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Treat Oral Cavity Cancers

RESEARCH ARTICLE

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Physical Properties of Meals that are Suitable for Patients after Surgery to Treat Oral Cavity Cancers

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Abstract

Objectives: To determine proper characteristics of food which would be safe and satisfactory for swallowing in oral cavity cancer patients undergoing surgery and to create a recipe that provides adequate nutrients, energy, good taste, and can be easily made at home. **Materials and methods:** Patients who were enrolled in this study underwent oral cancer surgery in the Department of Otorhinolaryngology, Faculty of Medicine Siriraj Hospital from September 2017 to July 2018. This experimental research was conducted postoperatively before receiving chemoradiation. Each type of food was prepared by the researchers to have a combination of two physical properties, which were 3 different consistencies (liquid, nectar-like, and honey-like) and 2 different temperatures (room temperature (25ºC) and cold temperature (4ºC)). Each patient had to swallow six different types of prepared food by random sequences. Flexible endoscopic evaluation of swallowing (FEES) was used to evaluate objective swallowing function by 3 parameters, including premature oropharyngeal spillage, laryngeal penetration or aspiration, and post-swallow retaining residues. Satisfaction measurement was evaluated with visual analog scale (VAS). **Results:** There were 42 postoperative oral cavity cancer patients enrolled in this study. Subjects consisted of 23 males (54.8%) and 19 females (45.2%) with the mean age of 62 ± 13 years. Most patients had oral tongue carcinoma (64.3 %). FEES revealed nectar at room temperature was the safest with score of 0.83 ± 0.82 (possible score of 0-3, with 0 was best). However, patients significantly preferred liquid at room temperature more than other kinds of food (VAS taste = 8.26 ± 1.52 and VAS easy swallowing = 8.05 ± 1.74). When evaluating specifically in patients with oral tongue cancer, FEES scores, VAS taste, and VAS easy swallowing showed similar results the liquid at room temperature was the best. **Conclusions:** We suggested that the nectar-like thickened food at room temperature was determined to be the most proper food characteristic for oral cancer patients undergoing surgery in order to prevent aspiration. However, patients' satisfaction analysis suggested that they preferred other type of food. The physician should advise patients of the proper kind of food for safe swallowing and avoidance of serious complication especially aspiration pneumonia.

Keywords: Oral cavity cancer- Swallowing, Food modification- Flexible endoscopic evaluation of swallowing (FEES)

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Introduction

Oral cavity cancer is the sixth most common cancer in Thailand. The incidence is about 4.3 per 100,000 in women and 5.5 per 100,000 in men per year based on 2013-2015 records (Ministry of Public Health, 2015). There were 77 new cases in our institute in 2016. The oral cavity comprises 7 subsites, which are mucosal lip, buccal mucosa, alveolar ridge, retromolar trigone, floor of mouth, hard palate and oral tongue. Therefore, oral cavity cancer is divided into 7 specific subsites according to 8th AJCC cancer staging manual (Ridge JA et al., 2017).

The mainstay treatment of oral cavity cancer is surgery. Surgery however usually results with facial disfigurement and function restriction, especially swallowing function. Dysphagia affects patients' quality of life and may lead to dehydration, weight loss, malnutrition, psychological problems, and also serious complications such as aspiration pneumonia, airway obstruction, and respiratory failure (Gillespie et al., 2004; Manikantan et al., 2009; Epstein and Huhmann, 2012; Carnaby, 2013). Surgical morbidity is related to the surgical site, the amount of tissue removed and the reconstruction performed. Postoperative safe swallow is crucial to improve the quality of life and prevent complications.

Food modification is one of the nonsurgical managements of swallowing disorders. The National Dysphagia Diet presented dietary modifications that could be used by postoperative oral cavity cancer patients (National Dysphagia Diet Task Force.; American Dietetic Association, 2002). A previous study showed that patients with head and neck cancer after treatment enjoyed the

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taste, texture and consistency of ice-cream (Trinidade et al., 2012). Pureed food was determined to be the safest food for esophageal cancer patients as evaluated by using videofluoroscopic study (Sonoi et al., 2016). However, the study of proper characteristics of food for postoperative oral cavity cancer patients has never been done before.

There are many methods to evaluate swallowing function. The method mainly used by otorhinolaryngologists is flexible endoscopic evaluation of swallowing (FEES). FEES involves the placement of a flexible scope into the nose going down to the level of the soft palate. It provides direct visualization of the pharynx during swallowing and allows clinicians to assess the anatomic and physiologic deficits of the palate, pharynx, and larynx. Moreover, it is preferred because it can be examined at bedside, is less expensive and requires no radiation exposure.

This study aimed primarily to determine the proper characteristics of food which would be safe and satisfactory for swallowing in oral cavity cancer patients after undergoing surgery by FEES. The secondary objective was to create a recipe that provides adequate nutrients, energy, good taste, and could be easily made at home.

Materials and Methods

Study design

The study was an experimental non-randomized study in patients with oral cavity cancer who underwent surgery at the tertiary care center, university hospital. This study was approved by the Siriraj Institutional Review Board (COA No. Si 475/2017).

Power analysis

The sample size calculation was based on the study of Mika Sanoi (Sonoi et al., 2016). The average proportion of normal swallowing patient in cases with esophageal cancer was 0.897. The significance level (α) was 0.05, power was 80% and the effect size was 0.064. The number per group was 33 patients. The statistician estimated the dropout rate about 20% so the sample size of this research was 42 patients.

Study population

Forty-two postoperative oral cavity cancer patients were enrolled in this study. All patients underwent surgery from September 2017 to July 2018. The participants were 18 years old or above and had not received chemoradiotherapy. The exclusion criteria were patients who had other causes of dysphagia such as stroke or neuromuscular disorders, high risk of serious complications from swallowing disorders such as the bedridden patients, and multiple cancers apart from those of the oral cavity. Patients who could not tolerate FEES procedure would be withdrawn from the study.

Preparation of food

Food with similar nutrients but different physical properties was prepared for this study. The recipe was formulated by the researchers to provide adequate nutrients and energy according to Thai Recommended Daily Intakes for of 6 years and up (Thai RDI) based on the energy demand of 30-35 kcal/kg/day. The ingredients (per meal) consisted of 600 ml of soybean milk and 10 teaspoons of lactose-free milk and 100 ml of juice, which provided approximately 0.86 kcal/ml. The physical properties examined here were consistency and temperature. For consistency, food was prepared to be liquid, nectar-like or honey-like. Nectar-like and honey-like food was thickened by food thickener, following the guidelines of the National Dysphagia diet published by the American Dietetic Association (Germain et al., 2006). For temperature, food was kept at room temperature (25ºC) or refrigerated (4ºC) until consumption. A thermometer was used to confirm the temperature. Six combinations of both physical properties were examined here. The price of food was approximately 3 USD per meal.

Intervention

Each patient had to swallow all six different types of prepared food by random sequences. Flexible endoscopic evaluation of swallowing (FEES) by the swallowing specialists was used to evaluate objective swallowing function. Participants had to swallow 20 ml of each kind of prepared food to achieve the reliability of the test. Satisfaction measurement about taste and easy swallowing was evaluated with visual analog scale (VAS). On each of the test session, the time interval between each food type was 3 minutes and pure water was drunk between each food intake.

Flexible endoscopic evaluation of swallowing (FEES)

FEES was used to evaluate swallowing of each type of food by 3 parameters; premature oropharyngeal spillage, laryngeal penetration or aspiration, and post-swallow retaining residues. Fattori et al., (2016) It was performed by our two swallowing specialists who were blinded to the sequence of the food with different temperature and consistency. The normal finding for each parameter would be scored 0 while the abnormal finding was scored 1. Therefore, the maximum score for each food in each participant was 3. The average FEES score of all participants in each food was then calculated. The score of 0 represented normal swallowing.

Satisfaction measurement

The participants were asked to evaluate their satisfaction according to taste and easy swallowing by visual analog scale (VAS). The score ranged from 0 to 10. Average VAS score was calculated for each food type and the score of 10 represented the most satisfaction.

Data analysis

Demographic and baseline data were presented using descriptive statistics. This study had a 2x3-factorial design (i.e. temperature (room, cold) and food consistency (liquid, nectar-like, honey-like) conducted in the same patient. Comparison of total FEES score (0-3) among 6 combinations of food in the same patient was performed using proportional odds model (ordinal logistic regression). Comparison of VAS taste and easy swallowing (0-10) was done by linear mixed model. Both proportional odds model

and linear mixed model had patients as a random effect and 3 independent variables i.e. temperature, food consistency and their interaction. For linear mixed model, unstructured covariance of VAS among 6 combinations of food was applied. In case of no interaction between temperature and food consistency, a reduced model with no interaction was then fitted, followed by three pairwise comparison among 3 consistencies (if statistically significant effect of consistency was determined). For each combination of food, comparison of total FEES score (0-3) between two most common subsites was performed using chi-square test for linear-by-linear association since FEES score was an ordinal variable. Proportional odds model and linear mixed model were fitted using SAS 9. Statistical analyses were performed by using SPSS statistics version 22.0 and P-value < 0.05 was considered statistically significant.

Results

Participant demographics

Forty-two postoperative oral cavity cancer patients before receiving chemoradiation were enrolled in this study. Subjects consisted of 23 males (54.8%) and 19 females (45.2%) with the age ranged between 27 and 86 years and the mean age of 62 ± 13 years. Most patients had oral tongue carcinoma (n=27, 64.3%) and the most common type was squamous cell carcinoma (n=39, 92.8%). Most patients'surgeries were reconstructed by primary closure. The postoperative date of study varied from 4 to 71 days (mean = 21.5 ± 17.7 days). The demographic data was shown in Table 1.

Objective evaluation (FEES results)

The FEES scores for all 6 types of food were shown in Table 2 and Figure 1. We observed that the participants (n=42) could most safely swallow the nectar-like thickened food at room temperature (average FEES score 0.83), followed by the liquid food at room temperature (average FEES score = 0.86) and the nectar-like thickened food at cold temperature (average FEES score = 0.88). Among the tongue cancer patients, the residual tongue of more than 50% allowed safer swallowing than minimal residual tongue, as shown in Figure 2. There was no any subject developed intolerance or severe aspiration during the procedure.

The tongue and alveolar ridge (gum) were the two most common sites of the primary cancer in this study. The liquid food at room temperature was the safest food for patients with oral tongue cancers (average FEES score 1, n=27). The nectar irrespective of temperature was the safest food for patients with gum cancer (average FEES score 0.29, n=7). When comparing between the two subsites by Chi-square test for linear-by-linear association, The FEES score for the nectar at room temperature, the nectar at cold temperature and the honey at cold temperature had statistically significant difference (p-value = 0.025, 0.015 and 0.022 respectively) (Table 3 and Figure 3).

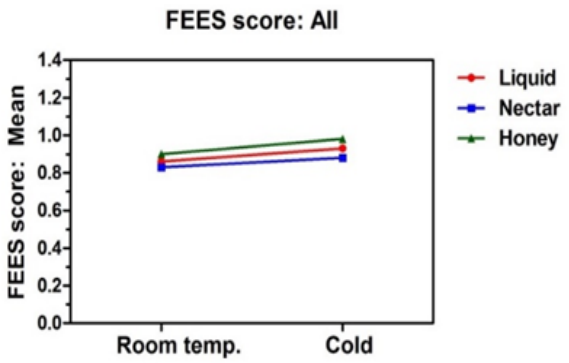

Figure 1. Average FEES Scores of 6 Kinds of Studied Food in All 42 Participants

Subjective evaluation (VAS score)

Most participants enjoyed the taste of liquid food at room temperature (average VAS = 8.26) followed by liquid food at cold temperature (average VAS = 8.24) (Table 4 and Figure 4). In aspect of the ease of swallowing most participants also preferred the liquid at room and cold temperature more than the others (average VAS = 8.05 and 7.83 respectively) (Table 5 and Figure 5).

Table 1. Demographic Data of 42 Postoperative oral Cavity Cancer Patients

Parameter	Number and percent
Sex (males : females)	23 (54.8%) : 19 (45.2%)
Underlying diseases;	
Diabetes mellitus	6 (14.3%)
Hypertension	3 (31.0%)
Dyslipidemia	9 (21.4%)
Others (atrial fibrillation, chronic kidney disease, gout and psoriasis)	8 (19.0%)
Subsite;	
Tongue	27 (64.3%)
Alveolar ridge (gum)	7 (16.6%)
Floor of mouth	3 (7.1%)
Lip	2 (4.8%)
Buccal mucosa	2 (4.8%)
Retromolar trigone	1 (2.4%)
Cell type;	
Squamous cell carcinoma	39 (92.8%)
Mucosal melanoma	1 (2.4%)
Adenocarcinoma	1 (2.4%)
Mucoepidermoid carcinoma	1 (2.4%)
Staging;	
I	7 (16.7%)
II	7 (16.7%)
III	4 (9.5%)
IV	24 (57.1%)
Reconstruction;	
Primary closure	24 (57.1%)
Skin graft	3 (7.1%)
Local flap	4 (9.5%)
Regional flap	5 (12.0%)
Free vascularized flap	2 (4.8%)
Prosthesis	3 (7.1%)
Secondary intention	1 (2.4%)

Table 2. Total FEES Scores of Six Characteristics of Studied Food

		Total score: Number of the patients (%)				
		0	1	2	3	Mean score ± SD
Room	Liquid	16 (38.1)	18 (42.9)	6 (14.3)	2 (4.8)	0.86 ± 0.84
	Nectar	16 (38.1)	19 (45.2)	5 (11.9)	2 (4.8)	0.83 ± 0.82
	Honey	10 (23.8)	26 (61.9)	6 (14.3)	0	0.90 ± 0.62
Cold	Liquid	17 (40.5)	13 (31.0)	10 (23.8)	2 (4.8)	0.93 ± 0.92
	Nectar	15 (35.7)	19 (45.2)	6 (14.3)	2 (4.8)	0.88 ± 0.83
	Honey	12 (28.6)	21 (50.0)	7 (16.7)	2 (4.8)	0.98 ± 0.81

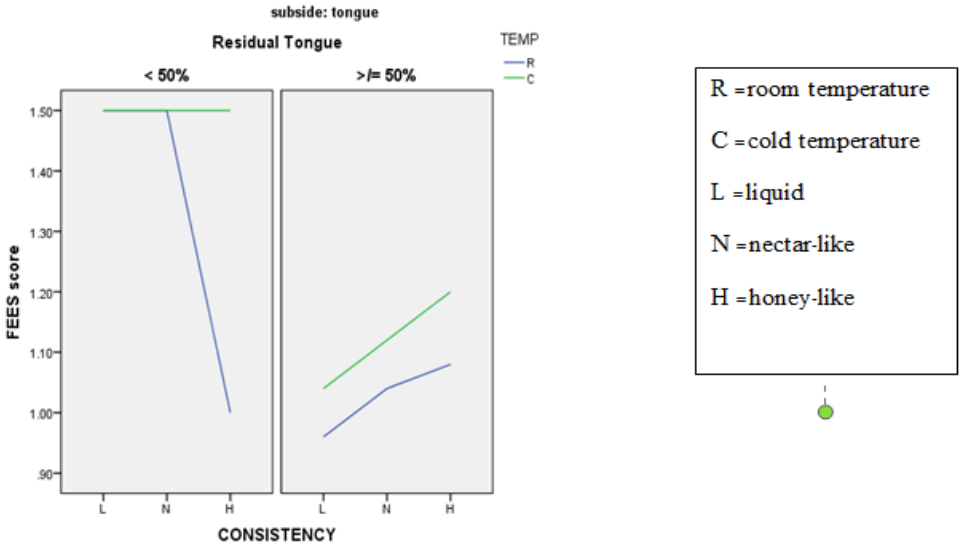

Figure 2. Average FEES Score of Patients with Residual Tongue Less than 50% (n=2) Compared to Residual Tongue 50% or Above (n=25). (Average FEES score of 0 was normal swallowing)

Table 6 illustrated the effect of temperature and consistency to total FEES score, VAS taste and VAS easy swallowing. There was no statistically significant association between the consistency and temperature. The interaction between food consistency and temperature was not found (p=0.94). Regarding the VAS scores of taste and easy swallowing, the difference in consistency of the food had statistically significant effect on VAS score (p=0.004 and <0.0001 respectively) while the food temperature did not (p=0.43 and 0.19 respectively). Pairwise comparisons for 3 types of food consistency appeared statistically significant for both VAS taste and easy swallowing except

Table 3. Comparison of Total FEES Scores between the Two most Common Subsites; Tongue (n=27) and Alveolar Ridge (gum) (n=7)

			Total score: Number of the patients (%)					
			0	1	2	3	p-value[@]	Mean score ± SD
Room	Liquid	Tongue	8 (29.6)	13 (48.1)	4 (14.8)	2 (7.4)	0.11	1.00 ± 0.88
		Gum	4 (57.1)	3 (42.9)	0	0		0.43 ± 0.54
	Nectar	Tongue	6 (22.2)	15 (55.6)	4 (14.8)	2 (7.4)	0.025	1.07 ± 0.83
		Gum	5 (71.4)	2 (28.6)	0	0		0.29 ± 0.49
	Honey	Tongue	3 (11.1)	19 (70.4)	5 (18.5)	0	0.16	1.07 ± 0.55
		Gum	3 (42.9)	3 (42.9)	1 (14.3)	0		0.71 ± 0.76
Cold	Liquid	Tongue	9 (33.3)	9 (33.3)	7 (25.9)	2 (7.4)	0.357	1.07 ± 0.96
		Gum	3 (42.9)	3 (42.9)	1 (14.3)	0		0.71 ± 0.76
	Nectar	Tongue	5 (18.5)	15 (55.6)	5 (18.5)	2 (7.4)	0.015	1.15 ± 0.82
		Gum	5 (71.4)	2 (28.6)	0	0		0.29 ± 0.49
	Honey	Tongue	4 (14.8)	15 (55.6)	6 (22.2)	2 (7.4)	0.022	1.22 ± 0.80
		Gum	4 (57.1)	3 (42.9)	0	0		0.43 ± 0.54

[@], Chi-square test for linear-by-linear association

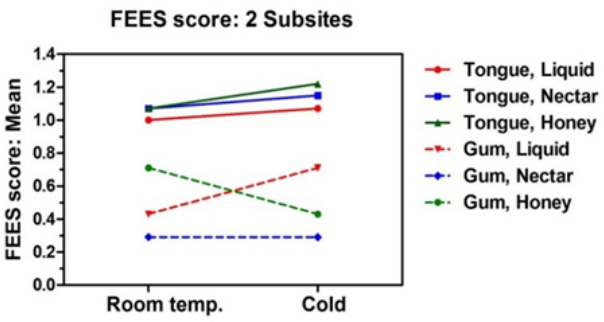

Figure 3. Average FEES Scores of 6 Kinds of Studied Food among Patients with Two Most Common Sites (Tongue and Gum)

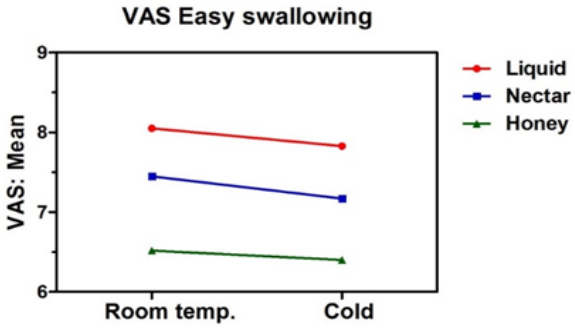

Figure 5. Average VAS Easy of Swallowing of 6 Kinds of Studied Food in All Participants

Table 4. Average VAS Taste of 6 Kinds of Studied Food among All Participants and Patients with Two Most Common Subsites (Tongue and Gum)

		VAS taste: Mean ± SD		
		Total (n=42)	Tongue (n=27)	Gum (n=7)
Room	Liquid	8.26 ± 1.52	8.59± 1.15	8.57 ± 1.40
	Nectar	7.98 ± 1.76	8.19± 1.39	8.43 ± 1.62
	Honey	7.74 ± 1.67	8.07± 1.33	8.14 ± 1.07
Cold	Liquid	8.24 ± 1.65	8.48± 1.34	8.29 ± 1.89
	Nectar	7.76 ± 1.81	7.89± 1.78	8.00 ± 1.53
	Honey	7.62 ± 2.04	7.78± 2.04	7.71 ± 1.89

Table 5. Average VAS for Easy Swallowing of 6 Kinds of Studied Food among All Participants and Patients with Two Most Common Subsites (Tongue and Gum)

		VAS easy swallowing: Mean ± SD		
		Total (n=42)	Tongue (n=27)	Gum (n=7)
Room	Liquid	8.05 ± 1.74	8.37± 1.74	8.00 ± 1.53
	Nectar	7.45 ± 1.81	7.44± 1.60	8.29 ± 1.70
	Honey	6.52 ± 2.04	6.48± 1.95	7.86 ± 1.68
Cold	Liquid	7.83 ± 1.61	8.11± 1.37	8.00 ± 1.83
	Nectar	7.17 ± 1.86	7.37± 1.64	7.57 ± 1.90
	Honey	6.40 ± 2.06	6.41± 2.10	6.86 ± 2.04

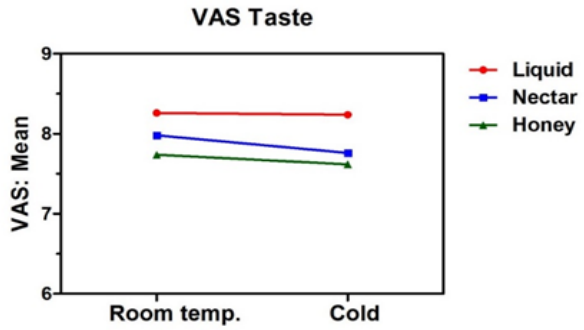

Figure 4. Average VAS Taste of 6 Kinds of Studied Food in All Participants

nectar vs. honey for VAS taste.

Discussion

This study aimed to find the proper characteristics of food which would be safe and satisfactory for swallowing and to create the recipe that provided adequate nutrients, energy, good taste, and can be easily made at home. Surprisingly, the study of proper characteristics of food for postoperative oral cavity cancer patients determined by FEES has never been done before.

The results of the objective study, FEES showed that

Table 6. Effect of Physical Properties (Temperature and Consistency) to Total FEES Score, VAS Taste and VAS Easy Swallowing

			p-value			p-value: Pairwise comparisons†		
		n	Temp	Consistency	Temp* Consistency	Liquid vs. Nectar	Liquid vs. Honey	Nectar vs. Honey
Total score[@] (0-3)	All	42	0.4125	0.2339	0.9413	-	-	-
	Tongue	27	0.3082	0.5598	0.9655	-	-	-
	Gum	7	1	0.1687	0.3557	-	-	-
VAS taste[#]	All	42	0.4352	0.0044	0.6083	0.0014	0.0005	0.1289
	Tongue	27	0.1829	0.0528	0.6493	-	-	-
	Gum	7	0.4886	0.2237	0.9078	-	-	-
VAS easy[#] swallowing	All	42	0.1937	<0.0001	0.6501	0.0042	<0.0001	<0.0001
	Tongue	27	0.416	0.0011	0.763	0.0083	0.0007	0.0003
	Gum	7	0.259	0.0865	0.228	-	-	-

[@], Proportional odds model; [#], Linear mixed model; †, 3 Pairwise comparisons for 3 types of food consistency (if statistical significances)

nectar-like food at room temperature gave the least score near to zero implying a lower prevalence of abnormal swallowing whereas the patients preferred to have liquid at room temperature. The liquid food was easy to eat and swallow but it caused more coughing, spluttering and aspiration than those with thicker consistency. The thickened food slowed the speed of transit through the oral and pharyngeal phases of swallowing. It could help avoid aspiration into the airway and improve the transit to the esophagus, however, that benefit brought into a risk of post-swallow residue remaining in the pharynx (Popa Nita et al., 2013; Steele et al., 2015). The patients should thicken liquid food by adding a food thickener like in this study. Nevertheless, average FEES score and VAS score in oral tongue cancer patients were concordant that liquid at room temperature was the best. Patients who underwent greater than 50% glossectomy had serious impairments in swallowing caused by damage to and/or resection of the musculature, skeleton, or nerves that affect swallowing-related structures (Huang et al., 2016; Son et al., 2015). For other specific subsites apart from oral tongue cancer, the number of patients was not enough to make the statistical analysis.

Instrumental assessment of swallowing comprises video fluoroscopic swallowing study (VFSS)and flexible endoscopic evaluation of swallowing (FEES). Both are instrumental assessment procedures commonly utilized in the evaluation of oropharyngeal dysphagia in the hospital and community settings. FEES provides direct visualization of the pharynx during swallowing and allows the clinicians to assess the anatomic and physiologic deficits of the palate, pharynx, and larynx. There are several benefits of FEES such as easily being performed at bedside, less expensive, no radiation exposure and being tested with real food in daily life (Langmore et al., 1988). There are some disadvantages of FEES that it could not evaluate some parameters of oral phase swallow such as inadequate lip movement, inadequate tongue control, inadequate chewing and delayed oral transit time. However, it can clearly evaluate premature oropharyngeal spillage which is the consequence of the problem in the oral cavity and has an effect on the laryngeal penetration and aspiration. Because of the familiar instrument, it is mostly used by otolaryngologists to determine the safety of oral food intake.

Nonsurgical management of swallowing disorders consists of postures, heightening sensory input, modifying bolus volume and speed of feeding, intraoral prosthesis and modifying food viscosity and texture. Postoperative oral cavity cancer patients could choose these methods apart from food modification to improve the safety and efficacy of swallow (van den Berg et al., 2008; Shaum and Milan, 2014).

The recipe created by researchers provides adequate nutrients, energy, good taste, and can be easily made at home. It would be choice of dysphagia diet for postoperative oral cavity cancer patients.

In conclusion, Nectar-like food at room temperature sounded the most proper food characteristics for the patients with oral cavity cancer undergoing surgery by the mean of FEES. However, patients' satisfaction from VAS score might not correlate with the FEES score. The physician should advise the patients about the selection of food with appropriate consistency and temperature for the safe swallows and avoidance of serious complication especially aspiration. Nonsurgical management of swallowing disorders could be used to improve the safety of swallowing in some subsites that the findings of the objective and subjective tests were not concordant.

The study could be used in the patients of other sites of head and neck cancer or patients who had swallowing disorders from other causes.

Finally, the food recipe and the results of this research would be the important information for home medical care and the medical foods industry in the future.

Author Contribution Statement

All authors contributed equally in this study.

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Limitation

Limitation of this study was the small numbers of patients with cancer of other subsites except those of oral tongue and alveolar ridge, so there were not enough subjects for statistical analysis.

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