

# Post-Laryngectomy Voice Rehabilitation: Comparison of Primary and Secondary Tracheoesophageal Puncture

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**ABSTRACT:** **Background:** Voice restoration following total laryngectomy is an important part of patients' rehabilitation and long-term quality of life.

**Objectives:** To evaluate the long-term outcome of indwelling voice prostheses inserted during (primary procedure) or after (secondary procedure) total laryngectomy.

**Methods:** The study group included 90 patients who underwent total laryngectomy and tracheoesophageal puncture (TEP) with placement of voice prosthesis at a tertiary medical center during the period 1990–2008. Background, clinical and outcome data were collected by medical file review. Findings were compared between patients in whom TEP was performed as a primary or a secondary procedure.

**Results:** TEP was performed as a primary procedure in 64 patients and a secondary procedure in 26. Corresponding rates of satisfactory voice rehabilitation were 84.4% and 88.5% respectively. There was no association of voice quality with either receipt of adjuvant radiation/chemoradiation or patient age. The average lifetime of the voice prosthesis was 4.2 months for primary TEP and 9.06 months for secondary TEP ( $P = 0.025$ ).

**Conclusions:** Primary TEP provides almost immediate and satisfactory voice rehabilitation. However, it is associated with a significantly shorter average prosthesis lifetime than secondary TEP. Chemoradiotherapy and patient age do not affect voice quality with either procedure.

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**KEY WORDS:** laryngeal cancer, laryngectomy, laryngeal speech, tracheoesophageal fistula, tracheoesophageal puncture (TEP), voice prosthesis

Total laryngectomy is the treatment of choice for advanced laryngeal/hypopharyngeal carcinoma, either as a primary procedure or as salvage following radiation or chemoradiation. The past three decades have witnessed significant progress in the rehabilitation of patients after total laryngectomy.

The introduction of the tracheoesophageal shunt and artificial valve dramatically improved patients' quality of life [1], and indwelling voice prostheses yielded high success rates for voice restoration [2]. Although large studies have proven the effectiveness, longevity and safety of voice prostheses [3–6], several factors may influence long-term voice outcome after total laryngectomy, including the administration of radiotherapy and chemotherapy, type of prosthesis, and tracheoesophageal puncture technique [7–9].

Indwelling voice prostheses have been associated with a high percentage of long-term users and fair-to-excellent voice quality [10–12]. In terms of acoustic measures, the speech produced with TEP compares better with normal laryngeal speech than esophageal or electromechanical speech (electrolarynx) [3–5]. At present, TEP with insertion of voice prosthesis is the preferred method for voice rehabilitation in patients undergoing total laryngectomy [13–15].

The aim of the present study was to compare the success rate of TEP performed as a primary procedure during total laryngectomy or as a second-stage procedure after total laryngectomy. The effect of background, clinical, and treatment-related factors on voice outcome was examined as well.

## PATIENTS AND METHODS

A retrospective study design was used. The sample consisted of all patients with laryngeal cancer who were treated with total laryngectomy and TEP for voice rehabilitation at a major tertiary care center during the period 1990–2008. Until 1997, TEP was performed exclusively as a second-stage procedure several months following laryngectomy. Primary TEP was then introduced and became the procedure of choice.

According to our departmental protocol TEP is performed under general anesthesia with a rigid esophagoscope. A fistula is created and the prosthesis is inserted through the esophagus. The external flange is removed through the fistula to form a round extremity. The prosthesis is considered to be correctly placed if it can be rotated 360° easily. Fiberoptic endoscopy

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TEP = tracheoesophageal puncture

should show an open esophageal flange lying flat against the anterior esophageal wall.

After TEP, patients are evaluated for voice function by an otolaryngologist and a speech pathologist. Maximum phonation time is assessed with an average of three consecutive trials. Maintenance of phonation for longer than 8 seconds is considered appropriate. Patients are also shown how to regularly clean the prosthesis with pipettes and brushes. Follow-up evaluations of prosthesis function and vocal quality are conducted 1 month postoperatively and thereafter every 6 months. Patients whose surgical margins are involved by tumor, and patients with perineural invasion, extralaryngeal extension, neck metastasis, or extracapsular extension of metastasis are referred for adjuvant radiation or chemoradiation treatment.

For the present study, background, operative and outcome data were collected from the medical files. Patient age at surgery, type of prosthesis, time of prosthesis placement, length of prosthesis use, administration of adjuvant therapy, and duration of follow-up were recorded. Findings were compared between patients after primary or secondary TEP. Fisher's exact test was used for statistical analysis. The study was approved by the Institutional Review Board.

## RESULTS

During the study period, 90 patients underwent total laryngectomy and TEP/prosthesis insertion. Ages ranged from 22 to 88 years, and the male: female ratio was 9:1. Of the 90 patients, 74 (82.2%) were smokers and 12 (13.3%) drank alcohol [Table 1].

Primary TEP was performed in 64 patients (71.1%) and secondary TEP in 26 (28.9%). The secondary TEP group included eight patients who underwent pharyngeal reconstruction with a pectoralis major myocutaneous flap. Average time from laryngectomy to TEP in the secondary TEP group was 6.45 months. The Provox indwelling voice prosthesis (Atos Medical AB, Horby, Sweden) was used in 67 patients (74.7%) and the Blom-Singer indwelling voice prosthesis (Inhealth Technologies, Carpinteria, CA, USA) in 23 (25.5%).

The duration of patient follow-up ranged from 12 to 132 months, with a mean of 38 months in the primary TEP group and 51 months in the secondary TEP group. Forty patients (59.7%) in the primary TEP group and 15 (15.7%) in the secondary TEP group were referred for adjuvant radiation or

**Table 1.** Demographics and risk factors of 90 patients after total laryngectomy

Age (yr)	66.4 (range 22–88)
Gender	
Male	81
Female	9
Smoking	74 (82.2%)
Alcohol	12 (13.3%)

**Table 2.** Clinical and pathological features of 90 patients after total laryngectomy

	No. of patients (%)
Primary TEP	64 (71.1%)
Secondary TEP	26 (28.8%)
<b>Prosthesis type</b>	
Provox	67 (74.4%)
Blom-Singer	23 (25.5%)
Radiotherapy	46 (51.1%)
Died of disease	8 (8.8%)

TEP = tracheoesophageal puncture

chemoradiation. The voice acquisition rate was 85.5% in the whole sample: 84.4% in the primary TEP group and 88.5% in the secondary TEP group ( $P = 0.34$ ). There was no association of the rate of voice acquisition with receipt (or not) of adjuvant therapy ( $P = 0.36$ ) or with patient age (more or less than 70 years), overall or by group.

The mean lifetime of the voice prosthesis was 4.2 months in the primary TEP group and 9.06 months in the secondary TEP group. This difference was statistically significant ( $P = 0.025$ ). There was no association of prosthesis lifetime with receipt (or not) of adjuvant therapy ( $P = 0.36$ ) or patient age (more or less than 70 years) ( $P = 0.87$ ).

Four patients, two in each group, acquired an esophageal voice and discontinued their use of the voice prosthesis. In three patients, the tracheoesophageal fistula dilated after chemoradiation therapy, necessitating additional procedures to close the fistula and create a new one. There was no difference in the rate of stomal stenosis between the primary and secondary TEP groups. None of the patients who required pharyngeal flap reconstruction had complications related to the TEP and all acquired good voice quality. Eight patients (8.8%) died of the disease during follow-up. Clinical and pathological features are presented in Table 2.

## DISCUSSION

We describe the experience of a tertiary medical center with voice rehabilitation following total laryngectomy. The study is important because of the relatively high percentage of secondary TEP procedures and the long follow-up period compared to previous studies. We found that both primary and secondary TEP are associated with high success rates, with no difference in complications.

Similar to our findings, Boscolo-Rizzo et al. [16] reported that primary and secondary TEP were equally safe and effective. By contrast, Maniglia et al. [17] reported that primary TEP for insertion of voice prosthesis was associated with a higher rate of complications than secondary TEP. However, in their study, only a small number of patients underwent the

secondary procedure. St Guily et al. [18] reported an increased risk of pharyngocutaneous fistula formation in primary versus secondary TEP following chemoradiation, although there was no difference from the primary TEP in patient acquisition of speech fluency. In the present study, radiation and chemoradiation therapy had no adverse effect on either voice quality or fistula formation in both groups. We also found no effect of age on voice quality, eliminating it as an exclusion factor in voice rehabilitation surgery.

It is noteworthy that in the present study primary TEP was associated with a shorter prosthesis lifetime compared to secondary TEP. Although self-care may play a role in the longevity of prostheses, all our patients received careful instruction on prosthesis hygiene and maintenance and all were under close, regular 6 month surveillance by an experienced speech pathologist. It is possible that fistula formation is better after the trachea and neopharynx have healed.

Although the tendency toward higher success rates for primary TEP in other studies [19] may be explained by the smaller number of patients who undergo secondary TEP, it is possible that immediate rehabilitation with earlier voice restoration exerts a positive psychological impact, as suggested by Boscolo-Rizzo et al. [16], and imparts a more intense motivation for oral communication. Alternatively, the central command and plasticity of the esophageal musculature of patients after secondary TEP may be deficient because the prolonged absence of the larynx eliminated the need for an airway protection mechanism. In addition, these patients commonly develop other adaptive speech mechanisms, such as pharyngeal phonation, that can disturb subsequent vocal rehabilitation with TEP and voice prosthesis.

In conclusion, this review of 90 patients with indwelling voice prosthesis after total laryngectomy suggests that primary TEP, besides eliminating the need for a second operation and interim tube feedings [20], may have important advantages such as shorter duration of postoperative aphonia, earlier voice restoration, and more rapid acquisition of fluent speech. It is as successful as secondary TEP in terms of final voice quality. The complication rates of both procedures are similarly low, and neither is adversely affected by the administration of radiation or chemoradiation or older patient age. We conclude that the benefits of the single-stage procedure may justify its adoption as the gold standard.

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**“What lies behind us and what lies before us are tiny matters compared with what lies within us”**

Ralph Waldo Emerson (1803-1882), American essayist, lecturer and poet, who was a champion of individualism and critic of the countervailing pressures of society