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Functional results after partial vertical laryngectomy

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There is an increasing popularity of the organ sparing (OS) approaches to tumour treatment also in the head-neck (HN) surgery, as these methods at the same time aim to fulfill the requirements of radical approach in oncology, yet with less aggressive surgery. Partial vertical laryngectomy (PVL) is a preferred OS method in the treatment of certain glottic malignancies. Patients soon get accustomed to their usual surroundings, but a significant deterioration of voice quality is unavoidable. In this work, we studied the act of swallowing and the effectiveness of voice therapy after PVL of various extents.

Methods: Between 1986 and 1996, the authors performed 51 PVL-s, 16 chordectomies (3 with conventional surgery and 13 with laser) and 35 hemilaryngectomies of various extents for the treatment of T1-T2 glottic tumours. The act of swallowing was tested by videofluorography on the 7th postoperative day and 8 weeks after surgery. Phoniatric therapy started immediately after the wound was healed: exercises were identical to the accepted exercises for recurrent laryngeal nerve paresis. The patients were called for indirect and direct (flexible Faryngo-Naso-Laryngoscope®, PENTAX) laryngoscopic control every week. Voice quality parameters (phonatory duration, vocal range, fundamental speech frequency) were examined before starting and 8 weeks after phoniatric therapy. Voice recordings were spectrographically analyzed, too.

Results: A marked aspiration was observed by videofluorography in 61 % (31/51) of the patients on the 7th postoperative day. The aspiration showed no correlation with the type of surgery. Eight weeks after surgery, all patients could swallow satisfactorily without any functional disturbance.An improvement in voice quality was deteced 2-3 months later; the phonatory duration and vocal range were extended. In normal social conversations the voice was audible, yet more or less hoarse in spite of the voice therapy.

Conclusions: After PVL the laryngeal closure seems to be preserved enough to prevent aspiration in all patients and allows oral feeding at will. On the basis of our data we can also conclude that the voice that seems better from the subjective point of view also shows better acoustical structure by objective analysis. The voice after OS laryngeal surgery is satisfactorily audible in normal social conversations, though more or less hoarse in spite of voice therapy.

Key words: laryngeal neoplasms; laryngectomy-methods; voice quality; speech therapy

Introduction

In case of malignant laryngeal tumour it is very important to select the type of surgery that is oncologically suitable but affects as small part of the larynx as possible.[1,2] The function preserving approach, trying to preserve the voice of the patients is becoming increasingly widespread in laryngeal surgery.[3-5] After the wound is healed, it is very important to help the patients to re-accustom to their surroundings as soon as possible and to regain their work abilities. Partial laryngectomy allows unhindered breathing without a tracheostoma thus allowing faster returning to the usual life. The quality of voice drops significantly after surgery. After partial vertical laryngectomy, voice can be formed only if the preserved side of the larynx finds some support on the resected side. In this type of surgery, the postoperative scar and the vocal cord of the

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preserved side usually form the glottis.[6] On the other hand, with the preserved laryngeal closure the aspiration during swallowing may be avoided and oral feeding allowed.[7,8]

In this work, we studied the act of swallowing and the possibilities of voice therapy and speech rehabilitation after partial vertical laryngectomy of various extents.

Patients and methods

Between 1986 and 1996, 51 partial vertical laryngectomies for T1 carcinomas of the larynx were performed at our department. The number of chordectomies was 16; 3 of these were done with traditional surgical methods and we have used surgical lasers in the other 13 cases. Twelve frontolateral vertical resections were performed, while among the other 23 hemilaryngectomies, there were 8 Moser type and 15 Hautant type interventions. The mean age of the patients was 57 years (31-74) at the time of the surgery. There were 48 male and three female patients. The results of the histologic examination showed in all cases squamous cell carcinoma.

After the removal of the endolaryngeal tampon and the closing of the temporary tracheostoma we were monitoring the condition of the larynx by indirect laryngeal examination and started with the voice exercises aimed at forming the best possible voice quality as soon as possible. The postoperative *voice therapy exercises* were practically identical to the accepted voice exercises for recurrent nerve paresis:[3,4,9] 1. hard voice-starting exercises; 2. voluntary coughing exercise; 3. phonation of deep voices, Gutzmann's subtonal grunting; 4. digital compression to increase the adductive tendency of the intact vocal cord; 5. head turning exercises for decreasing voice cord level inequality.

The voice exercises were performed first under permanent control then later independently, at home several times a day and the patients were called in for a laryngoscopic control examination every week. The exercises were modified according to the results of the laryngoscopic examination. After complete wound healing and the subsequent 2-3 month voice therapy, the voice characteristics (frequency of sound speech, phonatory duration, vocal range) were examined. Beside the indirect laryngeal examination, the patients were also examined by a flexible PENTAX Faryngo-Naso-Laryngoscope®. After the completed voice therapy, voice recording was made in a sound-treated room. The recordings were later analyzed with a CSL 50® digital acoustic analyzer up to a frequency of 5000 Hz with a band-width of 146 Hz.

The swallowing ability was tested by videofluorography (100 ml Gastrografin® - Schering, water-soluble contrast material) on the 7th postoperative day and 8 weeks after surgery.

Results

An improvement of the voice quality was noted after about 2 months of voice training, in the beginning only during the exercises, but later in normal speech, too (Table 1).

Table 1. Improvement of some parameters of voice quality after two months of voice training

	normal	after surgery	after voice therapy
Fundamental frequency (Hz)	98–130	90–110	96–118
Phonatory duration (sec)	20–25	5–10	10–15
Vocal range (octave)	2–2½	< 1	1–1½

The fundamental frequency in speech became deeper - according to the larynx condition - due to the turning off the undesirable compensation mechanisms. The improvement of the *phonatory duration* usually indicated a decrease in the glottic closing deficiency, but it was still far from the physiologic range. The ability to modulate might have improved a bit, but the *vocal range* remained narrow in spite of the voice therapy. The *ability to increase voice loudness* also increases due to the relaxation and breathing exercises and the training to increase the speed of the airflow.

The results of the objective analysis and the subjective judgment were identical. The recordings that seemed to have a better acoustical structure as determined by *spectrographic analysis* were also considered subjectively better by the listeners, the speech was more understandable.

A marked aspiration by videofluorography was observed in 61 % of the patients (31/51) on the 7th postoperative day. Aspiration showed no correlation with the type of surgery. All patients could swallow satisfactorily 8 weeks after surgery without any functional disturbance.

Discussion

There were only temporary functional disturbances in the swallowing act among our patients without any correlation with the applied type of organ sparing surgery. After 2 months, the laryngeal closure was healed enough to prevent aspiration in all patients and allowed a normal, oral feeding at will.

The voice condition is checked after the wound has been healed but before the speech exercises. The fundamental frequency in speech usually becomes deeper or similar to the voice of the false vocal cords. Phonatory duration is significantly shorter, the vocal range becomes very narrow, less than 1 octave, the ability to increase voice loudness decreases, the voice becomes faint.[10-12] Speech is an exhausting act due to the high ratio of wasted air caused by the closing deficiency of the glottis. We have observed that the "phonatory dyspnea" is usually characteristic in most of the patient as well as the inspiratory and expiratory phonation. Phonation is made harder by the frequent level difference between the scar of the operation area and the intact vocal cord. Voice training should be started as soon after wound healing as possible to prevent the formation of incorrect helping mechanisms (whispering, forced high pitch or head-voice, strained neck muscles) due to aphysiologic compensation attempts. The purpose of the exercises is to increase the overcompensation activity of the intact vocal cord, resulting in the improvement of the glottal closing deficiency, the intact vocal cord touches the scar or gets significantly closer to it.[7] Voice training must be tailored to each patient's needs. Intensive relaxation exercises are also necessary to compensate high stress of neck muscles caused by the aphysiologic compensation attempt, while the high ratio of air-wasting requires breathing and loudness-increasing exercises.

On the basis of our studies we can state that the voice which seemed better from the subjective point of view showed a better acoustic structure in the objective analysis, too. A very important factor is the success of the voice training aimed at the improvement of voice quality. The patients´ will and belief in the necessity of the treatment is an absolute requirement. There is no definitive correlation between the type of the applied organ sparing surgery and the phonatory defect. The sound quality may be different even in the case of identical operations due to individual differences in the size of the glottis, the extension, rigidity and elasticity of the scar tissue and the compensation abilities. Granulation tissues at the scar area and scary adhesions may spoil voice quality. Still, the voice forming after function preserving laryngeal surgery usually ensures good audibility in normal conversational speech and most of the patients can continue their life without serious problems.

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