ORIGINAL ARTICLE

Tracheoesophageal Shunt Method With Omohyoid Muscle Loop for Voice Restoration

Hitoshi Saito, MD; Shigeharu Fujieda, MD; Toshio Ohtsubo, MD; Gota Tsuda, MD; Takehisa Saito, MD; Yoshiyuki Shibamori, MD; Hiroshi Sunaga, MD

Objective: To decrease the aspiration rate of the previously reported simple mucodermal tracheoesophageal (TE) shunt method for voice restoration after total laryngectomy with the use of omohyoid muscle loop.

Design: Retrospective clinical analysis.

Setting: Department of Otorhinolaryngology, Fukui Medical University, Fukui, Japan.

Patients: Ten male patients underwent total laryngectomy and received TE shunt by the omohyoid muscle loop method for voice restoration. There were 5 patients with glottic laryngeal cancer, 2 with supraglottic laryngeal cancer, and 3 with hypopharyngeal cancer. Patients' age ranged from 46 to 66 years.

Intervention: The dermal incision on the neck was U-shaped with a superiorly pedicled, small U-shaped dermal flap. This small flap was used to form the anterior wall of the shunt. Bilateral omohyoid muscles were preserved at the total laryngectomy site with or without neck dissection. After creating a TE shunt directly on the posterior wall of the tracheal stump, the bilateral omohyoid muscles were looped through each other beneath the TE shunt.

Main Outcome Measurements: Maximum phonation time, maximum phonation intensity, and rating scales of shunt voice, aspiration rate, and survival time.

Results: Mean maximum phonation time was 20 seconds, while mean maximum phonation intensity was 83 dB. The first voice was obtained on postoperative day 29 on average. Of the 10 patients, 9 could phonate, with 1 case (10%) of slight aspiration 3 months after the surgery.

Conclusions: Although this omohyoid muscle loop method needs to preserve the hyoid bone with those muscles, aspiration was prevented more effectively compared with the former, direct mucodermal TE shunt method. The indication for this method is preferably glottic laryngeal cancer.

Arch Otolaryngol Head Neck Surg. 2003;129:321-323

From the Department of Otorhinolaryngology, Fukui Medical University, Fukui, Japan.

THERE HAVE been many surgical methods of tracheoesophageal (TE) shunt after total laryngectomy for voice restoration.[1-7] Among them, TE puncture with the use of voice prosthesis has been widely accepted in recent years,[8] and 2 different types of prostheses have been developed: nonindwelling type,[4] which can be removed and replaced by the patient, and indwelling type, which has to be managed by a clinician.[9-11] However, TE shunt without using a prosthesis still presents problems such as aspiration, stenosis, and technical difficulties.[6,12,13] The goal for the head and neck surgeon is to restore vocalization surgically without causing aspiration or using a prosthesis. Therefore, we used the omohyoid muscle for the previously reported mucodermal TE shunt method[7] as a sphincter to prevent aspiration.

METHODS

The omohyoid muscle loop method was performed on 10 male patients: 5 with glottic laryngeal cancer, 2 with supraglottic laryngeal cancer, and 3 with hypopharyngeal cancer. The mean patient age was 58 years.

The dermal incision on the neck was U-shaped, with a superiorly pedicled, small U-shaped dermal flap. This small U-shaped flap was used to form the anterior wall of the shunt. After conventional total laryngectomy with or without neck dissection, the lateral and anterior wall of the tracheal stump, including the tracheal rings, were removed to form a rectangular posterior mucosal flap about 10 to 15 mm wide and 15 to 20 mm long (**Figure 1**).

A vertical incision about 5 mm long and 5 mm below the stomal end was made in the esophagus on the posterior mucosa of the trachea. Side-to-side sutures were made at regular intervals around the primary shunt using nylon. A 5 mm–wide film drain was inserted through the shunt and left for 14 days to maintain the patency of the shunt.[7] The bilateral omohyoid muscles were preserved at the total laryngectomy site. The bilateral omohyoid muscles were looped through each other beneath the TE shunt. The distal end of the looped omohyoid muscle was elevated by about 3 cm toward the hyoid bone and

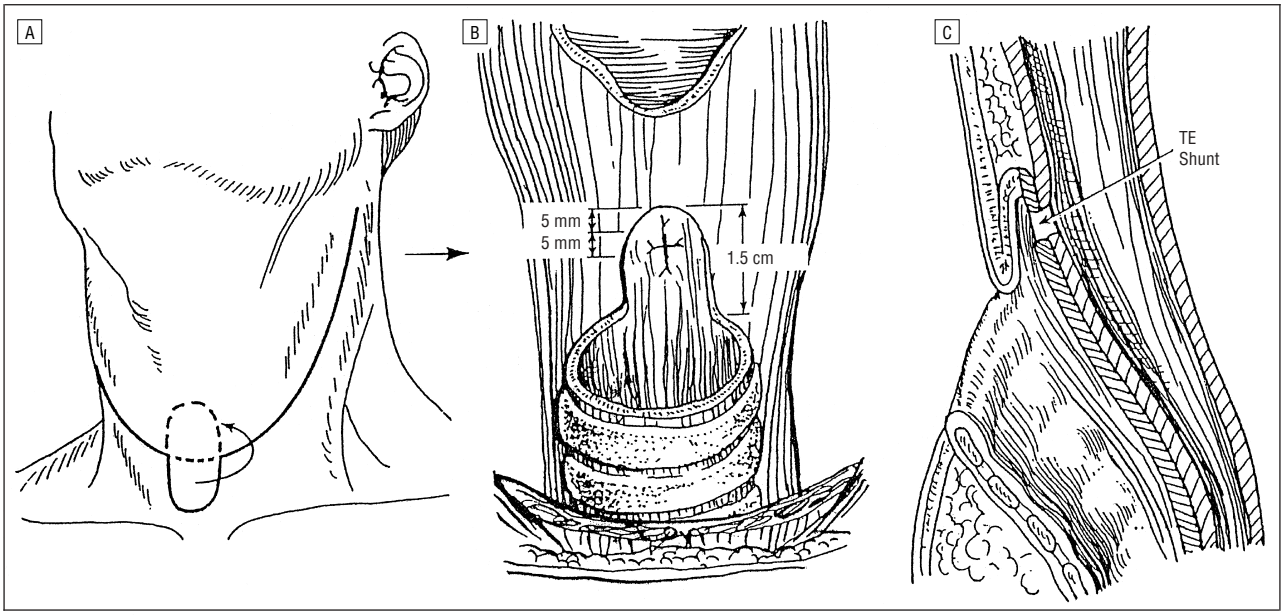

Figure 1. The simple mucodermal tracheoesophageal (TE) shunt method.[7] A, Incision and skin flap; B, mucosal design; and C, side view on completion.

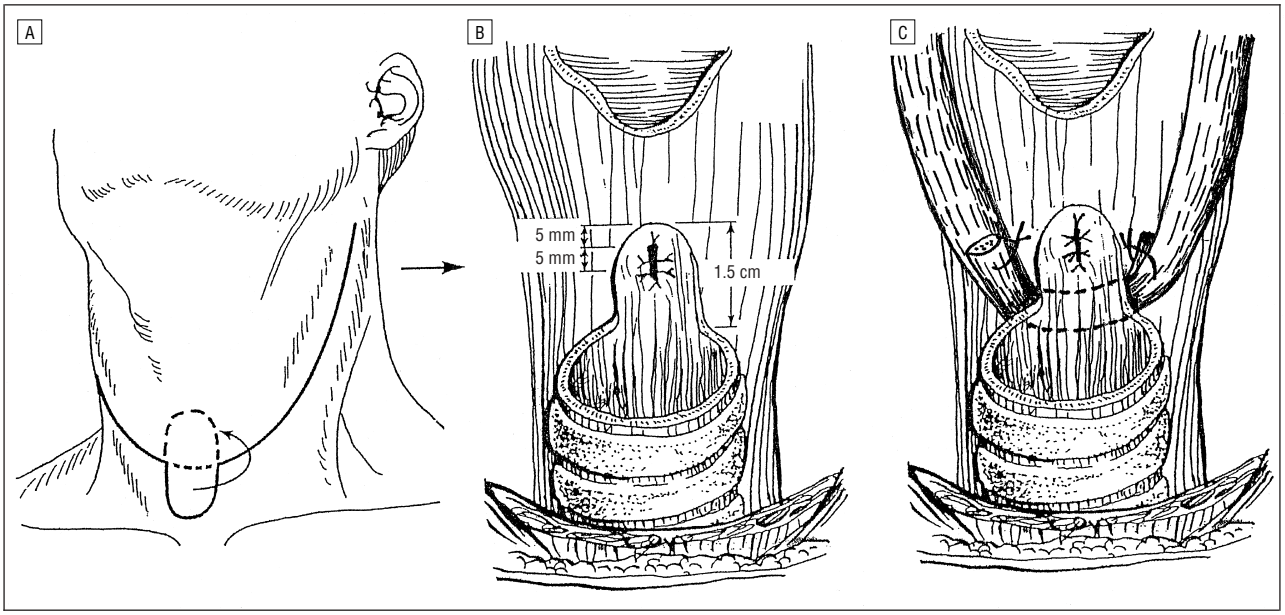

Figure 2. The omohyoid loop method. A, Dermal incision; B, mucosal design; and C, bilateral omohyoid loop.

sutured to the opposite omohyoid muscle using polyglactin 910 (Vicryl; Ethicon Inc, Somerville, NJ). The middle part of omohyoid muscle is slim and was placed directly under TE shunt. The TE shunt was placed under slight tension toward the hyoid bone by the looped omohyoid muscle. It was not necessary to preserve the ansa cervicalis (**Figure 2**). Maximum phonation time, maximum phonation intensity, and rating scales of the shunt voice,[8] aspiration rate, and survival time were evaluated.

RESULTS

The mean±SD maximum phonation time was 20±5 seconds, and the mean±SD maximum phonation intensity was 83±8 dB. The first voice was obtained on postoperative day 29±13. Three months after the operation, 9 patients (90%) could phonate, with 1 case (10%) of slight aspiration (**Table**). Tracheoesophageal speech was assessed by nonprofessional listeners as "good," "average," or "poor" according to rating scales measuring the number of syllables per breath, use of voice, and intelligibility.[8] Eight patients were assessed as "good," 1 as "average," and 1 as "poor."

Nine patients survived from 11 months to 7 years. One patient (patient 3) died of renal failure. All the patients had no recurrence of disease. This result indicates that preservation of the omohyoid muscle does not inhibit the curability.

Results of Tracheoesophageal Shunt Method With Bilateral Omohyoid Loop*

Patient No./Age, y	Site	TNM Stage	Rad	V, d	MPT, s	MPI, dB	Asp	Rating	Survival, mo
1/65	Hypo	T3 N2 M0	Yes	14	18	75	No	Good	>60
2/46	G	rT2 N0 M0	No	35	20	78	No	Good	>60
3/64	Hypo	T3 N1 M0	Yes	19	18	88	No	Good	19
4/58	SG	T2 N0 M0	Yes	PS	PS	PS	PS	PS	>60
5/60	Hypo	T3 N2 M0	Yes	57	30	75	No	Poor	>60
6/66	SG	T3 N0 M0	No	33	15	94	No	Good	>60
7/50	G	T3 N0 M0	No	38	20	74	NE	Good	>60
8/58	G	T3 N0 M0	Yes	21	18	89	No	Good	36
9/59	G	T3 N0 M0	No	30	16	81	No	Average	34
10/52	G	T3 N0 M0	No	17	24	91	No	Good	11

Abbreviations: Asp, aspiration; G, glottic laryngeal cancer; Hypo, hypopharyngeal cancer; MPI, maximum phonation intensity; MPT, maximum phonation time; NE, aspiration was prevented using a neck extension; PS, phonation could not be obtained due to pharyngeal spasm; Rad, postoperative radiation; SG, supraglottic laryngeal cancer; V, the day of the first voice.

*Phonation was obtained in 9 (90%) of 10 patients after 3 months and 7 (78%) of 9 patients after 1 year. Mean ± SD V, MPT, and MPI were 29 ± 13 d, 20 ± 5 s, and 83 ± 8 dB, respectively. Aspiration occurred in 1 (10%) of 10 patients.

COMMENT

The first problem was whether to use the omohyoid muscle unilaterally or bilaterally. One side of the omohyoid muscle was applied in the first case, supraglottic laryngeal cancer (T4 N0 M0) in a 62-year-old man. Although aspiration in this case was slight and was prevented with finger pressure on the shunt, sphincter action at deglutition only seemed to be weak from the unilateral muscle. The bilateral omohyoid muscles were used to form a loop beneath the shunt, with the expectation of stronger sphincter action thereafter. Therefore, this first case was excluded from the series.

The future condition of the looped omohyoid muscle is a matter of concern. We were fortunate to have the opportunity to observe the omohyoid muscle 7 months after looping. Patient 9 complained of passage disturbance of the esophagus and occasional efflux from the nose. The patient could phonate smoothly, but a radiographic fluorogram revealed stenosis around the hyoid bone. Therefore, a pharyngeal myotomy along the hyoid bone was carried out under general anesthesia. His swallowing improved following the myotomy. The atrophic omohyoid muscle was macroscopically confirmed during this operation. A biopsy specimen taken from the fibrous muscle revealed the existence of partial fibrosis and atrophy of the omohyoid muscle. This result indicated that fibrous changes in the omohyoid muscle had taken place but that it could still work as a sphincter even after a long time. Although maintaining innervation of the omohyoid muscles prevents atrophy of the muscle, it is doubtful whether patients treated with TE shunt by the omohyoid muscle loop method maintain good phonation without aspiration. Patient 5 failed to achieve a good voice. The reason remains unclear.

CONCLUSIONS

Although the omohyoid muscle loop method needs to preserve the hyoid bone with those muscles, aspiration was prevented more effectively compared with the former direct mucodermal TE shunt method. Additionally, this loop formation required only a few minutes to perform. The indication for this method is preferably glottic laryngeal cancer.

Accepted for publication August 29, 2002.

This study was presented as a poster at the Fifth International Conference on Head and Neck Cancer, San Francisco, Calif, July 29 to August 2, 2000.

Corresponding author and reprints: Shigeharu Fujieda, MD, Department of Otorhinolaryngology, Fukui Medical University, Matsuoka-cho, Yoshida-gun, Fukui 910-1193, Japan (e-mail: sfujieda@fmsrsa.fukui-med.ac.jp).

REFERENCES

1. Conley JJ. Vocal rehabilitation by autogenous vein graft. *Ann Otol Rhinol Laryngol.* 1959;68:990-995.
2. Asai R. Laryngoplasty after total laryngectomy. *Arch Otolaryngol Head Neck Surg.* 1972;95:114-119.
3. Komorn RM. Vocal rehabilitation in the laryngectomized patient with a tracheoesophageal shunt. *Ann Otol Rhinol Laryngol.* 1974;83:445-451.
4. Singer MI, Blom ED. An endoscopic technique for restoration of voice after laryngectomy. *Ann Otol Rhinol Laryngol.* 1980;89:529-533.
5. Amatsu M. A one-stage surgical technique for postlaryngectomy voice rehabilitation. *Laryngoscope.* 1980;90:1378-1386.
6. Strome M, Mustoe TA, Kelly JH. Voice rehabilitation following laryngectomy, myomucosal tracheoesophageal shunt. *Arch Otolaryngol Head Neck Surg.* 1986;112:1168-1171.
7. Saito H, Yoshida S, Saito T, Wakui S, Manabe Y, Tsuda G. Simple mucodermal tracheoesophageal shunt method for voice restoration. *Arch Otolaryngol Head Neck Surg.* 1989;115:494-496.
8. Ahmad I, Kumar BN, Radford K, O'Connell J, Batch AJG. Surgical voice restoration following ablative surgery for laryngeal and hypopharyngeal carcinoma. *J Laryngol Otol.* 2000;114:522-525.
9. Annyas AA, Nijdam HF, Escajadillo JR, Mahieu HF, Leever H. Groningen prosthesis for voice rehabilitation after laryngectomy. *Clin Otolaryngol.* 1984;9:51-54.
10. Hilgers FJM, Schouwenburg PF. A new low-resistance, self-retaining prosthesis (Provox) for voice rehabilitation after total laryngectomy. *Laryngoscope.* 1990;100:1202-1207.
11. Op de Coul BMR, Hilgerws FJM, Balm AJM, Tan IB, van den Hoogen FJA, van Tinteren H. A decade of postlaryngectomy vocal rehabilitation in 318 patients. *Arch Otolaryngol Head Neck Surg.* 2000;126:1320-1328.
12. Amatsu M, Makino K, Kinishi M, Tani M, Kokubu M. Primary tracheoesophageal shunt operation for postlaryngectomy speech with sphincter mechanism. *Ann Otol Rhinol Laryngol.* 1986;95:373-376.
13. Li S-L. Functional tracheoesophageal shunt for vocal rehabilitation after laryngectomy. *Laryngoscope.* 1985;95:1267-1271.