

Clinical Benefits of Videofluoroscopic Examination of Swallowing Using Texture Modified Test Food

Aya Nakajima¹, Shinsuke Nagami², Yoshie Yamagata³ and Jun Kayashita^{1,3*}

¹Graduate School of Comprehensive Scientific Research, Prefectural University of Hiroshima, Japan

²Department of Neurology, Graduate School of Medicine, Kyoto University, Japan

³Department of Health Sciences, Faculty of Human Culture and Science, Prefectural University of Hiroshima, Japan

***Corresponding Author:** Jun Kayashita, Graduate School of Comprehensive Scientific Research and Department of Health Sciences, Faculty of Human Culture and Science, Prefectural University of Hiroshima, Japan.

Received: November 13, 2017; **Published:** January 04, 2018

Abstract

Aim: The aim of this study was to investigate the influence of the test food used in videofluoroscopic examination of swallowing, on food form of the patient. This was done by modifying the texture of the test food corresponding to the meal served at the hospital.

Patients and Methods: Ninety patients who were requested to have an evaluation of their swallowing function and underwent videofluoroscopic examination, were recruited for this study. Among them, 43 were classified under the unmodified test food group, and 47 under the texture-modified test food group. The method of supplying nutrient, or the food grade of the patient before and after examination were replaced with a score to make comparisons between both group. In addition, we evaluated the change of the score in each clinical field.

Results: In the texture-modified test food group, the score increased gradually and approached regular food as compared to the score of the unmodified test food group. Moreover, we proved that a significant decrease in the score were able to avoid for a prolonged period, after videofluoroscopic examination.

Conclusion: It is shown that using test food with modified its texture corresponding to the actual meal served at the hospital, in videofluoroscopic examinations, was useful for improving the food form of patients.

Keywords: Videofluoroscopic Examination of Swallowing; Texture Modified; Test Food

Introduction

Japan's aging rate rose to 25.1% in 2014 [1], indicating that one out of four Japanese is a senior citizen aged of 65 or older. This pace creates a very peculiar situation, with no similarities seen in the world. Pneumonia becomes the third cause of death in Japan from 2011, and about 90% of the patients suffering from pneumonia are aged over 65 years [2]. Therefore, it becomes crucial for our country, where the elderly population is expected to increase even further, to take measures against pneumonia. In addition, about 60% of the patients having pneumonia have been reported to be hospitalised due to aspiration pneumonia [3]. The management of a patient having difficulty in ingestion or swallowing, which is one of several causes of aspiration pneumonia, is extremely important to improve the quality of life (QOL) of the elderly people and to reduce the burden on their caregivers. At the same time, it is important to prevent pneumonia.

When we provide meals for patients having a decreased swallowing function, we try to modify the texture of it (e.g. by mixing in a blender or by solidifying by using gelling agent), making it easy for each patient to eat. It is difficult to decide the suitable food form for each patient; it is thus assumed that the form is different in each hospital even if the ingestion/swallowing functions of the patients are nearly the same. Seirei Mikatahara General Hospital, which is where previous studies on providing food with modified texture to patients have been conducted, proposed the Pyramid of Dysphagia Diet criteria, a five-grade standard for the texture modified food for to be served in cases of hospitalization due to acute causes, to expedite the common use in clinical situations. Sakai, *et al.* analyzed the physical properties of the Pyramid of Dysphagia Diet criteria and reported the range of food texture in each grade [4]. Furthermore, the Japanese Dysphagia Diet 2013 criteria were proposed by The Japanese Society of Dysphagia Rehabilitation [5]. This criterion focused not only on the acute conditions requiring hospitalization, however, also on chronic situations requiring hospitalization and facilities for the welfare of elderly persons. Thus, the grade of texture-modified food was being proposed; however, diagnosis by imaging is considered to be the best method to decide food form of which grade should be provided to patients having difficulty in ingestion or swallowing [6].

Imaging diagnostic techniques such as videoendoscopic examination of swallowing (VE) and videofluoroscopic examination of swallowing (VF) were conducted to assess the swallowing function of the patient and to decide which food grade would be suitable for them [6,7]. In particular, it is important to use test food that is similar in texture to the texture-modified food provided at the hospital, in order to increase the precision of information obtained from VF [8,9]. However, it has been reported that the texture of test food used at different institutions differs greatly [10].

In the this study, we conducted a videofluoroscopic examination of swallowing using texture-modified test food or unmodified test food, and investigated their clinical benefits by comparing their effects on the patients having difficulty in ingestion or swallowing.

Patients and Method

Patients

Ninety patients having a score of one or greater on the Japan Coma Scale (JSC) among the inpatients at Hiroshima City Hiroshima Citizens Hospital between May 2011 and April 2013 were included in the study. These patients were requested to undergo an evaluation of their swallowing function at the Department of otolaryngology. Thus, patients scheduled to undergo head and neck surgeries were recruited for this study. In addition, outpatients and patients of the pediatrics, neonatology, and pediatric surgery departments were excluded from this study. Patients who underwent VF examination between May 2011 and April 2012 constituted the unmodified test food group, and patients who underwent the examination between May 2012 and April 2013 constituted the texture-modified test food group. The characteristics of the participants of both the groups are shown in table 1.

		Unmodified test food (n = 43)	Texture modified test food (n = 47)
Gender (Male/Female)		28/15	36/11
Age (mean ± SD)		69.0 ± 16.0	75.3 ± 8.4
Clinical de- partment	Neurosurgery	8 (18.6%)	6 (12.8%)
	Cardiovascular surgery	11 (25.6%)	7 (14.9%)
	Surgery	3 (7.0%)	11 (23.4%)
	Otolaryngology, head and neck surgery	4 (9.3%)	7 (14.9%)
	Neuropathic internal medicine	6 (14.0%)	2 (4.3%)
	Cardiovascular medicine	2 (4.7%)	4 (8.5%)
	Internal medicine	5 (11.6%)	4 (8.5%)
	Orthopedic surgery	2 (4.7%)	1 (2.1%)
	Respiratory medicine	1 (2.3%)	2 (4.3%)
	Respiratory surgery	-	2 (4.3%)
	Radiology	1 (2.3%)	-
	Urology	-	1 (2.1%)

Table 1: Characteristics of the object participants.

SD: Standard deviation

Research ethics

This study was approved by the ethics committee of Hiroshima City Hiroshima Citizens Hospital.

Methods

Preparation of the test food

We prepared a three-type test food, i.e. thick, porridge and liquid state constituted the unmodified test food. Thick-state test food was prepared by mixing 50 ml barium sulfate slurry (Baritogenzol 145 w/v%: Fushimi Pharmaceutical Co., Ltd. Japan) and 100 ml water, to which a thickening agent (Tururinko Quickly: Morinaga Milk Industry Co., Ltd. Japan) was added in a quality decided by the producer. In porridge-state test food, barium powder (Barikonku MX: Minakara Co., Ltd., Japan) was added to the porridge appropriately. Liquid-state test food was prepared by mixing 50 ml barium sulfate slurry and 100 ml water.

Texture-modified food based on the Pyramid of Dysphagia Diet criteria was served at Hiroshima City Hiroshima Citizens Hospital. Modified test food for this study was also adjusted to it. We used the report by Sakai, *et al.* as a reference [4] for the physical properties of each grade. In this study, we prepared texture-modified test food of five-grades, i.e. gel (L0), soft gel (L2), crush (L3), porridge (L4) and liquid (L5) state. L0 test food was prepared by mixing 50 ml barium sulfate slurry and 50 ml water, and then adding 20g (20 w/v%) of gelling agent (Quick jelly: Sanwa Kagaku Kenkyusho Co., Ltd., Japan). This mixture was then left to stand for at least 30 minutes. L2 test food was prepared by mixing 50 ml barium sulfate slurry and 50 ml water, and then adding 8 g (8 w/v%) of gelling agent (Quick jelly). This mixture was then left to stand for at least 30 minutes. L3 test food was prepared by mixing 100 ml barium sulfate slurry and 100 ml water (85°C or more), and then adding 4 g of gelling agent (Softia G: NUTRI Co., Ltd., Japan). After this mixture had gelled fully, it was cut 5-mm wide square sections. In L4 test food, barium powder was added to porridge so as to attain a ratio of 30 % for the mass of the powder to mass of the porridge. Liquid-state test food was prepared by the same method as that used for preparing unmodified test food.

Measurement of physical properties

We measured the physical properties according to the ‘Foods for the elderly with difficulty in swallowing’ standard. Each sample was tested using a CREEP METER (RE2-3305B, YAMADEN, Japan) fitted with a plate plunger (diameter: 20 mm). The measurements were performed at a clearance value of 5 mm (67% compression) and at a compression velocity of 1 mm/sec. The plunger fitted to the CREEP METER compressed the sample twice; subsequently, a texture curving line was obtained. The hardness, adhesiveness and cohesiveness of the samples were calculated from this curve. Measured sample temperature using a laser thermometer (THERMO-HUNTER PT-7LD : OPTEX, Japan) was 20 ± 2°C.

Videofluoroscopic examination of swallowing (VF)

Six otolaryngologists and five speech therapists conducted the videofluoroscopic examinations of swallowing for both groups. Thick and liquid state test food of the unmodified group were provided in the range of 2 to 30 ml as the patient swallowing function and porridge state test food was provided at a level spoonful volume. Texture modified test food was provided in the following state L0 and L2 were sliced; L3 and L4 test food were a level spoonful. The appropriate food grade for each patient, as determined from the results of their examination, was then served to them for meal.

Interpretation of clinical examination

The food forms for both the groups were observed five times, i.e., at hospitalization (or postoperative), during VF examination, after VF examination, one week after VF examination and at discharge. The texture modified food served at Hiroshima Citizens Hospital is classified into five grades, viz., L0, L1, L2, L3, and L4, according to the Pyramid of Dysphagia Diet criteria. The patients of both groups were served meals according to these criteria during this study. For objective evaluation, the method of providing nutrients and food grades of the patients were replaced with a score. We compared both groups to assess the usefulness of modifying test food. In addition, we investigated the difference in time taken for evaluation after VF examination and at other times (i.e. at hospitalization (or postoperative), during VF examination, one week after VF examination, and at discharge). The time taken for evaluation after VF examination was considered as the standard.

Statistical analysis

Comparisons between the unmodified test food group and the texture-modified test food group were evaluated by Mann-Whitney U test at each evaluation time. Differences in time taken for evaluation after VF examination and at other times were assessed using Kruskal-Wallis test, which was followed by multiple comparisons using the Steel test. We did not analyze the results of each clinical department statistically because the size of the sample was too small for this purpose.

Results

Physical properties of texture-modified test food

The results of physical property measurement of L0, L2, and L4 test foods are shown in table 2. The values of physical properties of the test food were decided based on the reference values of the Pyramid of Dysphagia Diet criteria in this study.

Amount of gelling agent added	Hardness [N/m ²]	Adhesiveness [J/m ³]	Cohesiveness	Classification as per the Pyramid of Dysphagia Diet criteria
20 w/v%	3160 ± 59	201 ± 27	0.40 ± 0.02	L0
8 w/v%	780 ± 41	72 ± 3	0.52 ± 0.01	L2
—	1279 ± 55	359 ± 20	0.67 ± 0.01	L4

Table 2: Physical properties of the texture modified test food (mean ± SD).

Comparison between unmodified test food and texture-modified test food

The scores of both groups, i.e. unmodified test food and texture-modified test food, at each evaluation time are shown in table 3. The scores were observed to increase gradually from hospitalization to discharge in both groups. The scores of the texture-modified test food group were remarkably higher than those of the unmodified test food group at hospitalization. No significant differences were observed in comparisons of other times. When we compared the values of the unmodified test food group obtained after VF examination and those obtained at other times, the scores obtained after VF examination were significantly higher than those obtained at hospitalization only. In contrast, in the texture-modified group, there were significant differences in the scores obtained during VF examination and those obtained at discharge time, in addition to the differences between the scores obtained after VF examination and those obtained at hospitalization

	Hospitalization (or Postoperative)	VF examination	After VF examination	One week after VF examination	Discharge
Unmodified test food (n = 43)	3.1 ± 2.7*§	3.6 ± 2.6	4.9 ± 2.2	5.2 ± 2.6	5.5 ± 2.9
Texture modified test food (n = 47)	1.5 ± 1.6*§	2.7 ± 2.4*	5.0 ± 2.3	5.3 ± 2.7	5.9 ± 2.9*

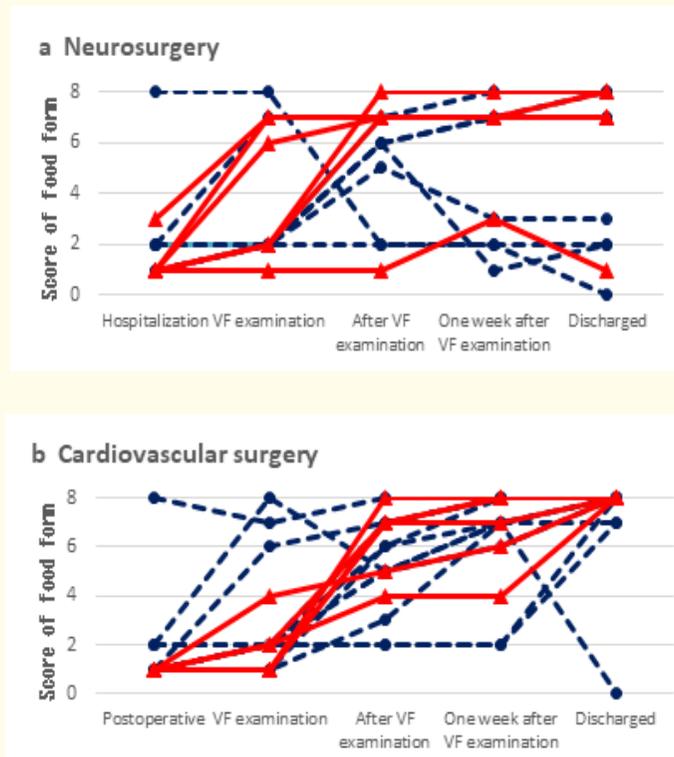
Table 3: Comparison between the unmodified test food and the texture modified test food (mean ± SD).

§: p < 0.05 (Comparison between the two groups, i.e., unmodified vs. texture-modified test food)

*: p < 0.05 (Comparison between the values obtained after VF examination and those obtained at other evaluation times, i.e. after VF examination vs. at hospitalization, during VF examination, one week after VF examination, and at discharge)

Comparison between unmodified test food and texture modified test food in each clinical department

The changes of score at each group; unmodified test food and texture modified test food were shown (Figure 1a-1e). The results were shown only the clinical departments which have more than three samples.



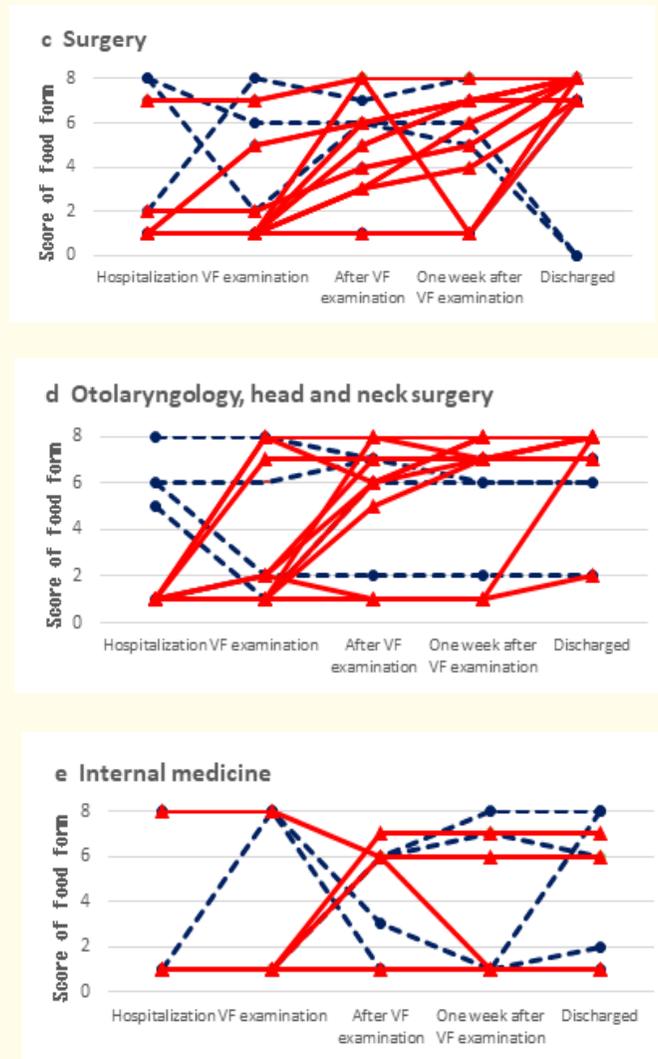


Figure 1a-1e: Change in scores of food form for all patients.

Neurosurgery (eight patients received unmodified test food while six received texture-modified test food)

In the unmodified test food group, the greater number of patients had lower scores than the texture- modified test food group at hospitalization. At the time of discharge, a higher number of patients with high scores were seen in the texture-modified test food group, and some of them could, by then, have regular meals (L5). In regards to the change of scores after the VF examination, though the scores of the unmodified test food group increased from hospitalization to after VF examination, further increase in scores up till discharge was observed only in a few patients. In contrast, in the texture-modified test food group, the scores kept increasing even after the VF examination.

Cardiovascular surgery (Eleven patients received unmodified test food and seven received texture- modified test food)

The scores of both groups showed an increasing trend, and many patients could have regular meals (L5). On comparing further, the scores of some patients were found to decrease after hospitalization in the unmodified test food group; however, all the patients in the texture-modified test food group had higher scores at discharge, without a decrease in scores at any evaluation time.

Surgery (Three patients received unmodified test food while eleven patients received texture-modified test food)

At hospitalization, the number of patients with lower scores in the texture-modified test food group was greater than those in the other group. There were many patients in the texture-modified test food group whose scores increased gradually, and most of them could have regular meal (L5) at the time of discharge. However, in the unmodified group, the scores of some patients were found to increase or decrease with time.

Otolaryngology, head and neck surgery (Four patients received unmodified test food while seven patients received texture-modified test food)

At the time of hospitalization, the number of patients with low scores in the texture-modified test food group was greater than those in the other group; all of the patients were being fed through tubes. In the unmodified test food group, a decreasing trend was observed, from hospitalization to after VF examination; the scores of most patients decreased till discharge. There was a greater increase in scores from hospitalization to after VF examination in the texture-modified test food group, and it continued to increase slightly till discharge. Scores of all patients increased from hospitalization to discharge and many patients could have regular meals (L5).

Internal medicine (Five patients received unmodified test food while four patients received texture-modified test food)

We could not confirm any trend in the changes in the scores of both groups, because a large number of patients had a greater dispersion in scores. Two patterns were observed after VF examination, and the scores increased and decreased in both groups.

Discussion

Various textures of food were served to patients having a compromised swallowing function; however, it is difficult to decide the appropriate food form for each patient. Therefore, it is assumed that the food texture is different in each hospital, even if the swallowing functions of the patients are comparable. In such a situation, several standards and physical properties were proposed to standardize the texture of food in clinical situations [4,5]. The grade of texture modified food has been set; however, imaging diagnostic methods are considered to be the best method to decide which grade should be provided to patients having difficulty in ingestion or swallowing [6].

The videofluoroscopic examination is conducted to assess the state of swallowing by means of an X-ray, by using test food that contains a contrast agent. From this examination, we can observe the movement of vocal and articulatory organs, aspiration during the swallowing reflex, and the esophageal stage of swallowing. The purpose of this examination is to decide a medical treatment for patients having difficulty in ingestion or swallowing. Several specialists, i.e. physicians, dentists, speech therapists, and nurses discuss a program of rehabilitation for each patient from the result of VF examination. However, it is reported that the texture of test food changes by adding a contrast agent [11,12]; therefore, there is a high probability that VF examinations are conducted by using test food having a different texture from the actual meal served at the hospital. To conduct appropriate VF examination, it is necessary to create a manual for preparing test food and to make it reproducible. However, it is reported that there is a large difference in the textures of test food in different hospitals [10]. This situation makes transfer of a patient to another hospital or an examination about the severity of a patient's illness conduct difficult. For adjusting the physical properties of test food, it may be useful to obtain feedback from patients regarding the difference the results of VF examination and the actual meal served at hospital [8,14]. In the present study, we conducted a videofluoroscopic examination of swallowing using texture-modified test food (L0~L4) following the Pyramid of Dysphagia Diet criteria adopted as a standard of food texture at Hiroshima City Hiroshima Citizens Hospital, and investigated the clinical benefits.

On comparing the results of the VF examination between the unmodified test food group and the texture-modified test food group, the scores of the texture modified test group were higher than those of the unmodified test food at hospitalization. From this result, it seems that the severity of a patient's illness was more advanced in the texture-modified test food group. When the scores obtained at each evaluation times were compared, significant increase was found between scores at VF examination time and those after the examination, only in the texture-modified group. In the unmodified test food group, there were only three states of test food, i.e. thick, porridge and liquid. These textures were very different. When we decided the state of the meal for a patient from the results of the VF examination, we tended to select the appropriate texture for a lesser swallowing function than the actual function of the patient, considering the risk of aspiration among others. That is why the increase of score was not significant in the unmodified test food group. In contrast, selecting the food form from result of the VF examination become easy by modifying the texture of test food, because it corresponded to the actual meal served at hospital. In addition, the variation in the test food was greater in the texture-modified test food group compared to the unmodified test food group. This enabled us to assess the swallowing function of the patient with greater detail, and we could change their food form more easily. Furthermore, the score at discharge time was markedly greater than that at the time of the VF examination in the texture-modified test food group. Consequently, selection of an appropriate texture became possible by conducting the VF examination using texture-modified test food and assessing the swallowing function of the patient in greater detail. It was shown that the grade of food form approached that of regular food.

Next, we consider the results for each clinical department. The subjects in neurosurgery had disease such as cerebral infarction, cerebral hemorrhage, cerebral embolism, vascular neoplasm. The state of dysphagia caused by cerebrovascular disorder vary by lesion area and its size [13]. It is proved that the cautious and detailed assessment by VF examination, using texture-modified test food, was useful in

improving their food form. In this study, there were many patients with dysphagia and they also had higher-order brain dysfunction. It is assumed that the VF examination using texture-modified test food is useful for these patients, because they could change their swallowing action to suit food texture when they followed instructions.

Many patients in cardiovascular surgery had a paralysis of the vocal cords as a postoperative complication. In paralysis of the vocal cords, aspiration results from complications like glottic insufficiency and paralysis of the vagus nerve or another cranial nerve [14]. It is also reported to occur from the inability to elevate the larynx because the patients were afraid to aspirate fluid and they could not perform extreme swallowing actions [15]. In these cases, not only the clinician, but also the patient appreciate the result of the VF examination by using texture-modified test food, and therefore it is suggested that the progress of the patient's food form may become quicker.

In surgery, many patients had been operated for esophageal cancer. There is a possibility that the disorder in swallowing may cause by damage of nerve and muscle resulted from surgical invasion in the upper esophageal and near the pharynx and larynx after operation of esophageal cancer [16]. In this case, a gradual change in food form is necessary, and it is inferred that using texture-modified test food is useful for them.

The subjects in otolaryngology, head and neck surgery were undergoing chemoradiotherapy and had undergone surgeries for head and neck cancer. Dysphagia caused by chemoradiotherapy and surgeries for head and neck cancer is mainly a structural disorder. In addition, the its condition varies greatly according to the place where it started, the type of surgery, of removal area of removal, the method of reconstruction, etc. In these cases, many patients cannot be served a regular meal; therefore, it is necessary to use the texture-modified food suitable for the structural disorder. We consider that to assess the swallowing function of patients, with certainty, by the VF examination, using texture-modified test food is important to serve an appropriate meal for the patient.

The patients in internal medicine had dementia, functional gastrointestinal disorders, renal functional disorders, and other such disorders. We concluded that the food form of patients did not improve gradually because of a declining desire and attention toward eating and problems of digestion and absorption.

From the above discussion, it can be assumed that the swallowing function of patients can be evaluated with greater more detail by conducting the VF examination using texture-modified test food, and as a result, the food form can be kept for a longer term or the transition to regular food can be hastened as the appropriate food is selected for the patient. Furthermore, when the selection of food form is inappropriate for the patient, it does not need to be lowered extremely due to the detailed result of the examination by modifying the texture of the test food and increasing its variety corresponding to the meal served at the hospital. The patients having various primary diseases were hospitalized in each clinical department, and the individual swallowing functions varied accordingly. There were some cases in which improvement in food form was not observed in this study.

Using texture modified test food also plays a significant role in clinical situations from a perspective of interprofessional coordination. The result of the VF examination was analyzed by a physician and speech therapist at Hiroshima City Hiroshima Citizens Hospital. The decision of food form served to the patient became easy to agree after texture-modified test food was used. A definitive decision of food form is desirable to coordinate with other professionals. An opinion that the result of the VF examination was easier to understand was expressed by the nurse and the nutritionist, because the form and texture of the test food corresponded to hospital diet after modifying the texture of test food. Moreover, it is assumed that the patients can understand the swallowing function by themselves. Most patients find it hard to understand their swallowing function from the point of view of function of the vocal and articulatory organs. However, the actual test food used for VF examination helps the patients to understand, and they can pay attention to the form of meal when they have it. In clinical situations, we often receive a demand for oral ingestion because patients have a good appetite even if they have difficulty in swallowing. However, the fact that they do not understand their present state can be given as a reason for such as an unreasonable demand; therefore, we cannot change their feeding methods carelessly to oral ingestion. In such a case, it is suggested that the patients be made to understand and judge their state easily if the texture of test food corresponds to that of the hospital meal.

Conclusion

The aim of this study was to investigate the influence of texture-modified test food corresponding to the actual meal served in hospitals, on food form of patients. In the texture-modified test food group, an appropriate selection of food form for patients was enabled because the swallowing could be evaluated with greater detail as compared to that in the unmodified test food group. As a result, the grade of food form for patients could be maintained for a longer term or it could be made to transition to regular food gradually. However, the number of types of test foods were different in both groups, i.e. the unmodified test food group had three and the texture modified test

food group had five types. The increase in this variation was also led to an appropriate decision for patients. Besides, it was suggested that usefulness of texture-modified test food for patients was different in each disease, symptom, and clinical condition. Therefore, further studies for the same are needed.

Bibliography

1. Cabinet Office (Japan). "White paper on aged society 2014 Report" (2014): 2.
2. Ministry of Health, Labour and Welfare (Japan). "Vital statistics of population 2015 Report" (2014).
3. Teramoto S., *et al.* "High incidence of aspiration pneumonia in community and hospital acquired pneumonia in hospitalized patients: a multicenter, prospective study in Japan". *Journal of the American Geriatrics Society* 56.3 (2008): 577-579.
4. Sakai M., *et al.* "Comparison of Food Physical Properties with reference to Clinically Effective Stepwise Swallowing Foods". *The Japanese Journal of Dysphagia Rehabilitation* 10.3 (2006): 239-248.
5. Fujitani J., *et al.* "Japanese Dysphagia Diet 2013 by the JSDR dysphagia diet committee (JDD2013) (Japanese)". *The Japanese Journal of Dysphagia Rehabilitation* 17.3 (2013): 255-267.
6. Schatz K., *et al.* "Endoscopic and videofluoroscopic evaluations of swallowing and aspiration". *Annals of Otolaryngology, Rhinology and Laryngology* 100.8 (1991): 678-681.
7. Langmore SE., *et al.* "Evaluation of oropharyngeal dysphagia: which diagnostic tool is superior?" *Current Opinion in Otolaryngology and Head and Neck Surgery* 11.6 (2003): 482-489.
8. Yamagata Y., *et al.* "Investigation of Test Foods for Videofluoroscopic Examination of Swallowing Suited to Stepwise Swallowing Diets". *The Japanese Journal of Dysphagia Rehabilitation* 12.1 (2008): 31-39.
9. Yamagata Y., *et al.* "The Methods of Simplified Test Food for Videofluoroscopic Examination of Swallowing". *Journal of Japanese Society for Medical Use of Functional Foods* 5.5 (2009): 343-348.
10. Ito A., *et al.* "Investigation of Foods used in Videofluoroscopic Swallowing Examinations at 25 Japanese Hospitals". *The Journal of Japanese Society for Parenteral and Enteral Nutrition* 29.4 (2014): 1017-1025.
11. Cichero JAY., *et al.* "How Thick Is Thick? Multicenter Study of the Rheological and Material Property Characteristics of Mealtime Fluids and Videofluoroscopy Fluids". *Dysphagia* 15.4 (2000): 188-200.
12. Ekberg O., *et al.* "Effect of Barium Sulfate Contrast Medium on Rheology and Sensory Texture Attributes in a Model Food". *Acta Radiologica* 50.2 (2009): 131-138.
13. Toh Y. "Dysphagia in Cerebro-Vascular disease-electromyographic and Radiographic Investigations". *The Journal of the Japan Broncho-Esophagological Society* 28.6 (1982): 1126-1160.
14. Shin T., *et al.* "Aspiration Caused by Recurrent Laryngeal Nerve Paralysis". *Otologia Fukuoka* 31.2 (1985): 416-420.
15. Murakami Y. "Pathogenesis and Therapy of Difficulty in Swallowing in the Second Stage". *The Journal of the Japan Broncho-Esophagological Society* 27.5 (1976): 362-366.
16. Muraoka M., *et al.* "Problems and Remedies after Esophageal Reconstruction". *The Japanese Journal of Gastroenterological Surgery* 28.10 (1995): 2062-2066.

Volume 13 Issue 1 January 2018

©All rights reserved by Jun Kayashita., *et al.*