

## Consensus statement on management in the UK: Transoral laser assisted microsurgical resection of early glottic cancer

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Accepted for publication 31 March 2009

*Clin. Otolaryngol.* 2009, **34**, 367–373

**Background:** Transoral laser assisted microsurgical resection of early glottic laryngeal cancer is a relatively new treatment modality that is practised in many centres across the UK. In the absence of the results from randomised clinical trials, clinicians may be guided by an expert panel consensus statement on transoral laser assisted microsurgical resection of early squamous cell cancer of the larynx.

**Objective:** To provide consensus recommendations on the various aspects of transoral laser assisted microsurgical resection for early glottic cancer.

**Evaluation method:** Nine centres across the UK were invited to describe current practice and outcomes for transoral laser assisted microsurgical resection of early

glottic cancer. Four working groups were created to draw consensus on standard of care, surgical procedures, outcomes measures and training/certification. The feedback from these groups was integrated into the consensus statement.

**Conclusions:** The consensus meeting confirmed the established and widespread use of transoral laser assisted microsurgical resection for early glottic cancer throughout the UK. The common experience gained allowed a full discussion of all aspects of the management with consensus achieved in key areas of standards of care, surgery, histopathologic reporting, outcomes assessment and training. This consensus statement will result in closer auditing of management and dissemination of results.

### Background

Annually, approximately 6000 new head and neck cancers are diagnosed in England & Wales, accounting for about 3% of the annual registration of 200 000 new cancer cases.<sup>1</sup> Laryngeal cancer is one of the most frequent head and neck cancer sites, with a current prevalence of 2.5 per 100 000 men and 0.6 per 100 000 women.<sup>2</sup>

There are three treatment options for T<sub>1</sub> or T<sub>2</sub> (early) glottic cancer; transoral laser assisted microsurgical resection (TLM), external beam radiotherapy and open surgery. It is agreed that, regardless of the chosen treatment, all patients with early glottic cancer should be managed with curative intent and with preservation of the larynx.<sup>3</sup> Current 5-year local control rates for T<sub>1</sub> tumours range

from 81–92% and for T<sub>2</sub>, 64–90%, with larynx preservation in 90–100% and 64–90% respectively.<sup>4</sup>

As all treatment options are of proven efficacy, factors influencing treatment choice include patient preference, post-treatment morbidity, quality of life, voice quality and cost of treatment.<sup>4,5</sup> The EaStER trial [Early Stage Glottic Cancer: Endoscopic Excision or Radiotherapy] has shown that TLM is the preferred treatment among patients offered treatment options for early laryngeal cancer.<sup>6</sup> The UK National Head and Neck Comparative Audit (DAHNO: Database for Head and Neck Oncology, Third Report<sup>7</sup>) reported approximately equal numbers of early glottic cancers are being treated by radiotherapy and surgery in England and Wales.<sup>7</sup>

### The need for a consensus statement

In the UK, gradual introduction of TLM resection techniques has led to clinicians in multi-disciplinary teams evolving various techniques of assessment, surgery, pathological evaluation and outcomes. There is a wealth

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of practical experience, but in the absence of the results from randomised clinical trials, clinicians may be guided by an expert panel consensus statement on TLM management of early squamous cell cancer of the larynx.

ENT-UK Head and Neck, the head and neck section of the British Association of Otolaryngology – Head and Neck Surgery, convened a consensus meeting in Birmingham on 5th June 2008 and 33 head and neck surgeons attended. The terms of reference were to set areas where consensus would be helpful and clinically beneficial. As there was no previous template for such an event, the meeting was structured to set the scene, invite multi-disciplinary teams to present their results and following this preliminary session, establish key areas to be addressed.

The nine short presentations from UK centres describing current practice and outcomes were followed by discussion of problem issues surrounding TLM; these are summarised in Table 1. The afternoon session consisted of four working groups looking at standard of care, surgical procedures, outcomes measures and training/certification. The outcome feedback from these groups was integrated into the consensus statement.

### The tumour

Clinically, early glottic cancer is described as limited to one (T<sub>1a</sub>) or both vocal cords (T<sub>1b</sub>). Such tumours may be limited to the vocal cords, or also involve the commissures; normal vocal cord mobility is maintained. In T<sub>2</sub> glottic cancer, tumour extends into the supraglottis and/or subglottis, with or without impaired vocal cord mobility.<sup>8</sup> When treated with fractionated external beam radiotherapy, tumours involving the anterior commissure (AC) are associated with a higher local residual and recurrence rate than those without AC involvement.<sup>9</sup>

### The surgery

In 2007, the European Laryngological Society (ELS) published a revision of their classification for documentation of the extent of endoscopic laser excision of glottic tumours, to aid with evaluation of oncological and functional outcomes.<sup>10,11</sup> The classification describes six types of cordectomy based on the extent of resection of the vocal cord and the adjoining structures (Table 2).

Transoral laser assisted microsurgical resection has several advantages; it is completed in one session with low morbidity and less likely to need for postoperative tracheostomy or nasogastric feeding compared to open partial laryngectomy and external beam radiation. TLM can be repeated, and if local recurrence occurs, further treatment options, including surgery via an external approach or

radical radiotherapy are available as salvage. Conversely, external beam radiotherapy requires a protracted period of fractionated treatments, frequently results in chronic long-term side-effects, and once given can normally not be repeated. Patients undergoing TLM or conventional surgery have a significantly lower incidence of locoregional recurrences and longer disease-free intervals when compared to patients treated with radiotherapy.<sup>12</sup> Some authors consider AC involvement a contraindication for endoscopic surgery,<sup>13</sup> while others report that AC involvement does not negatively influence oncologic outcome.<sup>14</sup> The consensus group concluded that patients should be given the choice of TLM for tumours involving the AC, but advised of the greater chance of adverse voice outcome when the AC is treated surgically.

The use of second look operation within 6–8 weeks after initial surgery, or when the margins are in doubt is helpful in detecting early local recurrence and in treating postoperative airway or voice problems.<sup>15</sup> Recurrence of early glottic carcinoma after irradiation may be salvaged by TLM resection.<sup>16–18</sup>

### Special pathologic considerations

It is well recognised that the surface appearance of the lesion does not predict the severity of dysplasia, nor differentiate between carcinoma *in situ* and invasive carcinoma between patients or in different areas of the same lesion; excisional biopsy and whole mount, multiple section histopathological analyses are necessary for accurate diagnosis.<sup>19</sup> It is also important to consider the third dimension of tissue thickness when removing such specimens.<sup>20,21</sup> For diagnostic accuracy, the pathologist must report the presence or absence of malignancy and the completeness of excision. To facilitate this, the surgeon must present the specimen correctly mounted and orientated to increase accurate histological interpretation. The consensus group recommends the Glasgow technique, mounting the orientated specimen on dehydrated cucumber, enabling accurate assessment of histological margins.<sup>22</sup> The technique provides a permanent specimen mount, allowing the whole specimen to be processed intact. This avoids loss of orientation and distortion of specimens.

### Outcome measures

Voice quality after TLM and cordectomy differs from controls, but improves in the majority of patients after the surgery; voice quality depends on the type of cordectomy performed.<sup>23</sup> While, as anticipated, more extensive surgery and AC resections have significantly worse functional outcome, there is still only minimal protocol

**Table 1.** Summary of the experience presented at the consensus meeting. The local control (LC) rates and disease specific survival (DSS) rates are calculated after salvage. The follow-up interval mentioned in the outcomes section is the minimum period for all patients

Centre	Period	All tumours	No. cases for radiotherapy	No. cases for TLM	Surgical procedure (ELS cordectomies)	Adjuvant radiation	Outcomes (oncologic and functional)
Belfast*	2000–2005	Total: 124 T <sub>1</sub> a: 75 T <sub>1</sub> b: 10 T <sub>2</sub> : 37	78	Total: 46 T <sub>1</sub> a: 35 T <sub>1</sub> b: 2 T <sub>2</sub> : 9	I: 2 II: 18 III: 9 IV: 2 V: 12 NA: 3	19.6%	DSS (3 years): 97.8%
Bristol	2003–2005	NA	NA	Total: 22† Tis: 3 T <sub>1</sub> : 2 T <sub>1</sub> a: 13 T <sub>1</sub> b: 3 T <sub>2</sub> : 1	I: 5 II: 4 III: 2 IV: 1 NA: 9	4.5%	LC (2 years): 91% DSS (2 years): 100%  Use GRBAS
Derby‡	2002–2004	Total: 32 Tis: 10 T <sub>1</sub> : 9 T <sub>2</sub> : 13	2	Total: 30 Tis: 10 T <sub>1</sub> : 8 T <sub>2</sub> : 12	I: 11 II: 1 III: 4 IV: 0 V: 14	13.3%	DSS (4 years): 93.3% Use GRBAS
Doncaster	1995–2003	Total: 92 Tis: 27 T <sub>1</sub> : 47 T <sub>2</sub> : 18	46	Total: 46 Tis: 19 T <sub>1</sub> : 27	NA	24%	DSS (5 years): 97.8%
Guys§,¶	2002–2004	Total: 32 Tis: 3 T <sub>1</sub> : 10 T <sub>2</sub> : 19	25	Total: 7† Tis: 2 T <sub>1</sub> : 2	Cold steel: 1 ELS I: 2 ELS II: 1	0%	LC (4 years): 85.7%
Liverpool	2002–2005	Total: 110 Tis: 12 T <sub>1</sub> : 52 T <sub>2</sub> : 46	39	Total: 71 Tis: 10 T <sub>1</sub> : 50 T <sub>2</sub> : 11	NA	8.5%	DSS (3 years): 90.9%
Manchester‡	2002–2004	Total: 107 Tis: 5 T <sub>1</sub> : 71 T <sub>2</sub> : 31	92	Total: 13 Tis: 3 T <sub>1</sub> : 6 T <sub>2</sub> : 6	I: 0 II: 5 III: 5 IV: 2 V: 1	7.7%	LC (4 years): 92.3%
Middlesbrough**	2002–2004	Total: 52 Tis: 10 T <sub>1</sub> a: 24 T <sub>1</sub> b: 4 T <sub>2</sub> : 14	29	Total: 19 Tis: 6 T <sub>1</sub> a: 10 T <sub>1</sub> b: 1 T <sub>2</sub> : 2	NA	21%	LC (5 years): 100%
Newcastle upon Tyne	2002–2004	Total: 98 Tis: 7 T <sub>1</sub> : 56 T <sub>2</sub> : 35	77	Total: 21 Tis: 6 T <sub>1</sub> a: 13 T <sub>1</sub> b: 1 T <sub>2</sub> : 1	I: 1 II: 1 III: 1 NA: 18	36.8%	DSS (4 years): 95.2%

\*Series excludes Tis cases.

†Includes one cold steel resection.

‡Includes radio-recurrent tumours.

§Incomplete data.

¶Includes non-glottic primaries as well.

\*\*Four patients received best supportive care.

GRBAS: grade, roughness, breathiness, asthenia, and strain functional voice scale; VoiSS: Voice Symptom Score; LC: local control; DSS: disease specific survival; OS: Overall survival.

**Table 2.** Endoscopic cordectomies (European Laryngological Society)

Terminology	Cordectomy type	Description
Subepithelial cordectomy	I	Resection of the vocal fold epithelium passing through the superficial layer of the lamina propria
Subligamental cordectomy	II	Resection of the epithelium, Reinke's space and the vocal ligament
Transmuscular cordectomy	III	Resection of the vocal fold down through the vocalis Muscle
Total cordectomy	IV	Resection of the cord which extends from the vocal process to the anterior commissure. The depth of the surgical margins reaches or includes the internal perichondrium of the thyroid ala.
Extended total cordectomy	Va	Resection includes the contralateral vocal fold and the anterior commissure.
	Vb	Resection includes the arytenoids
	Vc	Resection includes the subglottis;
	Vd	Resection includes the ventricle and false vocal cords
Anterior commissurectomy	VI	Resection of the anterior commissure with bilateral anterior cordectomy; may include the subglottic mucosa and the cricothyroid membrane

driven, multidimensional data on the degree of effect on function from the various types of endoscopic resections.<sup>24,25</sup> While there is no universally accepted functional measure to assess the impact of treatment on the voice, there is consensus about the oncologic outcomes of interest in laryngeal cancer, and these measures have been adopted into DAHNO.

### Training and certification

One of the essential pre-requisites for successful endoscopic surgery is adequate exposure, and therefore appropriate patient selection;<sup>26</sup> use of the correct instruments is essential. Endoscopic laser surgery as a method of resection of cancer requires skill and dexterity in phonosurgery techniques. These are difficult to learn operating on patients because of the narrow margin for success; specific skills should be taught on continuing educational courses using laryngeal dissection stations and mannequins.<sup>27,28</sup>

### Consensus agreement on standard of care

1 The standard of care for all patients who have squamous cell carcinoma of the glottis, staged T<sub>1</sub>a, T<sub>1</sub>b or T<sub>2</sub>a is that they are offered TLM as part of informed choice treatment options.

2 The option of TLM should be discussed by the MDT for all patients with glottic squamous cell carcinoma of stages T<sub>1</sub>a, b or T<sub>2</sub>, as a treatment option, with documentation of reasons why the particular treatment was selected.

3 The patient should be clearly informed of the range of feasible treatment choices; clinicians should ensure informed choice, using standardised information to avoid risk of bias.

4 All patients undergoing treatment for early glottic carcinoma must have their outcomes documented and continuously audited; the data derived from these audits should be submitted to the National Comparative Audit to enable regular review of a National database of TLM resections.

5 All patients should be eligible for consideration for inclusion into clinical trials, subject to patient consent and ethical approval.

### Consensus agreement on surgical care

1 The aim of endoscopic excision should be complete circumferential excision of all small lesions under magnification; the use of trans-lesional excision should only be used to improve surgical access or when it is not possible to safely excise the lesion completely as one specimen.

2 It is often necessary to remove part of the false cord (ventriculotomy) to gain exposure of the lateral aspect of the tumour.

3 All specimens must be orientated and mounted for histological analysis.

4 Ensure excellent reporting relationships between the surgeon and the pathologist. Traditional margins for head and neck squamous carcinoma are not applicable in this disease, with margins of the order of a millimetre being appropriate. Terminology such as 'complete excision', 'close margins' and 'incomplete excision' are misleading. It is advisable for the pathologist to precisely specify the sites on the orientated specimen where the margins are less than 1 mm. This will help in planning a second look and during follow-up.

5 There was no consensus in favour of routine intra-operative frozen section. If in doubt, the group

recommended that an extra margin be taken and sent separately for paraffin section. The group considered a 'second look' examination preferable to the routine use of frozen section.

**6** Based on the pathologist's report, the following actions are recommended:

(i) If the resection margins are considered surgically adequate and are clear by a millimetre or more on histology, no second look is warranted. Routine clinical monitoring is recommended.

(ii) If the surgical margins are not in doubt but the histology shows tumour at the margins, a second look is recommended 6–8 weeks later [Some attendees stressed the value of palpation of the cord at this review.].

(iii) If the surgeon has concerns about resection margins and residual tumour is confirmed on histological analysis, the feasibility of further TLM resection should be considered. Future management should be discussed at the MDT meeting and careful consideration given to alternative non-endoscopic treatment options.

**7** All final resections must be documented descriptively and summarised as per the ELS classification.<sup>10,11</sup>

**8** The consensus group recommended the following post-operative review protocol:

(i) every 4–6 weeks for the first year

(ii) every 2–3 months for years 2 and 3

(iii) every 6 months for years 4 and 5

If symptoms return, prompt and early review of patients is required. At the outset, patients should be informed of 'red flag' symptoms and advised how to bring forward their routine follow-up appointment.

**9** No routine imaging additional to the standard MDT protocol is recommended.

**10** Follow-up should be carried out by a surgical team that performs TLM resections. Photo-documentation should be performed at the time of resection, at the time of every operative intervention, and whenever possible during an outpatient consultation.

**11** Voice evaluation before, within 3 months and after 12 months following treatment is recommended. The use of the stroboscopy with high quality endoscopy is desirable.

**12** When tumour recurrence is suspected, a complete and thorough diagnostic work up of the recurrent lesion, as one would of a new tumour, is mandatory. The MDT should plan treatment of the recurrent lesion.

### Outcome measures

**1** Recording of outcome measures and routine collection of a minimum dataset are mandatory. The dataset should be incorporated into the National Comparative audit in head and cancer (DAHNO).

**2** Tumour stage should be documented as per the TNM classification and treatment by ELS classification for extent of resection.

**3** Tobacco use and alcohol consumption during treatment and follow up should be recorded.

**4** Local control is the primary outcome measure of interest. The timing of local failure should be documented. Failure occurring within 12 months should be considered residual disease and that occurring after 12 months as recurrent disease. Further management of local failure should be documented.

**5** Disease free survival should be recorded.

**6** Laryngectomy free survival should be recorded.

**7** The number of procedures to achieve control of cancer (excluding diagnostic biopsy, unless excision was performed with biopsy) should be documented as less than or more than two endoscopic procedures. It is rare for more than two attempts to be required for resection and if more than two procedures were performed, there should be explicit justification for this.

**8** All local morbidity (scarring, webbing and persisting granulations) and their time of occurrence should be documented by photo-endoscopy and description.

**9** The group also agreed that measuring voice outcomes should be integrated into routine practice for patients undergoing endoscopic resection. Assessment using the Voice Symptom Scale (VoiSS)<sup>29</sup> prior to treatment is recommended. The VoiSS questionnaire should also be completed 3, 6 and 12 months after TLM resection.

### Consensus agreement on training and certification

**1** Training in endoscopic resection should be directed at senior trainees who have made a planned career choice in head and neck surgery

**2** It is important that a mentor for established consultants is an experienced mentor and trainer in TLM techniques.

**3** A certification model should be developed via real time registration of cases and continuous personal audit. The opportunity to develop e learning packages and on line master-classes to maintain proficiency should be available in the UK.

**4** Each MDT should perform a local audit of case selection for TLM and identify reasons for selection or non-selection of cases.

**5** Further consensus work is required to develop a list of minimum equipment/instrument specification to support endoscopic resection.

**6** When early in the learning curve, the urge of a trainer to self perform all procedures due to small case numbers and lack of confidence in letting others achieve clear margins should be acknowledged.

## Conclusions

The ENT-UK Head and Neck consensus meeting on transoral laser assisted resection of early glottic laryngeal cancer confirmed the established and widespread use of this technique throughout the UK. The common experience gained allowed a full discussion of all aspects of the management with consensus achieved in many key areas. This consensus statement will result in closer auditing of management and dissemination of results. ENTUK Head & Neck will set-up a working group to identify and develop hands-on courses where TLM techniques can be taught. The group will also make recommendations for a list of minimum instrumentation and equipment needed to set up a TLM service.

### Keypoints

- Transoral laser assisted microsurgical resection (TLM) must be offered as a treatment modality to all patients with early glottic cancer.
- Close co-operation with pathology services is mandatory as there are specific requirements for interpretation of TLM specimens.
- Accurate documentation of the surgical procedure based on the ELS classification and photodocumentation of the tumour and surgical bed is mandatory.
- If re-resection is planned for residual tumour, this should be discussed in the MDT meeting, giving due consideration to other means to treat the tumour.
- Apart from the standard oncological outcomes, use of a functional outcome measure should be integrated into routine practice.
- The performance of the TLM service should be audited on a regular basis using the outcome measures mentioned above.
- Training in endoscopic resection should be offered to senior trainees who have made a career choice in head and neck oncologic surgery.

### Conflict of interest

None to declare.

### Acknowledgements

The authors are indebted to Peter Robb for critically reviewing and enhancing the manuscript. We are grate-

ful to the following individuals for presenting their data at the meeting: William Primrose (Belfast), David Grant and Martin Birchall (Bristol), Lisa McClelland and Sean Mortimore (Derby), Mark Watson (Doncaster), Nick Roland (Liverpool), Ricard Simo and Jean-Pierre Jeannon (London), Arun Cardozo and Jarrod Homer (Manchester).

### References

- 1 Department of Health. (2000) The NHS Cancer Plan: a plan for investment, a plan for reform. Stationery Office, London
- 2 Toms J.R. (ed). (2004) CancerStats Monograph. Cancer Research UK, London
- 3 Pfister D.G., Laurie S.A., Weinstein G.S. *et al.* (2006) American Society of Clinical Oncology clinical practice guideline for the use of larynx-preservation strategies in the treatment of laryngeal cancer. *J. Clin. Oncol.* **24**, 3693–3704
- 4 Ambrosch P. (2007) The role of laser microsurgery in the treatment of laryngeal cancer. *Curr. Opin. Otolaryngol. Head Neck Surg.* **15**, 82–88
- 5 Back G. & Sood S. (2005) The management of early laryngeal cancer: options for patients and therapists. *Curr. Opin. Otolaryngol. Head Neck Surg.* **13**, 85–91
- 6 Birchall MA (2008) Early Stage glottic cancer: Endoscopic excision or Radiotherapy - Feasibility study. Cancer Research UK, London
- 7 Wight RG (ed). (2008) National Head and Neck Comparative Audit (DAHNO) Third Annual Report. NHS, The Information Centre, London. April, 2008. <http://www.ic.nhs.uk/services/national-clinical-audit-support-programme-ncasp/audit-reports/head-and-neck-cancer>
- 8 Sobin L.H. & Ch W. (2002) TNM Classification of Malignant Tumours, 6th edn. John Wiley and Sons, New York
- 9 Bradley P.J., Rinaldo A., Suarez C. *et al.* (2006) Primary treatment of the anterior vocal commissure squamous carcinoma. *Eur. Arch. Otorhinolaryngol.* **263**, 879–888
- 10 Remacle M., Eckel H.E., Antonelli A. *et al.* (2000) Endoscopic cordectomy. A proposal for a classification by the Working Committee, European Laryngological Society. *Eur. Arch. Otorhinolaryngol.* **257**, 227–231
- 11 Remacle M., Van Haverbeke C., Eckel H. *et al.* (2007) Proposal for revision of the European Laryngological Society classification of endoscopic cordectomies. *Eur. Arch. Otorhinolaryngol.* **264**, 499–504
- 12 Thurnher D., Erovic B.M., Frommlet F. *et al.* (2008) Challenging a dogma – surgery yields superior long-term results for T1a squamous cell carcinoma of the glottic larynx compared to radiotherapy. *Eur. J. Surg. Oncol.* **34**, 692–698
- 13 Chone C.T., Yonehara E., Martins J.E. *et al.* (2007) Importance of anterior commissure in recurrence of early glottic cancer after laser endoscopic resection. *Arch. Otolaryngol. Head Neck Surg.* **133**, 882–887
- 14 Steiner W., Ambrosch P., Rodel R.M. *et al.* (2004) Impact of anterior commissure involvement on local control of early glottic carcinoma treated by laser microresection. *Laryngoscope* **114**, 1485–1491

- 15 Roh J.L., Kim D.H. & Park C.I. (2008) The utility of second-look operation after laser microresection of glottic carcinoma involving the anterior commissure. *Laryngoscope* **118**, 1400–1404
- 16 Motamed M., Laccourreye O. & Bradley P.J. (2006) Salvage conservation laryngeal surgery after irradiation failure for early laryngeal cancer. *Laryngoscope* **116**, 451–455
- 17 Bradley P.J., Ferlito A., Suarez C. *et al.* (2006) Options for salvage after failed initial treatment of anterior vocal commissure squamous carcinoma. *Eur. Arch. Otorhinolaryngol.* **263**, 889–894
- 18 Piazza C., Peretti G., Cattaneo A. *et al.* (2007) Salvage surgery after radiotherapy for laryngeal cancer: from endoscopic resections to open-neck partial and total laryngectomies. *Arch. Otolaryngol. Head Neck Surg.* **133**, 1037–1043
- 19 Zeitels S.M. (1995) Premalignant epithelium and microinvasive cancer of the vocal fold: the evolution of phonomicrosurgical management. *Laryngoscope* **105**, 1–51
- 20 Zeitels S.M. (1996) Phonomicrosurgical treatment of early glottic cancer and carcinoma in situ. *Am. J. Surg.* **172**, 704–709
- 21 Arens C., Glanz H., Wonckhaus J. *et al.* (2007) Histologic assessment of epithelial thickness in early laryngeal cancer or precursor lesions and its impact on endoscopic imaging. *Eur. Arch. Otorhinolaryngol.* **264**, 645–649
- 22 Murray C.E., Cooper L., Handa K.K. *et al.* (2007) A technique for the orientation of endoscopically resected laryngeal lesions. *Clin. Otolaryngol.* **32**, 201–203
- 23 Vilaseca I., Huerta P., Blanch J.L. *et al.* (2008) Voice quality after CO2 laser cordectomy – what can we really expect? *Head Neck* **30**, 43–49
- 24 Sjogren E.V., Langeveld T.P. & Baatenburg de Jong R.J. (2008) Clinical outcome of T1 glottic carcinoma since the introduction of endoscopic CO2 laser surgery as treatment option. *Head Neck* **30**, 1167–1174
- 25 Sittel C., Eckel H.E. & Eschenburg C. (1995) Phonatory results after laser surgery for glottic carcinoma. *Otolaryngol. Head Neck Surg.* **119**, 418–424
- 26 Mortuaire G., Francois J., Wiel E. *et al.* (2006) Local recurrence after CO2 laser cordectomy for early glottic carcinoma. *Laryngoscope* **116**, 101–105
- 27 Dailey S.H., Kobler J.B. & Zeitels S.M. (2004) A laryngeal dissection station: educational paradigms in phonosurgery. *Laryngoscope* **114**, 878–882
- 28 Stasche N., Quirrenbach T., Barmann M. *et al.* (2005) IMOLA – a new larynx model for surgical training. Education in transoral laser microsurgery of the upper airways. *Hno* **53**, 869–872, 74–5
- 29 Deary I.J., Wilson J.A., Carding P.N. *et al.* (2003) VoiSS: a patient-derived Voice Symptom Scale. *J. Psychosom. Res.* **54**, 483–489