and determined that the quality of voice after treatment with radiotherapy is 'indisputably superior to that after conservation surgery'.¹⁶ However, these investigators pointed out that a functional larynx was preserved in 92 per cent of patients treated surgically compared with 81 per cent initially treated with radiotherapy. As a result, Ton-Van *et al.* advocate the use of surgery as a primary mode of therapy in patients who can tolerate general anaesthesia. Exceptions include patients who are willing to accept a greater risk of total loss of the larynx in the effort to preserve the highest quality voice.

One of the key differences between transoral laser microsurgery and radiation is the ability to repeat transoral laser microsurgery in the event of local failure whereas radiation failures are most commonly treated with total laryngectomy.¹⁷ In this series

21.1 per cent of T₁ tumours and 41.2 per cent of T₂ tumours underwent a second procedure (to biopsy granulations, treat local recurrence or salvage with laryngectomy). Consequently final laryngeal conservation is probably higher for T₂ tumours using transoral laser microsurgery.¹⁸ Morris *et al.* carried out an intensive literature review and identified an overall 8.6 per cent failure rate at the primary site for T₁ glottic cancers managed surgically compared with a 16.7 per cent failure rate among similarly staged cancers managed with radiotherapy.¹⁹

- **Radiation has been the gold standard treatment of early glottic cancer**
- **Pioneers such as Steiner have shown transoral laser microsurgery to be a viable alternative for early glottic cancer**
- **Debate has surrounded the reproducibility of such results and functional outcomes following transoral laser microsurgery compared with radiotherapy**
- **This series shows excellent functional and survival outcomes following the first 10 years of transoral laser microsurgery in an Australian centre**
- **Due to repeatability, the need for salvage laryngectomy may be reduced with transoral laser microsurgery compared with radiotherapy**

One of the advocates for radiation, Jorgensen and others, described 1005 Danish patients treated at a single referral centre between 1965 and 1998.²⁰ All early glottic cancers (99 per cent) within a catchment area of 1.33 million people received primary radiotherapy and follow up was excellent (only three patients were lost to follow up). Three hundred and twenty-one T₁ glottic cancers were treated with irradiation with a five-year local control of 88 per cent and 233 T₂ glottic cancers were treated with irradiation with a five-year local control of 67.4 per cent. These investigators identify that this high recurrence rate (one out of three) for T₂ glottic cancers resulted in an overall laryngeal preservation of 80 per cent. This is substantially lower than the 95 per cent organ preservation reported by Chevalier's group using organ preservation surgery²¹ and the 91.2 per cent in this series.

Jorgensen and others argued that part of the excellent results reported by Chevalier and others reflected a selection bias. Jorgensen and others additionally pointed out that the voice quality is better after irradiation than after supracricoid laryngectomy. For these reasons, they have not altered their standard approach to managing T₂ glottic cancers with irradiation. Jorgensen observed that improved radiotherapy techniques, as well as the capacity to salvage irradiation failures with supracricoid laryngectomy²² will likely decrease the ultimate need for total laryngectomy. Undoubtedly the

salvage rate of transoral laser microsurgery for local recurrences is high²³ as is confirmed in this series. More recently, Steiner has shown that radiotherapy failures may also be salvaged by transoral laser microsurgery in many cases.²⁴

In conclusion, patients choosing transoral laser microsurgery for early glottic cancer have satisfactory voice outcomes. Although voice outcomes are probably better following radiation, very few patients require total laryngectomy despite local recurrences compared with radiotherapy, resulting in overall good functional outcomes. These issues are central to the choice of treatment for early glottic cancer.

References

- 1 AIHW & AACR. *Cancer in Australia 2001*. Canberra: AIHW & AACR, 2004;78–9 available at: <http://www.aihw.gov.au/publications/can/ca01/ca01-c03.pdf> [20 February 2006]
- 2 Hoffman HT, Karnell LH. Laryngeal cancer. In: Steele GD, Jessup JM, Winchester DP, Menck HR, Murphy GP, eds. *National Cancer Database Annual Review of Patient Care, 1995*. Atlanta: American Cancer Society, 1995;84–100
- 3 Dey P, Arnold D, Wight R, MacKenzie K, Kelly C, Wilson J. Radiotherapy versus open surgery versus endolaryngeal surgery (with or without laser) for early laryngeal squamous cell cancer. *Cochrane Database Syst Rev* 2003;2: CD002027. DOI: 10.1002/14651858.CD002027
- 4 Strong MS, Jako GJ. Laser surgery in the larynx: early clinical experience with continuous CO₂ laser. *Ann Otol Rhinol Laryngol* 1972;1:791–3
- 5 Steiner W. Results of curative laser microsurgery of laryngeal carcinomas. *Am J Otolaryngol* 1993;14:116–21
- 6 Shah JP, Karnell LH, Hoffman HT, Ariyan S, Brown G, Fee E *et al.* Patterns of care for cancer of the larynx in the United States. *Arch Otolaryngol Head Neck Surg* 1997;123:475–83
- 7 Parson JT, Greene BD, Speer TW, Kirkpatrick SA, Barhorst DB, Yanckowitz T. Treatment of early and moderately advanced vocal cord carcinoma with 6 MV X-rays. *J Radiat Oncol Biol Phys* 2001;50:953–9
- 8 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. *Eur Arch Otorhinolaryngol* 2000;257: 227–31
- 9 Oates J, Russell A. Learning voice analysis using an interactive multi-media package: development and preliminary evaluation. *J Voice* 1998;12:500–12
- 10 Cragle S, Brandenburg J. Laser cordectomy or radiotherapy: cure rates, communication and cost. *Otolaryngol Head Neck Surg* 1993;108:648–51
- 11 Casiano RR, Cooper JD, Lundy DS, Chandler JR. Laser cordectomy for T1 glottic cancer: a 10-year experience and videostroboscopic findings. *Otolaryngol Head Neck Surg* 1991;104:831–5
- 12 Epstein BE, Lee DJ, Kashima H, Johns ME. Stage T1 glottic carcinoma: results of radiation therapy or laser excision. *Radiology* 1992;101:49–54
- 13 Hoyt DJ, Lettinga JW, Leopold KA, Fisher SR. The effect of head and neck radiation therapy on voice quality. *Laryngoscope* 1992;102:477–80
- 14 Rydell R, Schalen L, Fex S, Elnor A. Voice evaluation before and after laser excision vs. radiotherapy of T1A glottic carcinoma. *Acta Otolaryngol (Stockh)* 1995;115: 560–5
- 15 Schuller DE, Trudeau M, Bistline J, LaFace K. Evaluation of voice by patients and close relatives following different laryngeal cancer treatments. *J Surg Oncol* 1990;44: 10–14
- 16 Ton-Van J, Stern JC, Buisset E, Coche-Dequeant B, Vankemmel B. Comparison of surgery and radiotherapy in T1 and T2 glottic carcinomas. *Am J Surg* 1991;162: 337–40

- 17 Howell-Burke D, Peters LJ, Goepfert H, Oswald MJ. T2 glottic cancer: recurrence, salvage, and survival after definitive radiotherapy. *Arch Otolaryngol Head Neck Surg* 1990;**116**:830–5
- 18 DeSanto LW. Early supraglottic cancer. *Ann Otol Rhinol Laryngol* 1990;**99**:593–8
- 19 Morris MR, Canonico D, Blank C. A critical review of radiotherapy in the management of T1 glottic carcinoma. *Am J Otolaryngol* 1994;**15**:276–34
- 20 Jorgensen K, Godballe C, Hansen O. Cancer of the larynx treatment results after primary radiotherapy with salvage surgery in a series of 1005 patients. *Acta Oncologica* 2002;**41**:69–76
- 21 Chevalier D, Laccourreye O, Brasnu D, Laccourreye H, Piquet JJ. Cricohyoidoepiglottopexy for glottic carcinoma with fixation or impaired motion of the true vocal cord: 5-year oncology results with 112 patients. *Ann Otol Rhinol Laryngol* 1997;**106**:364–9
- 22 Shah JP, Loree TR, Kowalski L. Conservation surgery for radiation failure in carcinoma of the glottic larynx. *Clin Otolaryngol* 1994;**19**:105–8
- 23 Eckel HE. Local recurrence following transoral laser surgery for early glottic carcinoma: frequency,

management and outcome. *Ann Otol Rhinol Laryngol* 2001;**110**:7–15

- 24 Steiner W, Vogt P, Ambrosch P, Kron M. Transoral carbon dioxide laser microsurgery for recurrent glottic carcinoma after radiotherapy. *Head & Neck* 2004;**26**:477–84

Address for correspondence:

Mr Tim Iseli,
Suite 90, level 9,
166 Gipps St,
East Melbourne VIC 3002,
Australia.

Fax: 613 9288 4650
E-mail: iselitim@hotmail.com

Dr T Iseli takes responsibility for the integrity of the content of the paper.
Competing interests: None declared
