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Swallowing function in patients who underwent after subtotal glossectomy and reconstruction with a rectus abdominis musculocutaneous flap

Kazuhide Matsunaga [1], Hirohisa Kusuhara [2], Akifumi Enomoto [1], Kazunori Mori [3], Mutsukazu Kitano [4], Takao Mukai [1], Takeshi Shimoide [1], Katsumi Doi [4], Noritaka Isogai [2], Suguru Hamada [1]

[1] *Department of Oral and Maxillofacial Surgery, Kindai University Faculty of Medicine.*
[2] *Department of Plastic and Reconstructive Surgery, Kindai University Faculty of Medicine.*
[3] *Department of Otorhinolaryngology, Kindai University Sakai Hospital Faculty of Medicine.*
[4] *Department of Otorhinolaryngology, Kindai University Faculty of Medicine.*

Abstract

Purpose: Swallowing function was evaluated 3 years after surgery in three tongue cancer patients who underwent bilateral total neck dissection and subtotal glossectomy with reconstruction using a rectus abdominis musculocutaneous flap.

Materials and Methods: The morphology of the flap and swallowing function were evaluated. Swallowing function was assessed by video fluorography with a 10 ml test diet. The items for evaluation of swallowing were: (1) holding the test diet in the oral cavity, (2) epiglottis turnover, (3) aspiration, (4) hyoid bone movement, and (5) maximum width of the esophageal entrance.

Results: With regard to flap morphology, two patients had a protuberant flap and one had a semi-protuberant flap. One patient was able to hold the test diet in the oral cavity, while slight flow of the test diet into the pharynx was observed in the other 2 patients. Epiglottis turnover was good in one patient, but was insufficient in two patients. Aspiration was not observed in any of the patients. The hyoid bone moved forward and upward in all three patients. The maximum width of the esophageal entrance was good in all patients.

Conclusions: Elevation of the hyoid bone was demonstrated in all three patients, even though almost all of the bilateral suprahyoid muscles had been resected with the exception of stylohyoid. For good postoperative swallowing function and hyoid bone movement after subtotal glossectomy, it is necessary to perform reconstruction with a flap that has sufficient volume and to retain the bilateral stylohyoid muscles.

Key words：tongue cancer, subtotal glossectomy, rectus abdominis musculocutaneous flap, swallowing function

Introduction

It is important for reconstructive surgeons to evaluate swallowing function in tongue cancer patients who have undergone glossectomy and flap reconstruction. We have previously reported on swallowing function in patients who have undergone hemiglossectomy and reconstruction with a pectoralis major myocutaneous flap [1], as well as in patients who have undergone subtotal mobile tongue component resection and reconstruction with a pectoralis major myocutaneous flap [2,3]. In this study, swallowing function was evaluated by video fluorography 3 years after surgery in three tongue cancer patients who have undergone subtotal glossectomy and reconstruction with a rectus abdominis musculocutaneous flap.

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Patients and Methods

Patients

Three male patients (age range 50-64 years) with tongue cancer who underwent subtotal glossectomy and reconstruction with a rectus abdominis musculocutaneous flap at Kindai University Hospital (Osaka, Japan) were evaluated. Table 1 shows the surgical procedures of these 3 patients. All 3 patients underwent bilateral total neck dissection. With regard to preservation of the suprahyoid muscles, Case 1 retained the bilateral stylohyoid muscles, Case 2 retained the bilateral posterior hyoglossus and bilateral stylohyoid muscles, and Case 3 retained the unilateral posterior belly of digastric along with unilateral posterior mylohyoid and bilateral stylohyoid muscles. Hyoid bone suspension was not performed in any patient.

Table 1 Surgical procedures of the 3 patients who underwent subtotal glossectomy and reconstruction with a rectus abdominis musculocutaneous flap

Case no.	Gender	Age	Neck dissection	Conserved suprahyoid muscles	Hyoid bone suspension
1	Male	50	Bilateral	Bilateral stylohyoid	-
2	Male	64	Bilateral	Bilateral hyoglossus (Posterior) Bilateral stylohyoid	-
3	Male	60	Bilateral	Unilateral posterior belly of digastric Unilateral mylohyoid (Posterior) Bilateral stylohyoid	-

-: not done

Evaluation of swallowing function

1) Intraoral findings

We evaluated the morphology of the flap at 3 years after surgery, with the flap being classified as protuberant, semi-protuberant, flat or depressed[4].

2) Video fluorography

Video fluorography was performed at 3 years postoperatively with the consent of each patient. The patients were given a 10 ml test diet and the following items were evaluated: (1) holding the test diet in the oral cavity, (2) epiglottis turnover, (3) aspiration, (4) hyoid bone movement and (5) maximum width of the esophageal entrance.

The extent of hyoid bone movement and the maximal widening of the esophageal entrance were examined by using the method of Matsunaga et al. (Figs. 1-3) [1,5]. Points A and B were set at the lower and upper borders of the 4th cervical vertebra, respectively. Points C and C' were set on the hyoid bone at rest and in the most elevated position, respectively. Then lines AC and AC' were drawn to measure the distance from point A to point C and the distance from point A to point C', respectively (relative to the height of the 3rd cervical vertebra on a lateral image set as 10.0). Angles BAC and BAC' were measured as the hyoid bone angle at rest and in the most elevated position, respectively (Fig. 1).

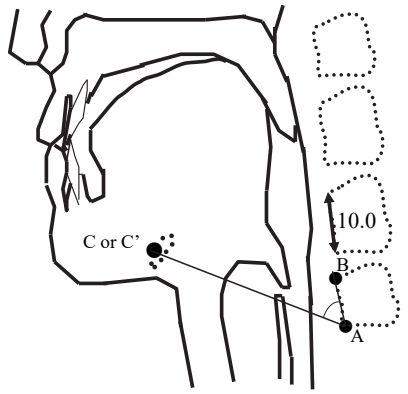

Fig. 1 Position of the hyoid bone (Matsunaga K et al., 2004)
A: Lower border of the 4th cervical vertebra.
B: Upper border of the 4th cervical vertebra.
C: Hyoid bone at rest.
C': Hyoid bone at maximum elevation.
AC: Distance from point A to point C (relative to the height of the 3rd cervical vertebra on a lateral image set as 10.0).
AC': Distance from point A to point C' (relative to the height of the 3rd cervical vertebra on a lateral image set as 10.0).
Angle BAC (°): Hyoid bone angle at rest.
Angle BAC' (°): Hyoid bone angle at maximum elevation.

Figure 2 shows the method of assessing the extent of hyoid bone movement. The Y-axis was set as a line linking points A and B, while the X-axis was set at 90 degrees to line AB. The line CC' was drawn to measure the distance between the hyoid bone position at rest and that at maximum elevation relative to the height of the 3rd cervical vertebra set as 10.0. Angle C'CX was measured as the angle of hyoid bone movement (Line CX: a line parallel to the X-axis).

Figure 3 shows the method of assessing the maximum width of the esophageal entrance. The maximum width of the esophageal entrance was measured during swallowing relative to the height of the 3rd cervical vertebra on a lateral image set as 10.0.

Results

1) Intraoral findings at 3 years postoperatively

With regard to flap morphology, two patients (Cases 1 and 2) had protuberant flaps and one patient (Case 3) had a semi-protuberant flap (Fig. 4).

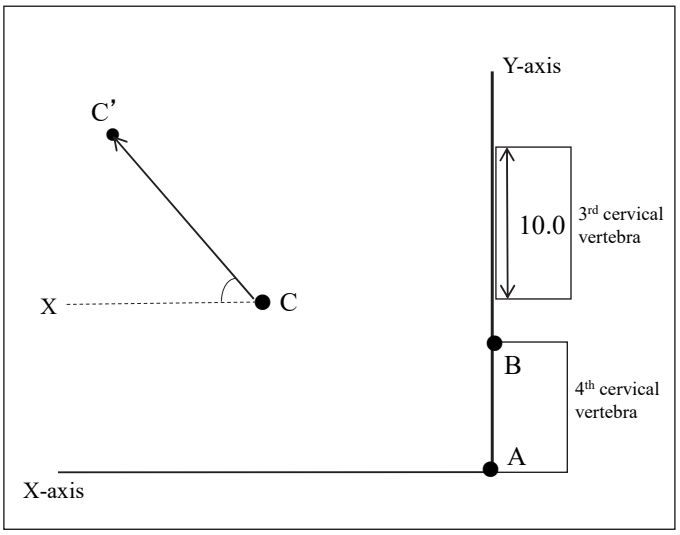

Fig. 2 Assessment of hyoid bone movement
X-axis: A line at 90 degrees to the AB line.
Y-axis: A line linking points A and B.
C : Hyoid bone at rest.
C': Hyoid bone at maximum elevation.
CC': Distance of hyoid bone movement (relative to the height of the 3rd cervical vertebra on a lateral image set as 10.0).
Angle C'CX (°): Angle of hyoid bone movement (CX: a line parallel to the X-axis)

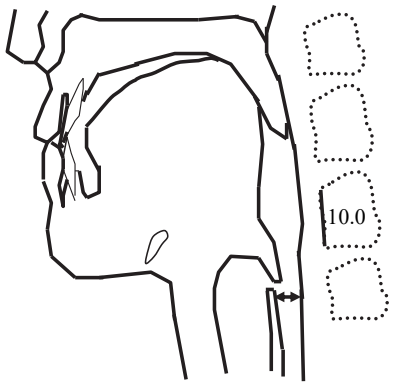

Fig. 3 Measuring the maximum width of the esophageal entrance (Matsunaga K et al., 2004, 2008)
Double-headed arrow: The maximal width of the esophageal entrance during swallowing (relative to the height of the 3rd cervical vertebra on a lateral image set as 10.0).

Fig. 4 Intraoral findings at 3 years postoperatively
a: The flap was protuberant (Case 1).
b: The flap was protuberant (Case 2).
c: The flap was semi-protuberant(Case 3).

2) Video fluorography at 3 years postoperatively
(1) Holding the test diet in the oral cavity

One patient (Case 1) was able to hold the test diet in the oral cavity and flow into the pharynx was not observed (Fig. 5). However, holding the test diet was incomplete and slight flow into the pharynx was observed in the other 2 patients (Cases 2 and 3) (Fig. 5).

(2) Epiglottis turnover

Epiglottis turnover during swallowing was good in one patient (Case 2), but was insufficient in two patients (Cases 1 and 3) (Fig. 6). Penetration during swallowing was not observed in any patient (Fig. 6).

(3) Aspiration

Elevation of the larynx was favorable in all patients and aspiration during swallowing was not observed in any of them (Fig. 7).

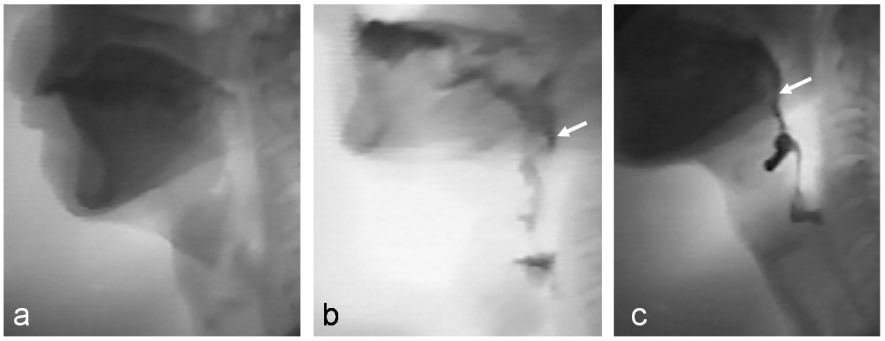

Fig. 5 Holding the test diet in the oral cavity
a: Good retention (Case 1).
b: Slightly flow of the test diet into the pharynx (Arrow) (Case 2).
c: Slightly flow of the test diet into the pharynx (Arrow) (Case 3).

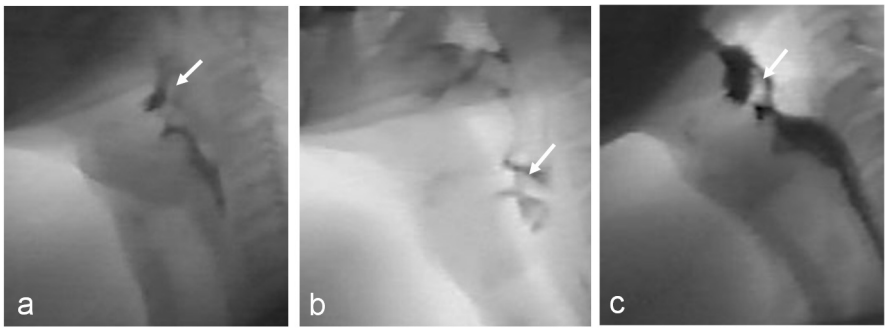

Fig. 6 Epiglottis turnover
a: Not seen (Arrow) (Case 1)
b: Good (Arrow) (Case 2)
c: Not seen (Arrow) (Case 3)

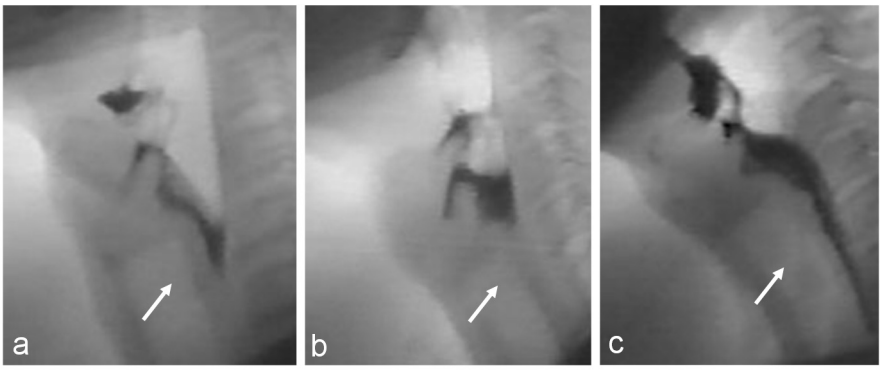

Fig. 7 Aspiration
a: None (Arrow) (Case 1).
b: None (Arrow) (Case 2).
c: None (Arrow) (Case 3).

(4) Hyoid bone movement

The positions of the hyoid bone at rest and at maximum elevation were different in all patients (Table 2). The extent of hyoid bone movement was evaluated by comparing its position at rest with that at maximum elevation. The distance of hyoid bone movement was 7.8, 10.6 and 11.9 in Cases 1, 2 and 3, respectively. The angle of hyoid bone movement in the anterior and upward directions was 74.0°, 55.5° and 79.8° in Cases 1, 2 and 3, respectively (Table 3). During swallowing, the hyoid bone elevated in the forward and upward direction above the base of the 3rd cervical vertebra in all three patients (Fig. 8).

(5) Maximum width of the esophageal entrance

The maximum width of the esophageal entrance was 7.1, 8.0 and 7.0 in Cases 1, 2 and 3, respectively (Fig. 9). Widening of the esophageal entrance during swallowing was good in all three patients.

Table 2 Data for calculation of hyoid bone movement

Case	Hyoid bone position at rest		Hyoid bone position at maximum elevation	
	AC	Angle BAC (°)	AC'	Angle BAC' (°)
1	23.7	88.9	28.3	64.8
2	24.5	79.8	33.2	66.2
3	29.4	92.0	33.2	71.5

AC: Distance of the hyoid bone at rest from the lower border of the 4th cervical vertebra
AC': Distance of the hyoid bone at maximum elevation from the lower border of the 4th cervical vertebra
Angle BAC: Hyoid bone angle at rest
Angle BAC': Hyoid bone angle at maximum elevation

Table 3 Extent of hyoid bone movement

Case	CC'	Angle C'CX (°)
1	7.8	74.0
2	10.6	55.5
3	11.9	79.8

CC': Distance of hyoid bone movement
Angle C'CX: Angle of hyoid bone movement

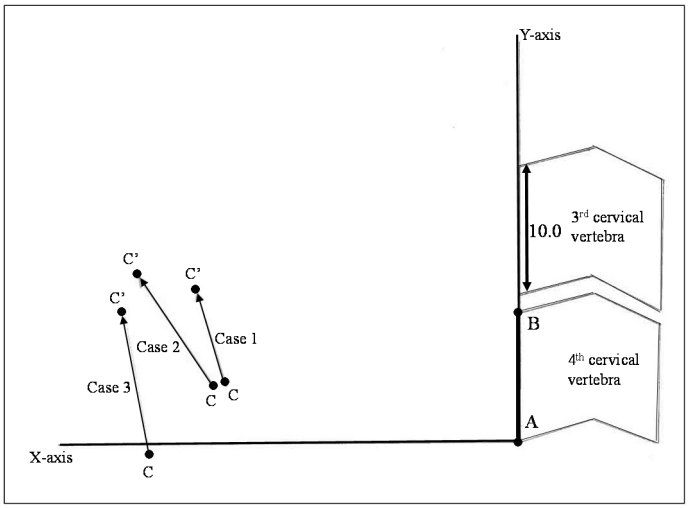

Fig. 8 The extent of hyoid bone movement

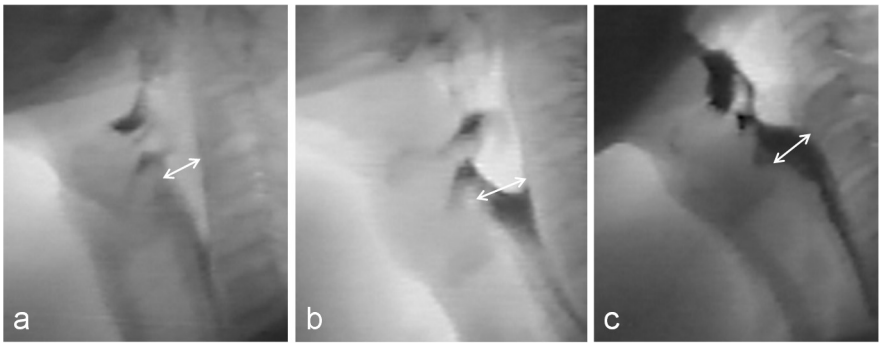

Fig. 9 Maximum width of the esophageal entrance
a: 7.1 (Double arrow) (Case 1)
b: 8.0 (Double arrow) (Case 2)
c: 7.0 (Double arrow) (Case 3)

Discussion

It is important for reconstructive surgeons to improve postoperative swallowing function after hemiglossectomy. We previously investigated swallowing function in patients who underwent hemiglossectomy and subtotal mobile tongue component resection followed by reconstruction with a pectoralis major myocutaneous flap [1-3]. Postoperative swallowing function was relatively good after hemiglossectomy and reconstruction with a pectoralis major myocutaneous flap, even though flap volume decreased over time in all patients[1]. With regard to swallowing function after subtotal mobile tongue component resection and reconstruction with a pectoralis major myocutaneous flap, it has been suggested that a decrease of flap volume could reduce swallowing pressure and lead to aspiration, so the mobile tongue component should be reconstructed with a bulky flap to ensure hard palate contact [2,3].

In this study, swallowing function was evaluated by video fluorography at 3 years after subtotal glossectomy and reconstruction with a rectus abdominis musculocutaneous flap. It has been suggested that defects after subtotal or total glossectomy should be reconstructed with a thicker and bulkier flap to optimize postoperative swallowing function [6-10]. Our three patients underwent reconstruction with bulky flaps. The flap volume was maintained postoperatively and transport of the test diet, elevation of the larynx, and widening of the esophageal entrance were all fairly good. As a result, aspiration was not observed in any of the patients at 3 years postoperatively. For good postoperative swallowing after subtotal glossectomy, reconstruction must be done with a flap that has sufficient volume to facilitate contact with the hard and soft palate. On the other hand, Yamazaki et al.[11] reported a patient in whom a decrease of free flap volume related to body weight loss led to deterioration of swallowing function after subtotal glossectomy. Therefore, it is necessary for reconstructive surgeons to observe chronological changes of flap volume and body weight.

With regard to the association between resection of the suprahyoid muscles and postoperative swallowing function, it has been suggested that hyoid bone movement is deceased significantly after resection of the suprahyoid muscles in comparison with preoperative movement [12]. We reported that forward movement of the hyoid bone was impeded after unilateral resection of the anterior and posterior bellies of the digastric, mylohyoid, geniohyoid and hyoglossus muscles, while both of forward and upward movements were impeded after bilateral resection of the anterior and posterior bellies of the digastric, mylohyoid, geniohyoid and hyoglossus muscles[6]. However, the extent of hyoid bone movement during swallowing has not been quantitatively evaluated before. In this study, we quantitatively evaluated hyoid bone movement during swallowing in three patients after bilateral total neck dissection and subtotal glossectomy. Our patients had almost complete resection of the bilateral suprahyoid muscles with the exception of the bilateral stylohyoid muscles. Though the extent of hyoid bone movement in our patients was definitely smaller than after unilateral radical neck dissection[5], the hyoid bone showed forward and upward movement in all three patients. From the aspect of improving postoperative swallowing, our findings suggested that the suprahyoid muscles should be conserved as far as possible, even in patients undergoing subtotal glossectomy.

Conclusions

Swallowing function was evaluated 3 years after surgery in three tongue cancer patients who underwent bilateral total neck dissection and subtotal glossectomy with reconstruction using a rectus abdominis musculocutaneous flap. For good postoperative swallowing function and hyoid bone movement after subtotal glossectomy, it is necessary to perform reconstruction with a flap that has sufficient volume and to retain the bilateral stylohyoid muscles.

Conflict to interest

All authors report no conflict of interest related to this manuscript

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