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Vocal function following laser and conventional surgery of small malignant vocal fold tumours

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Abstract

In the described study, 26 patients after conventional cordectomy, and 27 patients after laser cordectomy were examined six months or more after the operation. Videolaryngostroboscopy revealed that patients after laser cordectomy more often phonate on a purely glottic level (81 per cent) in comparison to patients after conventional cordectomy (19 per cent). Webs were more frequent and more extended after conventional cordectomy compared to endoscopic laser surgery. The maximal phonation time showed a very wide range with a mean value of 9 to 10 sec; there was no statistical difference between the groups of patients. Using Yanagihara's classification of sonograms, a better voice quality was measured after laser cordectomy than conventional cordectomy. The patients' estimation of their voice quality did not correlate with objective parameters.

Key words: Laryngeal neoplasms; Carcinoma, squamous cell; Surgery; Laser surgery; Voice quality

Introduction

Ten years ago most glottic T1a carcinomas were successfully treated with radiotherapy, because voice quality following radiotherapy was better than after surgery of these tumours (Hirano *et al.*, 1985; Rothfield *et al.*, 1989; Mendenhall *et al.*, 1994). Radiotherapy, however, has some disadvantages: the number of recurrences is slightly higher than after surgery (Rothfield *et al.*, 1989) and in the case of a recurrence radiotherapy cannot be applied again. The side effects such as dryness and inflammation are more frequent.

Since the first applications of the carbon dioxide laser for the treatment of laryngeal carcinomas (Strong and Jako, 1972), this technique has found wide acceptance (Bakeslee *et al.*, 1984; Eckel and Thumfart, 1992), but it has also been described as unjustifiable for T1 glottic carcinoma (Young, 1983). The number of recurrences and the rate of survival show no significant difference from those previously reported after conventional surgery (Kirchner and Owen, 1977; Wetmore *et al.*, 1986; Elner and Fex, 1988; Osoff and Matar, 1988; Crockett and Reynolds, 1990). In comparison to radiation therapy microlaryngoscopic surgery with, or without, laser has proven to be a cost effective treatment option (Myers *et al.*, 1994). As all types of therapy of small vocal fold tumours allow preservation of respiration and deglution, the quality of phonation is the most important criterion for the patient. This paper aims to assess and compare vocal function at six months after treatment of T1a tumours by conventional cordectomy and laser cordectomy.

Materials and methods

A total of 53 patients, two women and 51 men, who had been treated because of a histologically verified invasive squamous cell carcinoma of the glottis, T1a, served as subjects. Twenty-six patients had undergone conventional cordectomy by external approach, 27 an endoscopic microscopic laser cordectomy. A Sharplan SL 500 system was used. The patients' ages ranged from 41 to 85 years with a mean of 64.0 years for the patients undergoing conventional cordectomy and from 31 to 79 with a mean of 60.4 years for the patients undergoing laser cordectomy. None of the patients underwent an additional radiotherapy. Approximately half of each group (12 out of 26 after conventional cordectomy and 14 out of 27 after laser cordectomy) had logopaedic treatment in the post-operative phase.

The phonatory function tests were conducted at least six months after the operation. The patients having conventional cordectomy were examined in 1988 and 1989, those having laser surgery were operated between 1989 and 1994 and examined in 1994. The mean interval between surgery and voice examination was 25.5 ± 31.0 (SD) months in patients after conventional surgery and 16.1 ± 14.0 in patients after laser surgery.

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The patients were asked if voice problems had occurred and how they considered their own voice quality. They were asked to rate their voice as 'very good' (= 3), 'good' (= 2), 'acceptable' (= 1) or 'bad' (= 0).

A videostroboscopy was performed with a Wolf 5012 stroboscope, in most cases without anaesthesia. Laryngoscopy was able to demonstrate glottal closure and the existence and extension of webs. The vibration of the vocal folds or the phonatory replacement mechanism could be judged stroboscopically.

In the patient group phonating on the glottic level, a clinical score proposed by Ott *et al.* (1992) was used:

(a) morphological changes such as hyperplasia or formation of scars:	
marked	5
moderate	3
minimal	1
(b) insufficiency of the glottal closure:	
none	0
marked	5
moderate	3
minimal	1
none	0
(c) stroboscopy of the normal vocal fold:	
no vibration	3
considerable restriction of vibration	2
slight restriction of vibration	1
normal vibration	0
(d) vibrations on the operated side:	
existent	2
none	0

A spectrography of the sustained vowels [a, e, i] was performed using a KAY sonagraph (Digital Sona-Graph 7800; 0–8 kHz; narrow band analysis, 45 Hz; linear registration). Yanagihara's classification of hoarseness (Yanagihara, 1967) was used. A standard reading text (Im Café.) was used to register a phonetogram of the speaking voice (Homoth Phonomat). The maximal phonation time (MPT) was evaluated. Vital capacity, maximal expiratory and inspiratory flow were determined using a spirometer, and the percentage of the predicted normal volume was calculated (Vicatest 5 Fa. Hellige).

The results are given as arithmetric mean ± standard deviation. A correlation analysis was performed for the age, the time elapsed since the operation, the patient's estimation of his voice, the degree of hoarseness, the extent of a web, the maximal and the minimal frequency in the phonetogram of the speaking voice, the maximal phonation time and the classification of the laryngostroboscopical findings and a Spearman correlation coefficient was calculated. Patients after conventional cordectomy and laser cordectomy were compared using a t-test.

Results

Ninety-six per cent of our patients (51 out of 53) were quite, or completely, satisfied with their voice quality. The mean of the subjective rating was 2.2 ± 0.7 in patients after conventional cordectomy and 1.7 ± 0.9 in patients after laser cordectomy. There was no correlation between subjective impression and objective parameters of voice quality. The Spearman correlation coefficient was 0.043, −0.148, 0.163 and −0.138 for the correlation between the subjective rating and the maximal phonation time, the spectrography, the score of the stroboscopy and the extent of a web, respectively. This fact may be explained by the interrelation that older patients were satisfied in spite of moderate and even bad voices.

In eight of our 26 patients after conventional cordectomy and 22 of 27 patients after laser cordectomy we found phonation purely on the glottic level. Sixteen patients after conventional cordectomy and two patients after laser cordectomy phonated on a clearly supraglottic level. Two patients after conventional cordectomy and three patients after laser cordectomy used a mechanism involving both levels, no patient had an aphonia.

Using the classification of Ott *et al.* (1992) for the patients phonating on the glottic level, patients after conventional cordectomy reached a mean score of 12.8 ± 3.0, those after laser cordectomy of 7.1 ± 4.0. This difference was not statistically significant because of the small group of patients phonating on the glottic level after chordectomy.

Spectrography revealed a better voice in patients after laser cordectomy compared to conventional cordectomy. Seven patients after laser cordectomy had a nearly normal voice (Yanagihara I). As Figure 1 demonstrates, most patients had a slight (Yanagihara II) or moderate (Yanagihara III) hoarseness.

The fundamental frequency of the speaking voice showed a broad variation in all groups compared to normal patients as is demonstrated in Figure 2 for the male patients in our study. From a quarter up to a third of the male patients used frequencies typical for women. Patients with a high fundamental frequency used the glottic level more often. The

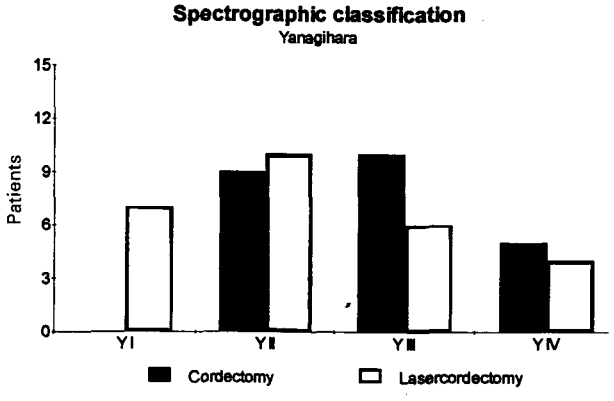

FIG. 1

Spectrographic classification in patients after cordectomy and laser cordectomy. Only after laser cordectomy was the voice practically normal (Y I). Most patients showed a slight (Y II) or moderate (Y III) hoarseness. Five patients after cordectomy and four patients after laser cordectomy suffered from a severe hoarseness. In two patients after cordectomy, spectrography was not performed.

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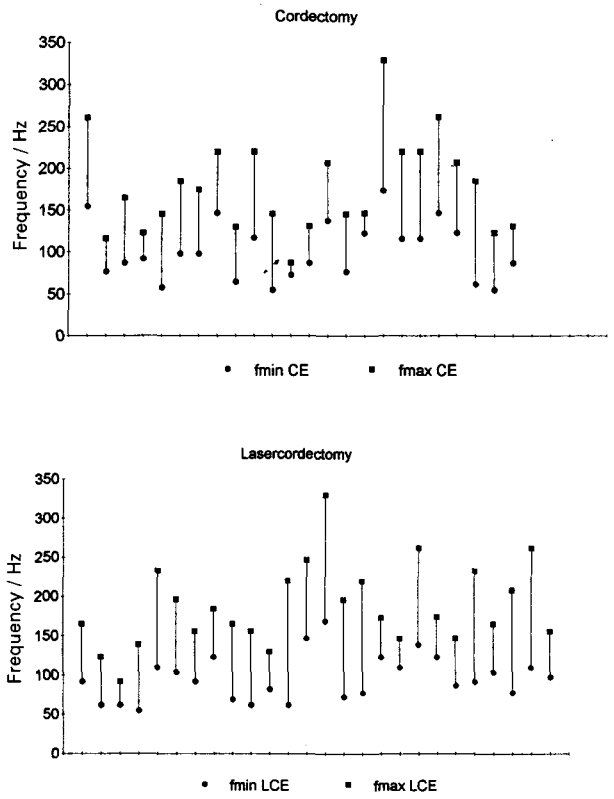

FIG. 2

Vocal range of the speaking voice in male patients after conventional and laser cordectomy. One patient after conventional cordectomy was omitted because of an aphonia. The normal range for male patients is about 80 to 150 Hz.

vibrations seen in the stroboscopy were mostly restricted as a sign of hyperfunction. Both women in our study (one after cordectomy and one after laser cordectomy) had slightly low frequencies for women.

Patients using a supraglottal mechanism for phonation tended to use lower fundamental frequencies, however some of them also had high fundamental frequencies.

Patients after conventional cordectomy had a maximal phonation time of 9.1 ± 4.5 s, those after laser cordectomy of 10.2 ± 5.0 s. There was no significant difference between patients after conventional and laser cordectomy.

Eight out of 26 patients after conventional cordectomy and five out of 27 patients after laser cordectomy had a web in the anterior commissure. The existence and the extent of the web showed no correlation to the maximal phonation time (p = 0.136) or the hoarseness (p = 0.284).

None of our patients revealed a restriction of the respiratory functions due to the larynx on spirometry.

Discussion

Voice is a major characteristic of every individual and normally allows us to judge sex and age. Voice is very important for interindividual contacts since it can transmit information and express emotions. A voice dysfunction, especially one that exists for a long time, threatens the self-esteem of the individual. Operations on malignant tumours in the larynx lead to an irreversible worsening of the voice in most cases. The need for post-operative voice rehabilitation has to be assessed in every patient. Some patients arrive at a sufficient voice quality without further treatment, but in most patients well-directed voice therapy is helpful. The treatment should start early in order to prevent a possible ankylosis of the arytenoids (Vigneau *et al.*, 1988).

Schleier *et al.* (1976), Spillmann *et al.* (1984), Hirano *et al.* (1985) and Rydell *et al.* (1995) found better voice quality after radiotherapy compared to conventional cordectomy and laser surgery using different parameters.

McGuirt *et al.* (1994) compared 13 patients after irradiation therapy to 11 patients after laser surgery of T1a glottic carcinomas and recorded no statistically significant difference between the two study groups.

In Spillmann's results (Spillmann *et al.*, 1984) vocal quality correlated only poorly with the patients self-assessment, comparable to the results of our investigation. Ptok and de Maddalena (1990) describe significant correlations between objective and subjective voice quality.

Stroboscopy In our results, a supraglottic phonation is frequently observed after operations with conventional surgical instruments. This observation is supported by other authors: 20 out of 38 (Mahlbeck and Schloßhauer, 1959); 10 out of 14 (Riska and Lauerma, 1966) and 11 out of 20 (Wendler and Seidner, 1977) after cordectomy, and five out of seven (Leeper *et al.*, 1990) after vertical hemilaryngectomy. After irradiation nearly all patients phonate on a glottic level (Riska and Lauerma, 1966). After laser cordectomy a phonation on the glottic level was much more frequent in comparison to patients who underwent conventional cordectomy in our patients. McGuirt *et al.* (1994) saw a glottic closure in 80 per cent of their patients after laser resection.

Spectrography Höfler and Bigenzahn (1986) used Yanagihara's classification of hoarseness (Yanagihara, 1967) and found four patients in group I, 14 in group II, 16 in group III and seven in group IV. They saw a clear correlation to the patients self-perception.

McGuirt *et al.* (1994) report no difference between the irradiated group and the laser operated group, with mean scores of both being 2.8. In our study, patients after laser cordectomy had a better spectrographic classification.

Fo (Fundamental frequency) Hirano *et al.* (1985) saw no systematic difference between patients after irradiation and different types of laser resection in the range of Fo. McGuirt *et al.* (1994) found a slightly increased fundamental frequency (157 Hz) after laser surgery of T1a glottic carcinomas compared to the irradiated group (136 Hz) and the historical norm (122 Hz) in their patients. In both groups they measured an increased laryngeal airway resistance and explained it with a subconscious, persistent compensatory mechanism resulting from the primary disease or the effects of the treatment on laryngeal

muscular function. Wendler and Seidner (1977) describe that an increase of the fundamental frequency is more frequent than a decrease. Patients using a supraglottic voicing mechanism were found to use lower fundamental frequencies (Blaugrund *et al.*, 1984), this was not always the case in our patients. In our investigation there was no statistically significant difference in the fundamental frequencies between the study groups. Since the increased frequency was often said to be the major problem for the patient (they are mistaken for a woman on the phone), it is an important part of the logopaedic treatment.

MPT (Maximal phonation time) Riska and Lauerma (1966) reported a significant difference in MPT in favour of the patients after irradiation (13.17 ± 5.75 s) compared to those after cordectomy (8.14 ± 6.74 s). Hirano *et al.* (1985) found no marked difference in MPT between patients after laser operations and after irradiation of glottic carcinomas. Höfler and Bigenzahn (1986) reported a mean MPT of 12.1 s after laser cordectomy. After vertical hemilaryngectomy (Leeper *et al.*, 1990) a mean value of 9.9 ± 4.6 s was given. McGuirt *et al.* (1994) found a maximal phonation time of 15.81 seconds after laser surgery of T1a glottic carcinomas and in the irradiated group of 19.26 seconds in their patients. In our investigation there was no significant difference in MPT between the different groups.

Conclusion

Laser treatment of glottic carcinoma seems to have the advantage that the patients have fewer webs and the patients are less likely to be hoarse after the treatment. In other respects such as the fundamental frequency and the maximal phonation time no differences were found in our examination.

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