Outcomes of primary and secondary tracheoesophageal puncture: A 16-year retrospective analysis

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Abstract
The current study retrospectively reviewed the cases of 68 patients who had undergone total laryngectomy and tracheoesophageal puncture (TEP) over a 16-year period. Fifty-one patients underwent primary TEP and 17 underwent secondary TEP. Nearly 80% of patients who received TEP at the time of laryngectomy achieved excellent voice quality perceptually. In contrast, only 50% of secondary TEP patients achieved excellent voice ratings. This difference was statistically robust (p = 0.03). Although both surgical and prosthesis-related complications occurred more frequently following primary TEP, statistically significant differences were not achieved. Neither pre- nor postoperative radiotherapy had any effect on voice restoration or complication rates. Based on these data, primary TEP may be preferable for several reasons, including a greater likelihood of successful voice restoration, a shorter duration of postoperative aphonia, and the elimination of the need for a second operation and interim tube feedings.

Introduction
In 1980, Singer and Blom popularized tracheoesophageal puncture (TEP) as a technique for voice restoration following total laryngectomy.\(^1,2\) In that study, 88% of patients successfully attained functional voice following total laryngectomy.\(^3\) In order to empirically address this issue, voice outcomes and complication rates were analyzed retrospectively in a relatively large cohort of patients who had undergone total laryngectomy and either primary or secondary TEP.

Patients and methods
The current study was approved by the Institutional Review Board at Memorial Sloan-Kettering Cancer Center. Medical records of all patients who had undergone laryngectomy and TEP from 1987 through 2002 were reviewed to determine the incidence and nature of successful voice acquisition and any complications associated with either the surgical procedure or the prosthesis.

Voice quality. Although TEP remains a popular means of voice restoration, no consensus exists as to the appropriate timing of TEP—that is, should it be performed during the total laryngectomy or later as a secondary procedure? The lack of consensus can be attributed to a paucity of data regarding the actual quality of voice restoration and the complications associated with the two procedures.

The obvious advantage of primary TEP placement is that patients are not subjected to a second operation for the acquisition of voice. In addition, patients do not require nasogastric feedings following laryngectomy, and they may initiate voice rehabilitation within 2 weeks of the laryngectomy.\(^1\) On the other hand, primary TEP is thought to be associated with an increased risk of surgical and stoma-related complications, such as fistula, leakage at the puncture site, stomal stenosis, and local infection. It has been suggested that the complication rate may be decreased if TEP is performed as a secondary procedure due to increased duration of tracheostomal healing.\(^1\) Moreover, secondary TEP patients may have more reasonable expectations regarding the quality of tracheoesophageal speech and therefore be more satisfied with their voice following the period of postoperative aphonia.\(^3\)
of a conversational speech sample. During the evaluation, phonation was adequate with minimal leakage around the tracheostoma using digital occlusion. TEP voices were classified as excellent, fair, or poor, based primarily on vocal duration, continuity, fluency, and vocal loudness during conversational speech. Although not psychometrically sound, this perceptual scale is employed commonly in clinical practice. In addition, the success of TEP was assessed by ascertaining the percentage of patients who consistently used the prosthesis as the primary mode of communication.

Surgical complications. Surgical complications of interest were the development of fistula, stomal stenosis, and pharyngoesophageal stricture.

Prosthesis-related complications. Prosthesis-related complications were defined as those that necessitated intervention—particularly, dislodgment and leakage. The latter was defined as leakage through the prosthesis within 3 months of its placement or leakage around the prosthesis, which indicated that either the health of the tissue was poor or the sizing of the prosthesis was unsatisfactory. When complications occurred, interventions included, but were not limited to, resizing the prosthesis, cauterizing granulation tissue, and administering antifungal rinses.

Radiation. As a secondary aim of the current investigation, the relationship between radiation therapy and voice acquisition, surgical complications, and prosthesis-related complications was determined.

Statistical analyses. Fisher’s exact test was employed in the current study. The investigation-wise alpha-level was set at 0.05.

Results
A total of 68 patients were identified and included in the current study (table). The median patient age at presentation was 59 years (range: 31 to 82). The male-to-female ratio was approximately 4:1. Of the 68 patients, 51 (75.0%) had undergone primary TEP and 17 (25.0%) had undergone secondary TEP.

In the primary TEP group, primary closure of the pharyngeal defect was achieved in 42 patients; 5 patients required a pectoralis major myocutaneous flap, 3 required a jejunal free flap, and 1 required both. In the secondary group, primary closure was achieved in 13 patients, while 3 patients required closure with a pectoralis flap and 1 required a jejunal free flap. The median length of time between laryngectomy and secondary TEP was 23 months. Approximately half of these patients had elected to undergo secondary TEP because they had experienced only minimal success with esophageal speech; most of the others cited displeasure with electrolaryngeal speech as their motivation.

Voice quality. Perceptual evaluations of voice quality were available for only 50 of the 68 patients—36 in the primary group and 14 in the secondary group (table). Excellent voice quality was achieved by 28 of the primary TEP patients (77.8%) and 7 of the secondary patients (50.0%); the difference between the two groups was statistically significant ($p = 0.03$).

Of the remaining primary TEP patients, 5 had a fair voice (13.9%) and 3 had a poor voice (8.3%). Of the secondary TEP patients, 5 had a fair voice (35.7%) and 2 had a poor voice (14.3%).

Following TEP, only 52 of the 68 patients (76.5%) used...
tracheoesophageal speech as their primary mode of communication—40 of the 51 patients in the primary group (78.4%) and 12 of the 17 in the secondary group (70.6%). Tracheoesophageal speech was abandoned completely by 1 primary patient and 2 secondary patients.

Surgical complications. In the group as a whole, surgical complications occurred in 27 of 68 patients (39.7%) (table). When analyzed by subgroup, surgical complications occurred in 22 of the 51 primary TEP patients (43.1%) and in 5 of the 17 secondary TEP patients (29.4%). The difference between the two rates was not statistically significant ($p = 0.40$).

In the primary group, there were 10 cases of fistula, 10 cases of stomal stenosis, and 6 pharyngoesophageal strictures (some patients in both groups experienced multiple complications). Surgical complications in the secondary group included 3 fistulas, 3 stomal stenoses, and 1 pharyngoesophageal stricture.

Prosthesis-related complications. Prosthesis-related complications occurred in 29 of the 68 patients (42.6%)—in 24 primary patients (47.1%) and 5 secondary patients (29.4%) (table). The difference was not statistically significant ($p = 0.26$).

In the primary group, the most common complications were prosthesis leakage, which occurred in 20 patients (39.2%), and dislodgement, which occurred in 6 (11.8%). Likewise, leakage was the most common complication in the secondary group, occurring in 4 patients (23.5%); only 1 case of dislodgment (5.9%) was noted in the secondary group.

Radiation. In the primary TEP group, 30 patients underwent preoperative radiation with or without chemotherapy and 19 received postoperative radiation; 5 of these patients received both (table). Seven patients did not receive any radiotherapy.

In the secondary TEP cohort, 7 patients underwent preoperative radiation treatment with or without chemotherapy and 7 received postoperative radiation; 2 of these patients received radiotherapy both before and after laryngectomy (table). Five patients in the secondary TEP group did not receive any radiotherapy.

Post hoc analyses suggest that radiation therapy (before and/or after laryngectomy) had no impact on voice acquisition, surgical complications, or prosthesis-related complications (figure).

Discussion

Previously published direct comparisons of primary and secondary TEP have shown that the two procedures were equally successful in restoring voice.$^{1-12}$ Studies focusing on primary TEP yielded success rates ranging from 52 to 89%.$^{1-14}$ Reported success rates for secondary TEP range from 56 to 94%.$^{2,7,9,13-20}$ One exception was a series reported by Trudeau et al, who found that 27% of secondary TEP patients remained permanently aphonic while 100% of primary TEP patients regained speech.$^{10}$ Another notable finding was reported by Recher et al, who demonstrated an excellent success rate (91%) among patients who underwent secondary TEP electively; these patients performed significantly better than a subgroup of patients who underwent secondary TEP after they had already failed to achieve esophageal speech (64%).$^{21}$ Donegan et al identified several factors that contribute to voice acquisition difficulties, including patients’ inability to care for the prostheses.$^{22}$

The success rates in the current investigation were similar to those reported previously. Among the primary TEP patients, 77.8% achieved excellent voice quality and 78.4% used tracheoesophageal speech consistently. In the
secondary TEP cohort, the corresponding rates were 50.0 and 70.6%. The difference between the rates of excellent voice quality in the two groups was statistically significant (p = 0.03). This finding provides surgeons with valuable data for consideration during treatment planning.

In addition to voice acquisition, surgical complications must be considered. In their original series, Singer et al suggested that complications of TEP are uncommon. However, conflicting data exist. For example, Maniglia et al reported that TEP was associated with significant complication rates regardless of its timing. In that study, complications occurred in 36% of primary TEP patients and 21% of secondary TEP patients, although most of those complications were transient and easily managed. Similarly, Mehle et al reported that 23% of secondary TEP patients experienced major complications associated with the surgical procedure.

Ho et al initially found that primary TEP patients may experience higher rates of stomal stenosis than do secondary TEP patients. However, when they performed a subsequent multivariate analysis, they found that primary TEP was not an independent risk factor for tracheostomal stenosis.

Risk factors that have been reported to predispose patients to complications include radiotherapy, chronic obstructive pulmonary disease, and an extended laryngectomy. Complications that occur during the immediate postoperative period have been associated with a need for stricture dilation. Pharyngeal stricture was also implicated as a cause of poor speech in two reports by Lavertu et al.

In the current study, complications were not associated with the timing of the procedure. Although patients in the primary TEP group had a higher incidence of both surgical and prosthesis-related complications, the differences were not statistically significant.

Several investigators have identified radiotherapy as a risk factor for unsuccessful voice outcomes and the development of complications after TEP. Silverman and Black found that primary TEP patients who had not been irradiated postoperatively achieved better voice outcomes than did those who had been irradiated. Cantu et al reported that not only postoperative radiation but also a history of radiation decreased the success rate. On the other hand, several studies have found that radiotherapy had no effect on vocal rehabilitation or complication rates. In one of these studies, LaBruna et al retrospectively reviewed 77 patients who had undergone TEP following radiotherapy. All of those patients regained voice function, and 97% of them continued to use tracheoesophageal speech consistently. Only 10% of those patients developed complications during the course of treatment. LaBruna et al concluded that TEP after radiotherapy is a safe and effective method of vocal rehabilitation.

Since the advent of organ-preservation treatment strategies for laryngeal carcinoma, many of the patients in the current study had already received irradiation with or without chemotherapy by the time they presented for surgical management. Data from the current investigation suggest that neither pre- nor postoperative radiotherapy has any effect on the success of voice restoration or the incidence of complications. However, it is possible that the differences in this study would have reached the level of statistical significance had a larger sample of patients been studied.

In conclusion, given that the rates of surgical and prosthesis-related complications associated with primary and secondary TEP are comparable, it appears that primary TEP may be the preferable procedure in view of its superiority with regard to voice acquisition. Furthermore, primary TEP is associated with a shorter duration of aphony following laryngectomy, and it obviates the need for a second operation and interim tube feedings.

References