

Deglutition Assessment, Using Fiberoptic Endoscopic Evaluation of Swallowing in Patients underwent Frontolateral Laryngectomy

Sunun Ongard, MD¹, Phawin Keskoool, MD¹, Chanticha Chotigavanich, MD¹, Navamon Plasen, MD¹, Choakchai Metheetrairut, MD¹

¹ Department of Otorhinolaryngology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

Objective: To assess the long-term deglutition in patients that undergone frontolateral laryngectomy (FL) by fiberoptic endoscopic evaluation of swallowing (FEES) and to identify factors that might influence the swallowing outcomes of these patients

Materials and Methods: A cross-sectional descriptive study in patients that undergone FL between 2004 and 2014 with postoperative time of six months or more. Three parameters, premature spillage of material, retention/pooling of material, and the presence of penetration or aspiration were evaluated. All parameters were graded from one (severe) to five (normal).

Results: Thirty-six patients including 31 males and five females, with mean age of 58±12.9 years were included in the present study. Twenty-nine cases (80.6%) presented with stage I glottis cancers and seven cases (19.4%) presented with stage II glottis-subglottic cancers. For their treatment by surgery, 30 cases (83.3%) underwent FL and six cases (16.7%) underwent extended FL. Swallowing function was determined to be normal in 27 cases (75%), however, six cases or 16.7% had mild residue accumulation after food swallowing, whereas three cases (8.3%) had moderate symptoms of either minimal pharyngeal stasis plus unsafe airway or moderate pharyngeal residue accumulation. When considering each factor that may worsen post-operative swallowing function, the results suggested that there were significant associations with age of 65 years or older ($p=0.036$), tumor stage II ($p=0.049$), and the presence of postoperative wound infection ($p=0.012$).

Conclusion: In the present study, the authors confirmed that FL had minimal impacts on swallowing functions as the majority of patients who underwent FL recovered normal or near-normal swallowing function after six months as determined by FEES. However, long-term swallowing functions should be monitored especially in patients aged 65 years or older, patients with tumor stage II, and patients with postoperative wound infection.

Keywords: Frontolateral laryngectomy; Glottic cancer; Fiberoptic endoscopic evaluation of swallowing; FEES; Penetration and aspiration; Deglutition

Received 4 August 2023 | Revised 23 August 2023 | Accepted 24 August 2023

J Med Assoc Thai 2023;106(9):882-8

Website: <http://www.jmatonline.com>

Early-stage glottis carcinoma (T1-T2No) are treated using treatment options such as external radiation therapy (RT), endoscopic laser surgery (TLS), and opened partial laryngectomy. A variety of partial laryngectomy and reconstruction techniques have been proposed. The decision to choose a certain surgical technique depends on tumor extension and

location, as well as preference of each surgeon. Frontolateral laryngectomy (FL) is described as a surgical technique that involves vertically resecting parts of the thyroid cartilage including ipsilateral false and true vocal cord with or without arytenoid removal. This operation is ultimate for T1a glottis cancer with entire vocal cord involvement or T1b glottis cancer in which the tumor extended to the anterior commissure and had minimal invasion to the contralateral vocal cord, or less than one third of its length, and for T2 glottis cancer. The concept of en-bloc tumor resection is considered superior to RT or TLS in terms of oncological control when tumor is localized at the high-risk anterior commissural region, but functions conserved after opened surgery are inferior to RT or TLS^(1,2). In FL, surgical defects after tumor resection are usually reconstructed either with epiglottic sliding down flap or bipedicle sternohyoid flap⁽³⁻⁶⁾. Natural changes in anatomy and physiology

Correspondence to:

Metheetrairut C.

Department of Otorhinolaryngology, Faculty of Medicine Siriraj Hospital, Mahidol University, 2 Wanglang Road, Bangkoknoi, Bangkok 10700, Thailand.

Phone: +66-2-4198047, **Fax:** +66-2-4198044

Email: Choakchai.mee@mahidol.ac.th

How to cite this article:

Ongard S, Keskoool P, Chotigavanich C, Plasen N, Metheetrairut C. Deglutition Assessment, Using Fiberoptic Endoscopic Evaluation of Swallowing in Patients underwent Frontolateral Laryngectomy. *J Med Assoc Thai* 2023;106:882-8.

DOI: 10.35755/jmedassocthai.2023.09.13892

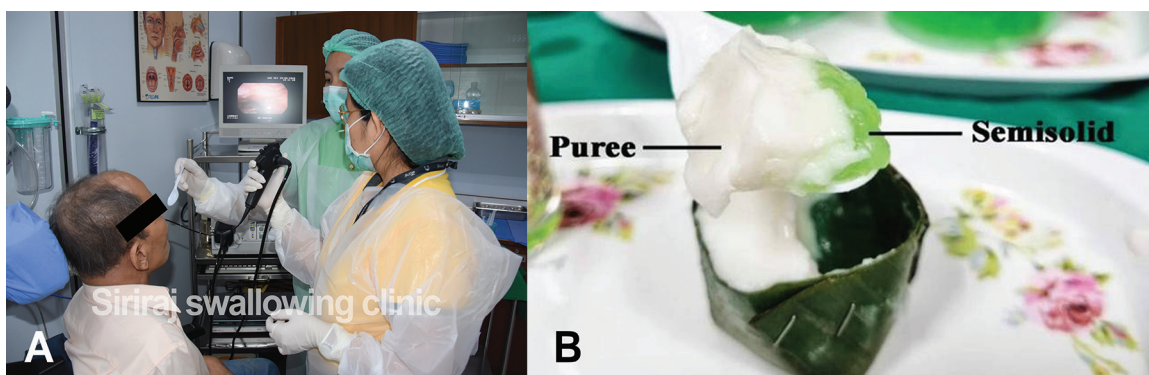


Figure 1. (A) FEES setting for deglutition evaluation, (B) Coconut custard (called Tako in Thai) which contained coconut custard top (white part) and semisolid sweet pudding at its base (green part).

after surgical resection of one side of this structure or epiglottic mobilization could interfere with the deglutition function⁽⁴⁾. After surgery, swallowing dysfunction may last for three to six months until complete recovery, and the prevalence of dysphagia after opening partial laryngectomy in general varied from 12.9% to 67.3% depending on the extent of surgical resection but for FL with more laryngeal structures preserved, dysphagia was found in only 4% to 9%^(4,5).

The purpose of the present study was to assess the long-term deglutition in patients who undergone FL by fiberoptic endoscopic evaluation of swallowing (FEES) and to identify factors that might influence the swallowing outcomes of these patients.

Materials and Methods

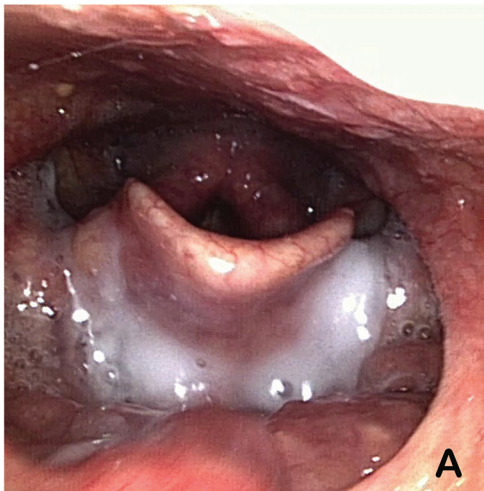
This cross-sectional descriptive study was approved by the Institutional Review Board of Siriraj Hospital (COA no. Si 719/2013) and was conducted between February 2014 and December 2015. The inclusion criteria were laryngeal cancer patients who had undergone FL in the Department of Otorhinolaryngology, Faculty of Medicine Siriraj Hospital, Mahidol University between 2004 and 2015 who were younger than 80 years old at the time of evaluation and had no contraindication criteria for the present study, including severe movement disorder, agitation, sinonasal and anterior skull base tumors, previous facial trauma or surgery, nasopharyngeal stenosis, or xylocaine toxic reaction. FEES was performed more than six months after surgery with a Kay-Pentax model VNL-9CP endoscope couple to VDO recording system (EPK-1000 VDO processor).

FEES was done in steps as follows. Firstly, the scope was inserted transnasally until the tip was placed behind the free edge of the soft palate to

observe the hypopharyngeal and laryngeal structures prior to and during swallowing. Secondly, each patient was instructed to swallow foods with different textures, for example, soft green drink and coconut custard, called Tako in Thai, which contained pureed content on top and semisolid content at the base (Figure 1). Three parameters were graded during and after swallowing. The first parameter was food bolus premature spillage, which would indicate the tongue's ability to hold the food bolus within the oral cavity and the tongue base contraction to initiate swallowing. The second parameter was secretion and food retention or pooling parameter, which would indirectly show the efficiency of oropharyngeal swallowing to deliver the food bolus into the upper esophagus. Thirdly, after each swallowing, the endoscope was advanced to the level just above the laryngeal vestibule to assess the presence of penetration or aspiration as the third parameter. This parameter would evaluate the swallowing safety. A five-point scoring system suggested by Zacharek et al.⁽⁷⁾ and Schindler et al.⁽⁸⁾ was applied to assess each parameter and the grading definition of each score was documented and provided to the endoscopic clinicians (Figure 2).

Statistical analysis

A descriptive analysis of the evaluated parameters was performed. Patient demographics and clinical characteristic data were summarized as means for continuous data and percentages for discrete data. Factors affecting swallowing were estimated using chi-square or Fisher's exact test. All statistical analyses were performed by IBM SPSS Statistics, version 22.0 (IBM Corp., Armonk, NY, USA) and a p-value less than 0.05 was taken to indicate significance.



Finding	Severity	Score
Premature spillage of material	<input type="checkbox"/> Severe	<input type="checkbox"/> 1
	<input type="checkbox"/> Marked	<input type="checkbox"/> 2
	<input type="checkbox"/> Moderate	<input type="checkbox"/> 3
	<input type="checkbox"/> Mild	<input type="checkbox"/> 4
	<input type="checkbox"/> None	<input type="checkbox"/> 5
Retention/pooling of material and/or secretion	<input type="checkbox"/> Severe	<input type="checkbox"/> 1
	<input type="checkbox"/> Marked	<input type="checkbox"/> 2
	<input type="checkbox"/> Moderate	<input type="checkbox"/> 3
	<input type="checkbox"/> Mild	<input type="checkbox"/> 4
	<input type="checkbox"/> None	<input type="checkbox"/> 5
Entrance of material and/or secretion into the larynx or trachea: Presence/Absence of Reflex Cough	<input type="checkbox"/> Entrance of material into trachea ; No reflex cough	<input type="checkbox"/> 1
	<input type="checkbox"/> Entrance of material into trachea ; With reflex cough forming	<input type="checkbox"/> 2
	<input type="checkbox"/> Entrance of material into larynx, remaining above the trachea ; No reflex cough	<input type="checkbox"/> 3
	<input type="checkbox"/> Entrance of material into larynx, remaining above the trachea ; With reflex cough forming	<input type="checkbox"/> 4
	<input type="checkbox"/> No entrance of material into larynx or trachea	<input type="checkbox"/> 5
Total FEES scores		

Severity of Premature spillage / Retention of Material
 Severe : >75% of food bolus
 Marked : 51-75% of food bolus
 Moderate : 26-50% of food bolus
 Mild : <25% of food bolus
 None : no premature spillage or retention of material

Figure 2. (A) The finding of food retention in patient’s vallecula region after swallowing, (B) Five-point scoring system.

Results

Thirty-six patients who underwent FL were enrolled for the present study. Thirty-one were male and five were female. The mean age was 58±12.9 years, with a range from 25 to 76 years. Twenty-six cases (72.2%) were classified as T1aNoMo, including one liposarcoma case, and three as T1bNoMo glottis cancers. Meanwhile, seven cases were T2NoMo glottis-subglottic cancers. Therefore, 30 patients underwent FL and six had extended FL performed (Table 1).

All patients had operations performed more than six months before this objective swallowing evaluation and their immediate clinical laryngeal functional assessments were uneventful. Instrumental assessment by FEES was performed during their follow-up hospital visit between February 2014 and December 2015. Seventy five percent of cases (27 cases) were found to have normal swallowing function after surgery with no premature spillage, no pharyngeal residue, and no evidence of aspiration or penetration. Nine patients had abnormal FEES scores. None had premature food spillage during swallowing. For these nine patients, six (16.7%) had only minimal residue accumulation seen as less than one-fourth of residue found in vallecula or pyriform sinus, thus, a residue score of 4. The other three cases (8.3%) had either minimal pharyngeal stasis and unsafe airway problems or moderate pharyngeal residual (Table 2). Therefore, 33 cases (91.7%) were considered to have normal or near-normal swallowing functions.

In terms of secretion or food retention after swallowing parameter, eight out of nine patients had

Table 1. Demographic data of patients who underwent FL (n=36)

Patient characteristics	n (%)
Sex	
Male	31 (86.1)
Female	5 (13.9)
Age (years)	
Range	25 to 76
Mean±SD	58±12.9
<65 years	24 (66.7)
≥65 years	12 (33.3)
Glottic tumor	
Stage 1	29 (80.6)
• T1aNoMo	26
• T1bNoMo	3
Stage 2	7 (19.4)
Type of surgery	
Frontolateral laryngectomy	30 (83.3)
Extended frontolateral laryngectomy	6 (16.7)
Post-operative RT	
Yes	4 (11.1)
No	32 (88.9)

SD=standard deviation; RT=radiation therapy

minimal accumulation of food or mucous secretion at the vallecula or hypopharynx. Only one patient had moderate food residue remaining, with a residue score of 3.

Among the nine patients with abnormal FEES findings, penetration or aspiration was found in two elderly patients (70 and 73 years old) and both were asymptomatic at the time of the FEES test. One patient had both minimal food retention or residue and secretion penetration into laryngeal vestibule. This

Table 2. FEES findings of 36 patients after FL

Swallowing function	n (%)
Normal (total score of 15)	27 (75.0)
Minimal food retention	6 (16.7)
Laryngeal penetration or aspiration + minimal food retention	2 (5.5)
Moderate food retention	1 (2.8)
Total	36 (100)

patient could tolerate oral intake well by practicing postural maneuver with neck flexion and head turning to the defect site during swallowing. The other also had minimal residue and aspiration during semisolid food swallowing with reflex coughing thus, an aspiration score of 2. This patient had stage II glottis cancer and obtained postoperative chemoradiation due to unclear margin. He had delayed laryngeal elevation during swallowing and persistent laryngeal mucosal edema with immobile left vocal fold at the time of FEES.

Various clinical parameters including age, gender, tumor staging, type of surgery, prior medical conditions, post-operative complications, and pathological finding of the tumor were compared between the groups with normal, with a FEES score of 15, and abnormal, with a FEES score of 14 or less, swallowing functions. We found three factors being associated with abnormal swallowing functions, age equal to or more than 65 years old ($p=0.036$), stage II glottis cancer (T2NoMo) ($p=0.049$), and the presence of postoperative wound infection ($p=0.012$) Other variables showed no statistically significant difference between normal and abnormal swallowing groups (Table 3).

Discussion

Swallowing is a dynamic process of passing food or liquid from the mouth down to the digestive tract for digestion. It starts from voluntary movement in preparatory phase and oral phase to deliver the bolus to the oropharynx. In the pharyngeal phase, the bolus continues to move downward with a combination of actions including laryngeal elevation and closure, contraction of inferior constrictor muscles, and relaxation of the upper esophageal sphincter (UES) in order to propel foods through the esophagus into the stomach. In general, both pharyngeal and esophageal phases of swallowing are involuntary processes that occur continuously within a short movement⁽⁴⁾.

Dysphagia is an inability to complete this entire process of swallowing especially for foods with normal consistency^(4,9,10). In general, modulation

Table 3. Factors affecting dysphagia in patients who underwent FL

Patient characteristics	Number of those with normal swallowing n (%)	Number of those with dysphagia n (%)	p-value
Age group			0.036*
<65 years	21 (77.8)	3 (33.3)	
≥65 years	6 (22.2)	6 (66.7)	
Sex			0.302
Male	22 (81.5)	9 (100)	
Female	5 (18.5)	0 (0.0)	
Tumor staging			0.049*
T1NoMo	24 (88.9)	5 (55.6)	
T2NoMo	3 (11.1)	4 (44.4)	
Type of surgery			0.63
Frontolateral laryngectomy	23 (85.2)	7 (77.8)	
Extended frontolateral laryngectomy	4 (14.8)	2 (22.2)	
Medical condition			
HT			1.0
• Yes	11 (40.7)	4 (44.4)	
• No	16 (59.3)	5 (55.6)	
DM			0.558
• Yes	3 (11.1)	2 (22.2)	
• No	24 (88.9)	7 (77.8)	
Post-operative complications			
Pneumonia			0.557
• Yes	3 (11.1)	0 (0.0)	
• No	24 (88.9)	9 (100)	
Wound infection			0.012*
• Yes	0 (0.0)	3 (33.3)	
• No	27 (100)	6 (66.7)	
Post-operative RT			0.255
Yes	2 (7.4)	2 (22.2)	
No	25 (92.6)	7 (77.8)	

HT=hypertension; DM=diabetes mellitus; RT=radiotherapy

of swallowing pressure at the level of tongue base depends on bolus textures and volume⁽¹¹⁾. To maintain efficient pharyngeal pressure during the pharyngeal phase of swallowing, an effective velopharyngeal closure, complete tongue base retraction and then inferior constrictor muscle contraction should all be obtained. Inadequate pharyngeal pressure during swallowing will minimize the UES lateral opening and prolong pharyngeal transit time, leading to pharyngeal residue remaining^(10,11). Abnormal tongue base retraction as the consequence of surgical resection, tumor invasion, or hypopharyngeal nerve palsy could also cause spillage of the solid food into small fragments that multiple swallowing attempts in the oropharynx are necessary. For our concerns, moderate to severe pharyngeal residues including

secretion or food particles is a significant clinical sign for potential aspiration. Residue within the larynx is considered an early critical diagnostic sign for lower airway invasion and pneumonia^(12,13). Therefore, in dysphagic patients, significant parameters such as severity of food spillage, residue, degree of penetration, aspiration, and efficiency of valve mechanism of larynx should be carefully evaluated to confirm swallowing efficiency and safety.

Dysphagia is a common complication after opened partial horizontal laryngectomy (OPHL)^(6,11,14-17). The prevalence of dysphagia after supracricoid laryngectomy (SCL) ranged from 12.9% to 67.3% with the highest rate observed within the first year after surgery, whereas the number of dysphagic patients after FL was only 4% to 9% due to more laryngeal structures being conserved^(4,5,14). Swallowing impairment after most partial laryngectomy could be the result of changes of local anatomical structures leading to inadequate laryngeal elevation, incomplete laryngeal closure, and abnormal pharyngeal muscle contraction, thus the common findings were aspiration and pharyngeal residue^(11,14). Most patients with OPHL had swallowing difficulty in the early postoperative phase and this could recover subsequently. The speed of postoperative swallowing function recovery depends on the extent of surgical resection, postoperative swallowing rehabilitation, and food modifications^(4,6). It was usually within three to six months after surgery. If swallowing function could not be recovered within one year, then silent aspiration, especially of liquid, could be encountered, which could affect the patients' quality of life^(11,15).

FEES has been widely used as the assessment tool for oropharyngeal dysphagia since 1988. It is a safe procedure and is easy to use for diagnosis and treatment planning among dysphagic patients^(12,15-20). It is also a suitable instrument for comprehensive evaluation in the pharyngeal phase of swallowing functions in 3D. Although video-fluoroscopic swallowing study (VFSS) is another ideal instrument for swallowing evaluation, it had a logistic problem in transporting patients to a radiology suit and radiation exposure concern⁽¹³⁾. VFSS had its advantage in evaluation of oral and esophageal phase of swallowing over pharyngeal phase but most laryngeal structures such as interarytenoid space, pyriform sinus, and posterior pharyngeal mucosa could be visualized by FEES better than VFSS^(4,13,18-22). Under direct visualization, accumulation of secretion or food residue in the region could be graded as the higher

the volume, the higher severity level of swallowing disorders^(12,13,19). Penetration is considered when these materials enter the airway in the laryngeal vestibule. However, if the secretion or food residue passed below the vocal fold into the trachea with or without reflex coughing, it could turn into aspiration. The most severe form of dysphagia could lead to pneumonia and death^(19,22).

In previous studies, Giovanni et al.⁽⁵⁾ and Fakhry et al.⁽⁶⁾ reported an early postoperative difficulty in swallowing during resuming oral feeding in FL using epiglottic flap reconstruction. This may be a result of epiglottic downward displacement or abnormal epiglottic movement after reconstruction, but this problem should be minimized after swallowing rehabilitation. In the present study, which used bipedicle sternohyoid muscle flap reconstruction of FL, 27 patients (75%) had normal deglutition as determined by FEES. This technique preserved epiglottis in its natural position and took bipedicle muscle flap to oppose the remaining vocal cord. That could be a key factor for the high swallowing success rate in the early oral feeding phase at 96% and late phase at 91.7%^(3,23). However, even though there was no pharyngeal mucosa and tongue base resection, food retention could be observed in 25% (9 patients). It was noticeable that six patients among this group were over 65 years, three developed postoperative wound infection and two had postoperative RT. In fact, minimal deglutition abnormalities of 10% to 20% could be detected among healthy elderly population as a result of deterioration change in neural mechanism that delays the pharyngeal transit time and occasional penetration could be expected in these presbyphagic elderlies without surgery as well⁽¹⁶⁾. Local wound infection after FL and postoperative RT could promote tissue fibrosis of various degrees in the region and this may also minimize the muscle contraction and limit laryngeal elevation.

The key issue for FL in preserving a good voice and preventing aspiration is to ensure complete airway closure by good approximating of remaining vocal cord to the reconstruction flap and at least one cricoarytenoid unit should be movable. Aspiration after FL has been reported in the literature for as high as 18% in the early oral intake phase and this could affect the swallowing safety⁽²¹⁾. However, in this study, two patients (5.6%) had evidence of penetration or aspiration during swallowing without symptoms. All patients in this study did not have food spillage problem since the base of tongue was left undisturbed during tumor resection. Related factors

have been reported to be associated with abnormal swallowing after partial laryngectomy. Bento et al.⁽¹⁵⁾ found that for patients who underwent SCL, the age of over 70 years old and the extent of surgical resection had a significant relationship with aspiration, but the contrary result was reported by Schindler et al.⁽⁸⁾. They indicated that age was not found to have significant impact on long term functional results. Freitas et al.⁽¹⁴⁾ found that aspiration in SCL was related to low serum albumin, weight loss in early postoperative period, patient's age, and history of diabetes mellitus. However, Fakhry et al.⁽⁶⁾ showed that only T-stage could influence early swallowing outcomes in FL. In the present study, the authors found that patients with advance age (65 years or older), high tumor volume (stage II), and wound infection might be related to a poor swallowing outcome. However, gender, type of surgery, preoperative medical condition, postoperative pneumonia, and radiotherapy were found to have no association with the swallowing function.

Conclusion

The impact of swallowing after partial laryngectomy varies by the extent of resection and reconstruction, and this could jeopardize the patients' quality of life. However, deglutition function after FL is excellent when compared to other types of partial laryngectomy. The problem of aspiration or penetration could be minimized with an appropriate surgical reconstruction. In the present study, 91.7% of patients assessed by FEES had a normal or near normal swallowing function, which could confirm the efficient pharyngeal mobility after six months. However, long-term abnormal swallowing functions should be monitored and detected closely by FEES especially in patients aged 65 years and older who had high tumor volume or postoperative wound infection.

What is already known on this topic?

Most previous studies discussed dysphagia in patients who underwent SCL, but not FL as the present study focused on. Previous studies showed only indirect study of dysphagia in patients who underwent FL as the percent of tube feeding after surgery.

What does this study add?

This study showed scientific data of dysphagia in late period of post FL by objective measurement. Furthermore, the study confirmed significant risk of dysphagia in patients post FL.

Acknowledgement

The authors would like to thank Cheerasook Chongkolwatana for patients' information and suggestions in the present study, Chulaluk Komoltri for statistical analysis, and Ms. Jeerapa Kerdnoppakhun for manuscript assistance.

Authors' contributions

SO: study conception and design, data analysis and interpretation, drafting and critical revision of the manuscript, final approval, and agreement to be accountable for all aspects of this research. PK: data acquisition, analysis, and interpretation, drafting of the manuscript, final approval, and agreement to be accountable for all aspects of this research. CC and NP: data acquisition, final approval, and agreement to be accountable for all aspects of this research. CM: study conception and design, data analysis and interpretation, critical revision of the manuscript, final approval, and agreement to be accountable for all aspects of this research.

Funding disclosure

There was no funding for this study.

Conflicts of interest

The authors declare that they do not have any conflict of interest regarding this research.

References

1. Kotz T, Costello R, Li Y, Posner MR. Swallowing dysfunction after chemoradiation for advanced squamous cell carcinoma of the head and neck. *Head Neck* 2004;26:365-72.
2. Li R, Wang Q, Yan L, Zhu Y, Wang S, Tian S. Radiotherapy versus partial laryngectomy in the management of early glottic cancer with anterior commissure involvement: A propensity score matched study with 256 patients. *Oral Oncol* 2021;116:105230.
3. Sureepong P, Methetrairut C. Frontolateral laryngectomy: Siriraj experience. *J Med Assoc Thai* 2014;97:841-9.
4. Pillon J, Gonçalves MI, De Biase NG. Changes in eating habits following total and frontolateral laryngectomy. *Sao Paulo Med J* 2004;122:195-9.
5. Giovanni A, Guelfucci B, Gras R, Yu P, Zanaret M. Partial frontolateral laryngectomy with epiglottic reconstruction for management of early-stage glottic carcinoma. *Laryngoscope* 2001;111:663-8.
6. Fakhry N, Michel J, Giorgi R, Robert D, Lagier A, Santini L, et al. Analysis of swallowing after partial frontolateral laryngectomy with epiglottic reconstruction for glottic cancer. *Eur Arch Otorhinolaryngol* 2014;271:2013-20.

7. Zacharek MA, Pasha R, Meleca RJ, Dworkin JP, Stachler RJ, Jacobs JR, et al. Functional outcomes after supracricoid laryngectomy. *Laryngoscope* 2001;111:1558-64.
8. Schindler A, Favero E, Nudo S, Albera R, Schindler O, Cavalot AL. Long-term voice and swallowing modifications after supracricoid laryngectomy: objective, subjective, and self-assessment data. *Am J Otolaryngol* 2006;27:378-83.
9. Ward EC, Bishop B, Frisby J, Stevens M. Swallowing outcomes following laryngectomy and pharyngolaryngectomy. *Arch Otolaryngol Head Neck Surg* 2002;128:181-6.
10. Ponfick M, Linden R, Nowak DA. Dysphagia-a common, transient symptom in critical illness polyneuropathy: a fiberoptic endoscopic evaluation of swallowing study*. *Crit Care Med* 2015;43:365-72.
11. Pizzorni N, Schindler A, Castellari M, Fantini M, Crosetti E, Succo G. Swallowing safety and efficiency after open partial horizontal laryngectomy: A videofluoroscopic study. *Cancers (Basel)* 2019;11:549.
12. Neubauer PD, Hersey DP, Leder SB. Pharyngeal residue severity rating scales based on fiberoptic endoscopic evaluation of swallowing: A systematic review. *Dysphagia* 2016;31:352-9.
13. Pisegna JM, Langmore SE. Parameters of instrumental swallowing evaluations: Describing a diagnostic dilemma. *Dysphagia* 2016;31:462-72.
14. Freitas AS, Santos IC, Furia C, Dornelas R, Silva A, Dias FL, et al. Prevalence and associated factors of aspiration and severe dysphagia in asymptomatic patients in the late period after open partial laryngectomy: a videofluoroscopic evaluation. *Eur Arch Otorhinolaryngol* 2022;279:3695-703.
15. Benito J, Holsinger FC, Pérez-Martín A, García D, Weinstein GS, Laccourreye O. Aspiration after supracricoid partial laryngectomy: Incidence, risk factors, management, and outcomes. *Head Neck* 2011;33:679-85.
16. Dworkin JP, Hill SL, Stachler RJ, Meleca RJ, Kewson D. Swallowing function outcomes following nonsurgical therapy for advanced-stage laryngeal carcinoma. *Dysphagia* 2006;21:66-74.
17. Zanaret M, Giovanni A, Gras R, Cannoni M. Near total laryngectomy with epiglottic reconstruction: long-term results in 57 patients. *Am J Otolaryngol* 1993;14:419-25.
18. Pizzorni N, Schindler A, Fantini M, Bertolin A, Rizzotto G, Ambrogi F, et al. Relationship between swallowing-related quality of life and fiberoptic endoscopic evaluation of swallowing in patients who underwent open partial horizontal laryngectomy. *Eur Arch Otorhinolaryngol* 2018;275:973-85.
19. Pluschinski P, Zaretsky E, Stöver T, Murray J, Sader R, Hey C. Validation of the secretion severity rating scale. *Eur Arch Otorhinolaryngol* 2016;273:3215-8.
20. Pilz W, Vanbelle S, Kremer B, van Hooren MR, van Becelaere T, Roodenburg N, et al. Observers' agreement on measurements in fiberoptic endoscopic evaluation of swallowing. *Dysphagia* 2016;31:180-7.
21. DiSantis DJ, Balfe DM, Koehler RE, Lee JK, Weyman PJ, Setzen M, et al. Barium examination of the pharynx after vertical hemilaryngectomy. *AJR Am J Roentgenol* 1983;141:335-9.
22. Marvin S, Gustafson S, Thibeault S. Detecting aspiration and penetration using FEES with and without food dye. *Dysphagia* 2016;31:498-504.
23. Vella O, Blanchard D, de Raucourt D, Rame JP, Babin E. Function evaluation of laryngeal reconstruction using infrahyoid muscle after partial laryngectomy in 37 patients. *Eur Ann Otorhinolaryngol Head Neck Dis* 2020;137:7-11.