Tracheoesophageal Speaking Fistula with Sphincter Mechanism*

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During the past three decades, several authors reported various surgical techniques for voice restoration after total laryngectomy.[1-11] The principle behind these procedures is to divert pulmonary air into the pharynx or esophagus to achieve intelligible voice. The resultant speech compared satisfactorily with esophageal speech, which had been the most frequently used method of vocal rehabilitation. However, tracts made between the trachea and the esophagus for phonatory purposes risk possible aspiration, unless a protective mechanism provides a sphincter or valve during deglutition. Surgical procedures for voice restoration after total laryngectomy previously reported rely on passive shunt closure or the use of a prosthetic one-way valve.[9,11] To achieve surgical voice restoration, voice production must be compatible with normal deglutition.

During the past 12 years we have been performing the tracheoesophageal speaking fistula operation. We had used the membranous part of the trachea for the purpose of primary voice restoration at laryngectomy(original technique without sphincter mechanism).[12,13]

This paper presents further additional technique designed to eliminate aspiration, using bilateral esophageal constrictor muscle flaps(BECMF).

METHOD

Under local anesthesia, a horizontal skin incision is made for the tracheostomy between the level of the cricoid cartilage and the sternal notch. The lumen of the trachea is entered at the level of the third and fourth tracheal rings. An anesthetic tube of smaller proportions than for a standard laryngectomy is inserted to facilitate later peristomal surgery. The skin incision is extended as an apron flap and if a neck dissection is planned, the incision is shifted laterally and extended to the mastoid tip. A conventional laryngectomy is performed and the posterior wall of the trachea must not be separated from the esophagus. The level of tracheal transection depends on the extent of tumor and is usually sectioned just below the cricoid cartilage.

This newly designed technique consists of the following six basic steps (Fig 1) : a tracheal flap formation, BECMF formation, side-to-side anastomosis, hypopharynx closure, TE fistula construction, dnd BECMF approximation.

Tracheal Flap Formation. On completing the resection, the anterior five cartilaginous tracheal rings are removed. The 2.5-cm posterior tracheal wall is used as atracheal flap.
The lower circumference of the tracheostoma is formed at this stage.

Formation of BECMF. The esophageal wall at the level of the tracheal flap is exposed by blunt

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dissection of the thyroid lobe. A inferiorly besed esophageal flap, which includes both outer and inner muscle layers (15×7mm), is obtained from the posterolateral wall.
The top of this flap should not project beyond the level of the side-to-side anastomosis. This procedure is performed bilaterally. It is important not to perforate the esophageal mucosa.

Side-to-Side Anastomosis. The left index finger is placed against the back wall of the tracheal flap through the pharyngotomy defect. The left thumb holds a clamp placed against the esophageal wall with the help of the index finger. A 10-mm midline vertical incision is made starting 2 mm inferior to the superior margin of the tracheal flap. The esophageal lumen is entered very carefully so as not to lose sight of the incised mucosal margin. The margin is clamped at several points and a side-to-side anastomosis is created by approximating the incised margin of the esophageal mucosa to that of tracheal mucosa with eight stitches of absorbable thread.

Hypopharyngeal Closure. A transnasal feeding tube is inserted into the esophagus and the hypopharyngeal defect is closed in T or Y fashion using 3-0 chromic catgut. The pharyngeal constrictor muscles are not approximated to enhance postoperative voice production. Since preoperative irradiation may complicate wound healings, pharyngeal constrictor muscles are approximated to reinforce the mucosal closure in these cases.

TE Fistula Construction. The lateral margins of the tracheal flap are approximated from above with 3-0 chromic catgut to form a mucosa-lined tube. This establishes a fistula from the tracheostoma to the esophagus.

Approximation of BECMF. Bilateral esophageal constrictor muscle flaps are approximated with sutures of 4-0 chromic catgut over the middle of the TE fistula. Suction drains are placed before skin closure. The upper circumference of the tracheostoma is formed and the skin is closed.

We do not advise this surgery in patients with reduced pulmonary reserves. Factors such as age, motivation, and need to speak are considered before this technique is applied. For irradiated patients a minimum interval of 8 weeks is needed prior to surgery.

RESULTS

One hundred sixty-three patients had TE speaking fistula operation during the past twelve years. Of these 163 patients, sixty-eight underwent the operation with sphincter mechanism (SM^+), whereas ninty-five underwent the original operation without sphincter mechanism (SM^-). Most of the cases in both groups were laryngeal carcinoma (Table 1).

The success rate in the group with sphincter mechanism was 88%, whereas the rate for the group without sphincter mechanism was 80%. The overall rate was 83%(Table 2).

The causes of failure in fistula speech were tabulated (Table 3). The most frequent cause was the stenosis at the side-to-side anastomosis.

The initial phonation of the primarily cured patients occured on the 17th post operative day in the group without sphincter mechanism, and on the 22nd postoperative day in the group with sphincter mechanism(Table 4).

As far as the swallowing function is concerned, fifty-four of the sixty complained of no aspiration in the group with sphincter mechanism. This surpassed the rate of aspiration in the group without sphincter mechanism(Table 5).

DISCUSSION

There is no doubt that voice can be produced by connecting the trachea to the pharynx or esophagus. Resultant speech has been evaluated by standard test measures[14-16] and is noted to be superior to that of conventional esophageal speakers.

The greatest difficulty inherent in any fistula procedure is the problem of aspiration, because most of the previously reported surgical techniques lacked an intrinsic mechanism to prevent aspiration. To date, the use of a valve placed in a short side-to-side TE tunnel is the only relatively safe and reliable way for both voice restoration and tracheal reflux prevention [9,11]

In contrast to previous reports [12,13,16] this method introduces a protective mechanism for the TE fistula against tracheal reflux. This procedure is unlikely to reduce the ultimate cure rate nor to preclude voice acquisition, since the essential construction of the TE fistula is compatible with oncologic resection and has not been altered.

In this method using the BECMF, aspiration is effectively avoided in most cases. Both dilation and elevation of the cervical esophagus with the BECMF seem to approximate the sphincter mechanism against tracheal reflux during deglutition.

The fistula is constricted from posteriorly by the dilated cervical esophagus during deglutition, while the BECMF approximated anteriorly, restrain it. This is mechanically reinforced by elevation of the cervical esophagus. It is concluded from these observations that a loop of the BECMF in which the TE fistula is located acts as a sphincter during deglutition. Therefore, proper case selection may achieve a high success rate for preserving normal deglutition and restoring speech after total laryngectomy.

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Table 1. Patients undergoing TE shunt Operation

Primay lesion	Sphincter mechanism (+)	Sphincter mechanism (−)	Total
Larynx	61	84	145
Hypopharynx	5	11	16
Mesopharynx	2	0	2
Tatal	68	95	163

Table 2. Success rate for shunt speech in 163 patients

Sphincter mechanism	Success	Failure	Success rate
(+)	60	8	88 %
(−)	76	19	80 %
Tatal	136	27	83 %

Table 3. Causes of failure in shunt speech

Causes	Sphincter mechanism (+)	Sphincter mechanism (−)	Total
Stenosis	5	14	19
Breakdown of shunt	0	2	2
Pharyngeal stricture	1	2	3
Loss of motivation	2	1	3
Total	8	19	27

Table 4. Initial phona-

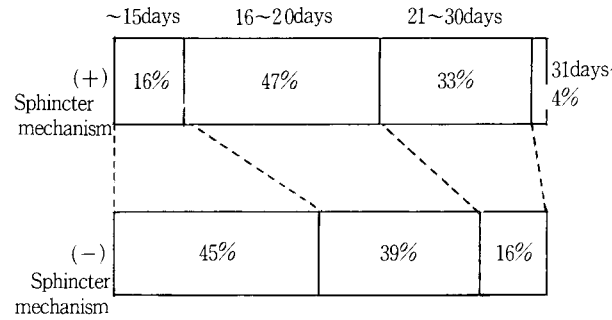

Table 5. Swallowing function

Aspiration	Sphincter mechanism (+)	Sphincter mechanism (−)
(−)	54	54
(+)	6	22
Tatal	60	76