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# Overview of 100 Patients with Voice Prosthesis after Total Laryngectomy – Experience of Single Institution

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## ABSTRACT

*Surgical procedures, especially total laryngectomy, used for treatment of advanced laryngeal carcinoma, have a profound adverse effect on the patient's physical, functional, and emotional health, and almost always decrease quality of life. There are three main types of voice rehabilitation after surgery. They are: esophageal speech techniques, the use of artificial larynx devices and tracheoesophageal puncture with the insertion of various types of voice prostheses. Voice prosthesis was inserted in 100 patients in the ENT Department, University Hospital Center Zagreb, from January 2004 until February 2011, and 91 of these patients were included in our study. The prosthesis was inserted secondary at 71 patients, while in other 20 it was inserted primary, i.e. immediately after laryngectomy as a part of the same procedure. Voice rehabilitation was initiated 10<sup>th</sup> day after primary insertion and 1<sup>st</sup>–3<sup>rd</sup> day after secondary insertion. The postoperative voice quality was compared with a five degree scale, which was taken from Hilger's retrospective study (2000). The rehabilitation was successful in 75.8% of our patients. Early complication rate was 4.4%, and 10.9% of patients had late complications. Statistical analysis didn't show significant differences regarding the complications rate and success rate of rehabilitation between groups of patients, formed according to age, irradiation status and timing of prosthesis insertion.*

**Key words:** voice prosthesis, laryngectomy, tracheoesophageal puncture

## Introduction

Larynx is a complex organ situated at the junction between respiratory and digestive tracts. As it is well known, larynx has three major functions. It serves as an air conduit during respiration, armed with its cartilages. Apart from it, it moves during the swallowing, when all of the laryngeal sphincters, aryepiglottic, ventricular and vocal folds, close. In this way larynx protects the lungs from food and liquids entering the lungs, and cause suffocation or aspiration pneumonia. Third, and by evolution youngest laryngeal function is phonatory<sup>1</sup>. Vocal folds vibrate during the air flow, thus producing voice, which is formed into speech with the help of other articulation organs, such as the pharynx, tongue, nose and others. Surgical procedures used for treatment of laryngeal carcinoma, and rarely some other laryngeal diseases,

damage these functions. How much will they be damaged depends on the extensivity of the procedure. The most mutilating procedure is total laryngectomy, which is sometimes inevitable for treating an advanced cancer. It has a profound adverse effect on the patient's physical, functional, and emotional health, and almost always decreases quality of life, by the means of loss of voice, altered swallowing, and a permanent tracheotomy<sup>2</sup>. Ever since Billroth performed first total laryngectomy in 1873, numerous attempts to restore the patient's voice have been performed. There are three main types of voice rehabilitation after surgery. They are: esophageal speech techniques, the use of artificial larynx devices and surgical voice restoration techniques. There are several surgical methods used in attempt to restore fonatory larynx

geal function, tracheoesophageal puncture with the insertion of various voice prostheses being the most often used. The choice of speech rehabilitation varies from patient to patient, but tracheoesophageal (TE) voice has become the preferred method. Singer and Blom introduced the tracheoesophageal puncture and voice prosthesis in 1979<sup>3</sup>. Since then, general principles remain the same, though numerous variations on the procedure and of the prosthesis itself have been performed<sup>2</sup>. TE fistula formation allows air, initially coming from lungs, to flow through the trachea into the esophagus, while the valve in the prosthesis at the same time prevents entering of food and liquid backwards into the trachea (Figure 1.). The voice is then formed in the vibratory segment of the



Fig. 1. Voice prosthesis with automatic valve.

pharynx after passing through the fistula. This method has become the most successful voice rehabilitation technique. TE puncture can be undertaken at the time of total laryngectomy (primary) or at a later stage (secondary) (Figure 2). Hamaker et al., in 1985, were the first to use the procedure as a primary puncture during a laryngectomy<sup>4</sup>. The tracheoesophageal voice success rate following total laryngectomy varies between 70–95%. There

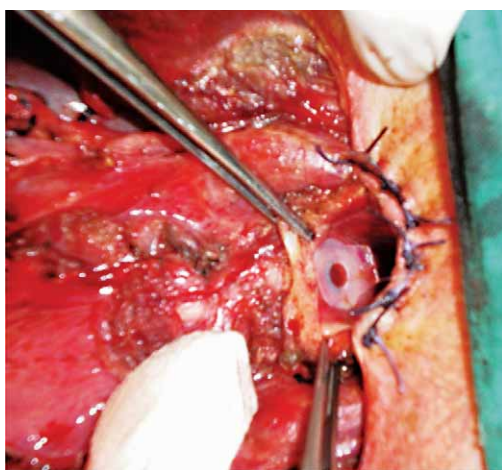


Fig. 2. Primary insertion of the voice prosthesis.

are multiple advantages of such method. Voice rehabilitation is possible as early as few days after the surgery, which contributes to the patient's psychological recovery<sup>5</sup>. The fistula also can be easily closed if necessary, and the speech is learned faster than esophageal speech. It uses lung-powered air flow for sound generation (cca 500 mL vs. 40–70 mL in esophageal speech), so the voice is more fluent, louder and steadier<sup>3</sup>. Despite the simplicity of the method of TE puncture, it is very important to provide a thorough assessment of the patient to determine whether he is a candidate and its timing. The disadvantages are: patient has to close his tracheostoma with a finger, voice therapist has to change the prosthesis and complications are always possible.

Voice failure after prolonged speech therapy may be due either to TE puncture or prosthesis related complications or may be due to poor motivation of the patient.

The aim of this study was to determine and compare the success of the voice prosthesis rehabilitation in our patients belonging to different groups formed according to age, irradiation status and timing of prosthesis insertion.

## Methods and Patients

Voice prosthesis was inserted in 100 patients in the ENT Clinic, Zagreb University Hospital Centre, from January 2004 until February 2011. A total laryngectomy was performed in the usual way, as described elsewhere in the literature. A tracheoesophageal fistula was then created between the posterior wall of the tracheostome and the upper esophagus and one-way silicone valve was inserted.

A retrospective study was conducted in April 2011. At that time, 91 of initial 100 patients were alive. There were 88 male and 3 female patients, 47–86 years old (median 64 y.o.). The prosthesis was inserted as a secondary procedure at 71 patients, while at other 20 it was inserted primary, 73 patients underwent radiotherapy while 18 of them didn't. The majority of the prostheses were PROVOX 2. Since 2008 we started to use Blom-Singer prostheses also.

The patients had to fulfill certain conditions before receiving the prosthesis. They had to be in a good physical condition, with well formed tracheostoma, and above all they had to be motivated<sup>6,7</sup>. Voice rehabilitation was initiated 10<sup>th</sup> day after primary insertion and 1<sup>st</sup>–3<sup>rd</sup> day after secondary insertion.

The voice quality was compared with a five degree scale, which was taken from Hilger's retrospective study from the year 2000<sup>8</sup>. The voice quality was evaluated by the logopedist and ENT specialist and the median was established. Excellent postoperative voice, fluent and understandable in every social occasion was graded with 5, and no voice at all was 1. The patients whose voices were ranked as 3–5 were considered successfully rehabilitated, and patients ranked as 1–2, or those who gave up were considered unsuccessfully rehabilitated.

The complications were also evaluated. Patients were divided into groups according to age: those younger and those older than 60 years, those who received radiotherapy and those who didn't and according to the insertion timing: primary or secondary.

## Results

The results of our study are shown in the following tables. 75.8 % of patients were successfully rehabilitated, with early complication's rate 4.4 %, 10.9 % of patients had late complications. 8.8 % patients gave up the rehabilitation (Table 1).

Regarding the success rate of the rehabilitation, statistical analysis didn't show any significant difference among groups (Table 2).

Regarding the incidence of complications (both early and late), statistical analysis also didn't find differences between groups (Table 3).

Out of 14 patients that had some complication during postoperative period, 11 have finally been successfully rehabilitated.

## Conclusion

Tracheoesophageal puncture with the insertion of voice prosthesis remains the most successful rehabilitation method following the total laryngectomy. Rehabilitation success rates and the incidence of complications (of which leakage being the most common) in our study were comparable with the results of other long term retrospective studies regarding the subject. Our results didn't

**TABLE 1**  
THE RESULTS OF THE STUDY

	Total	5	4	3	2	1	Successful rehab.	Not succes. rehab.	Early compl.	Late compl.	Gave up
Patients	91	20	20	35	13	3	69	22	4	10	8
Primary inserted	20	4	5	10	1	0	18	2	1	3	1
Secondary inserted	71	16	15	25	12	3	51	20	3	7	7
Patients > 60 y.o.	56	9	12	27	5	3	43	13	3	7	7
Patients ≤ 60 y.o.	35	11	8	8	8	0	26	9	1	3	1
Irradiated	18	5	4	6	3	0	13	5	1	4	3
Non irradiated	73	15	16	29	10	3	56	17	3	6	5

**TABLE 2**  
RESULTS REGARDING THE SUCCESS RATE OF THE REHABILITATION

	Total	Successful rehab.	Not succes. rehab.	Successful rehab..	P
Primary inserted	20	18	2	90.0%	0.078*
Secondary inserted	71	51	20	71.8%	
Patients > 60 y.o.	56	43	13	76.8%	0.786**
Patients ≤ 60 y.o.	35	26	9	74.3%	
Non irradiated	18	13	5	72.2%	0.764*
Irradiated	73	56	17	76.7%	

\* Fisher's test, \*\*  $\chi^2$ -test

**TABLE 3**  
RESULTS REGARDING THE INCIDENCE OF COMPLICATIONS

	Total	Early compl.	Late compl.	Total compl.	P
Primary inserted	20	1	3	20.0%	0.987*
Secondary inserted	71	3	7	14.1%	
Patients > 60 y.o.	56	3	7	17.9%	0.071*
Patients ≤ 60 y.o.	35	1	3	11.4%	
Non irradiated	18	1	4	27.8%	0.922*
Irradiated	73	3	6	12.7%	

\*  $\chi^2$ -test

show any influence of the age, the timing of prosthesis insertion or irradiation status on rehabilitation results

or incidence of complications. The results are similar to the results of some other retrospective studies<sup>9</sup>.

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## PREGLED 100 BOLESNIKA SA GOVORNOM PROTEZOM NAKON TOTALNE LARINGEKTOMIJE

### SAŽETAK

Kirurški zahvati koji se koriste u liječenju karcinoma grkljana, a posebno totalna laringektomija, imaju izražen negativni učinak na fizičko, funkcionalno i emocionalno zdravlje bolesnika i gotovo uvijek snižavaju životnu kvalitetu bolesnika. Postoje tri glavne skupine glasovne rehabilitacije nakon zahvata. To su: ezofagealni govor, govor upotrebom elektrolarinksa i traheozofagealna fistulizacija sa ugradnjom govorne proteze. Na Klinici za otorinolaringologiju KBC Zagreb je ugrađeno 100 govornih proteza od siječnja 2004. do veljače 2011. U studiju je uvršten 91 bolesnik. Kod 71 bolesnika su one ugrađene sekundarno, a kod 20 primarno, dakle istodobno kada i laringektomija. Rehabilitacija je započimana 10. dana nakon primarne ugradnje, te već 1.–3. nakon sekundarne ugradnje. Postoperativna kvaliteta glasa je uspoređivana sa 5 stupanjskom ljestvicom, uzetom iz Hilgerove retrospektivne studije (2000.). 75,8% bolesnika je uspješno rehabilitirano, uz stopu ranih komplikacija 4,4%. Stopa kasnih komplikacija je bila 10,9%. Statistička analiza nije pokazala značajne razlike između uspješnosti rehabilitacije kod skupina bolesnika, formiranih na osnovu dobi, prethodnog zračenja i vremena ugradnje.