

## Properties of Rice Porridge ( Gruel ) as a Meal for Patients with Swallowing Disorder

OKAZAWA MASASHI<sup>1)</sup>, KONISHI HIROKAZU<sup>1)</sup>, YOSHIDA TOMOHIRO<sup>1)</sup>,  
KATSUMATA AKITOSHI<sup>2)</sup>, IIDA YUKIHIRO<sup>2)</sup> and FUJISHITA MASAMI<sup>2)</sup>

*The food texture properties of rice porridge ( gruel ) were studied and the findings of a clinical video fluoroscopic swallow study ( VFSS ) using gruel as the test food were reviewed. As a result, it was noted that the texture of gruel changes with the rice to water ratio, the cooking device, and other factors. The findings from clinical VFSS revealed that the adhesion of gruel to and the residue in the oral and pharyngeal cavity were significant.*

Key words: Gruel, Food texture, Swallowing disorder, VF

### INTRODUCTION

In our dental hospital, patients, including those with cerebral palsy, after a stroke, and after treatment for oral cancer, underwent a video fluoroscopic swallow study ( VFSS )<sup>1)</sup>. The first role of VFSS in patients with dysphagia is to diagnose aspiration<sup>2)</sup>. Simultaneously, compensatory feeding postures and changing food properties are tested during VFSS<sup>3-5)</sup>. To develop adequate compensatory strategies, each patient's usual foods were used as the VFSS test material. In Japan, rice porridge, in other words, gruel, is the most common soft and easy to swallow hospital meal. It is also the most common substitute for rice given to patients with a swallowing disorder. However, from the findings of clinical VFSS using gruel as the test food, there was adhesion to and residue in the oral and pharyngeal cavity of patients with a swallowing disability. Aspiration was also observed in some cases. The softness of gruel changes according to how it is cooked, especially by the amount of water added to the rice. However, there has been no detailed investigation concerning the appropriate consistency of gruel for patients with a swallowing disorder; therefore, our objective was to examine the characteristics of gruel given to patients with a swallowing disorder. The following items were studied.

- 1 ) Measuring and evaluating the food texture properties of gruel when cooked in various ways.
- 2 ) Reviewing VFSS images for patients with swallowing disorder, using gruel.

### MATERIALS AND METHODS

- 1 ) Measuring the texture of gruel

An outline of the equipment for assessing texture is shown in Fig.1. To prepare normal rice, the ratio of rice to water should be approximately 1: 1.

We prepared three different gruels with a rice to water ratio of 1 : 7 1 : 10 1 : 20. We used a cooking pot and an electric rice cooker to prepare the test food. Using the texture analyzing system, we measured each sample 10 times. As shown in Figure 2, when measuring the texture, we placed the sample in a metal container ( Fig.2 ). A plastic cylinder plunger was used to ac-

quire data by compressing twice. Using the compressed load data, the software calculated the hardness, stickiness, and cohesiveness of gruel.

Similarly, the texture properties of the following items were measured:

- ( 1 ) Gruel that had stood for 3 and 5 hours after cooking
- ( 2 ) Processed rice in a food processor
- ( 3 ) Gruel used as the test food for VFSS.

- 2 ) Reviewing the VFSS images

In our facility, we try to recreate usual daily eating habits, in other words, we encourage patients or their families to bring their regular food for use with VFSS; therefore, VFSS was performed according to patients' usual food and eating position. The VFSS system consisted of a fluoroscopic x-ray unit, a special chair, and recording devices. Non-ionic iodine contrast media was added to the test foods. Figure 3 shows the VF examination system and an example image of a patient ( Fig.3 ). Eight examples of rice or gruel, which were VFSS tested, were selected to classify the pharyngeal residue and aspiration into 3 levels ( none, slight, severe ) seen on VFSS images. The texture of the gruel brought by the patient was tested to compare with the texture of the gruel evaluated above.

### RESULTS

- 1 ) Texture analysis of gruel

When the gruel was cooked differently, the hardness, stickiness and cohesiveness changed, as shown in the Fig.4 a, b, c. As more water was added to the gruel, it became softer and less sticky. When cooked using the same water ratio, the gruel cooked in a cooking pot was harder and much stickier than that in an electric rice cooker. There was no subtle difference in cohesiveness according to the cooking device or the amount of water; the ratio ranged from 0.6 to 0.8.

Fig.5 a demonstrates the effects of elapsed time on the hardness and stickiness of gruel. As time increased after cooling, the hardness and stickiness of the gruel increased. Fig.5 b shows the hardness and stickiness of processed rice in a food processor. Very sticky gruel was noted when a food processor was used as

<sup>1)</sup>Fifth Grade Student of Asahi University School of Dentistry

<sup>2)</sup>Department of Oral and Maxillofacial Radiology, Division of Oral Pathogenesis and Disease Control

Asahi University School of Dentistry  
1851 Hozumi, Mizuho, Gifu 501 - 0296, Japan  
( Accepted April 17, 2008 )

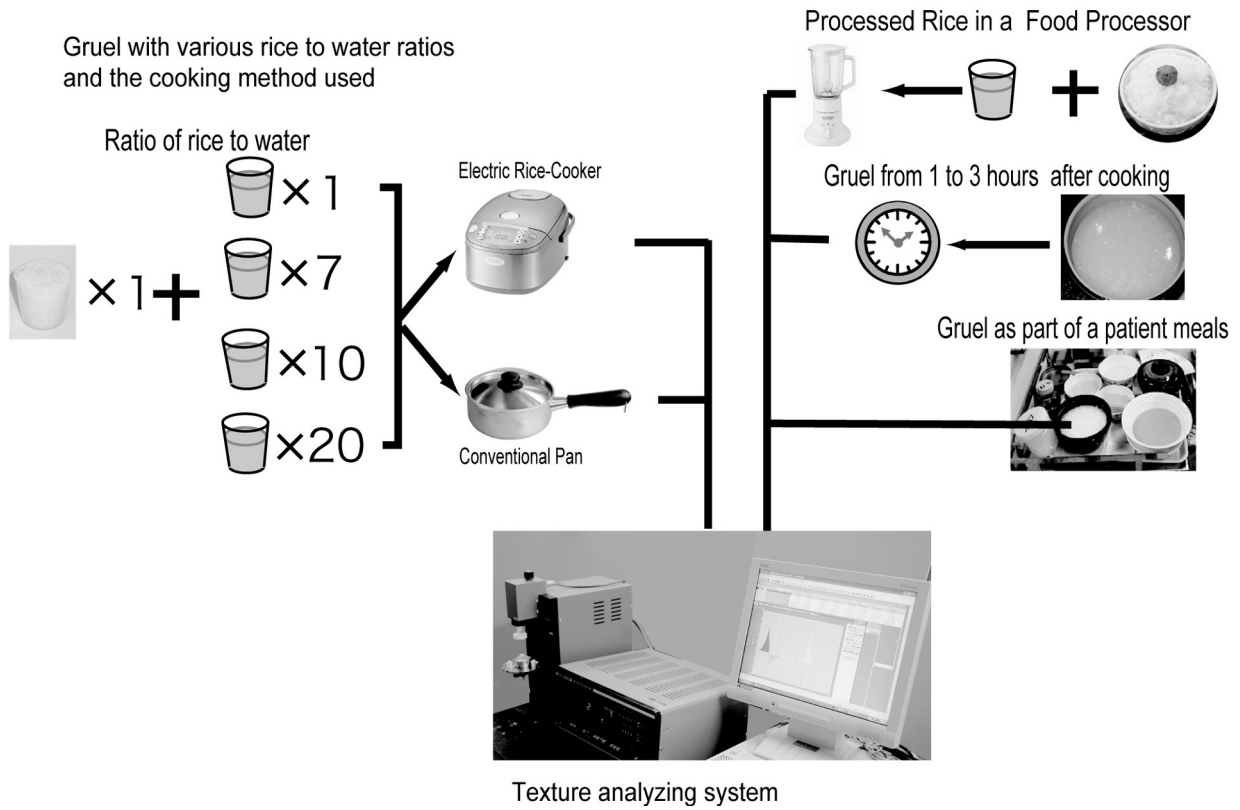


Fig. 1 Gruel for which food texture properties were measured.

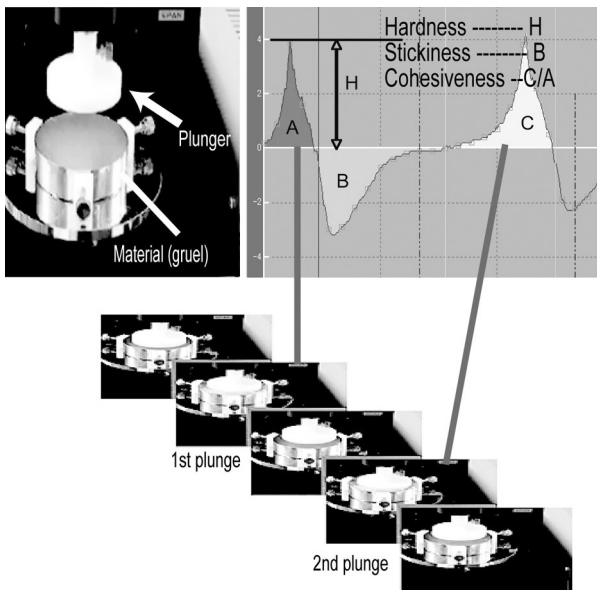


Fig. 2 Procedure of the food texture measurement.

an alternate cooking device to create gruel-like rice. Fig.5 c compares the hardness and stickiness of gruel used as patients' test food for VFSS with the above-analyzed gruel. The gruel used as the test food for VFSS showed very high stickiness (Fig. 5 a, b, c )

## 2 ) VFSS analysis

VFSS findings of patients are summarized in Table 1. Among



Fig. 3 Fluoroscopic unit, special chair and an example VF image of a patient with a swallowing disorder.

eight subjects with a swallowing disorder, four were pediatric patients with cerebral palsy, and the remainder were geriatric patients with an underlying disease, such as stroke, dementia, or Parkinson's disease. When swallowing gruel, 7/8 patients had residue in the oral and pharyngeal cavity. VFSS images of a patient showing the sticking and residue of gruel are shown in Fig. 6. Aspiration of gruel was not seen in the reviewed patients.

## DISCUSSION

One of the most important causes of aspiration is the entrance of food and fluid into the pharynx<sup>6</sup>. Normal subjects can hold food and liquid in their mouth safely with any head posture. Loss of this ability may cause aspiration of fluid with lower consistency foods such as custard pudding. Subsequent aspiration will not occur if the swallowing reflex starts promptly. For patients with dysphagia, the reflex is delayed, becoming a risk factor of aspiration; therefore, it is conceivable that if the entrance rate of food into the pharynx is slow, the risk of aspiration will

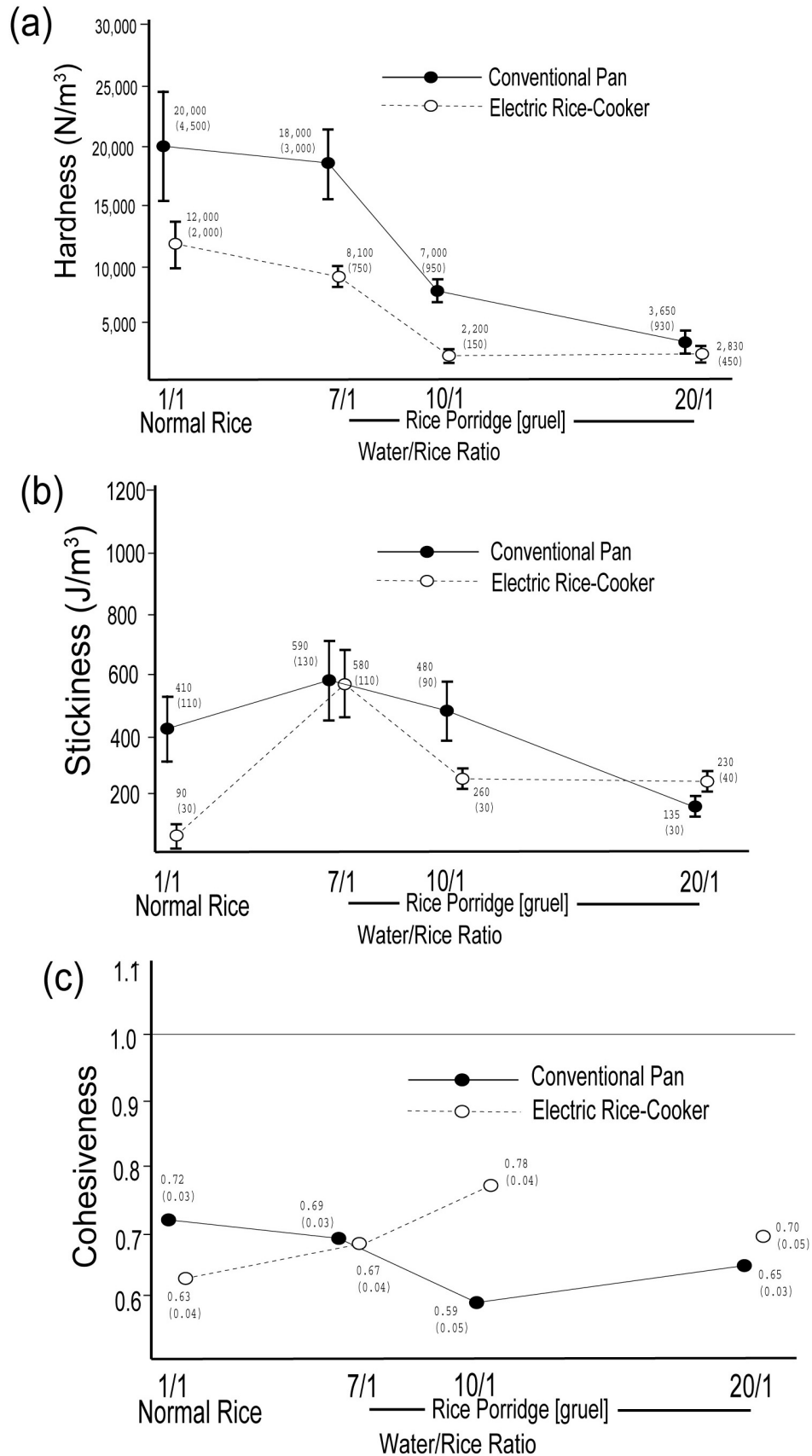


Fig. 4 Food texture of gruel with various rice to water ratios and the cooking device used. Graphs represent the hardness( A ) stickiness( B)and cohesiveness( C )

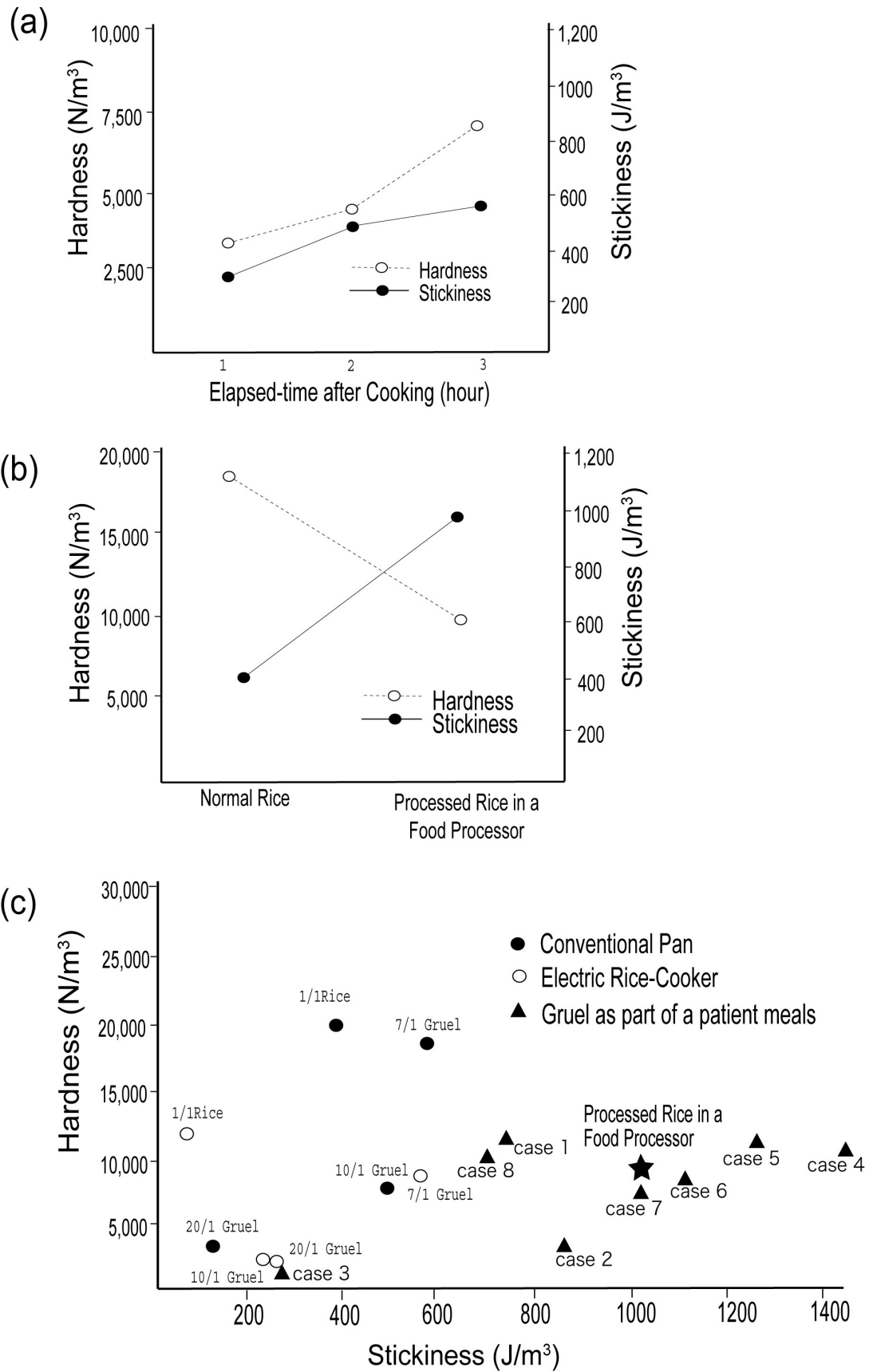


Fig. 5 Hardness and stickiness of gruel. Gruel 3 and 5 hours after cooking (A), rice processed in a food processor (B), and gruel used as the patients' test food for VFSS compared with other gruel (C)

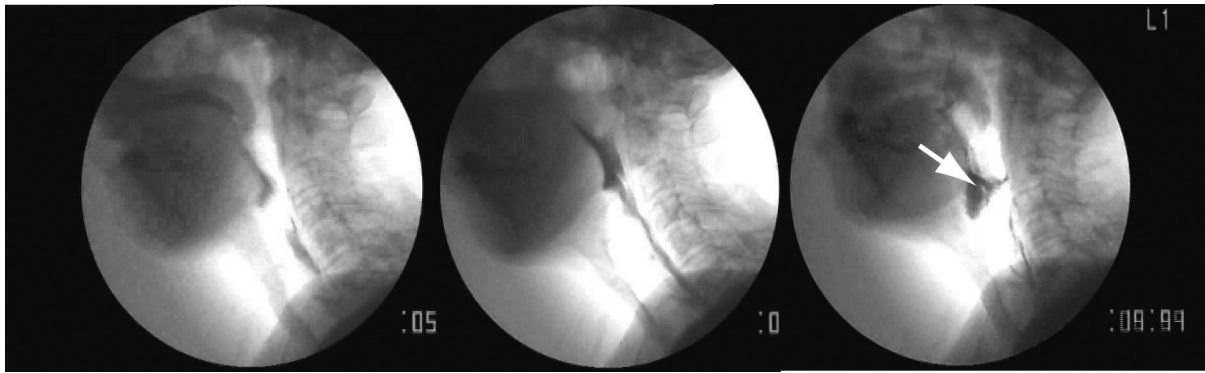


Fig. 6 VFSS images of pharyngeal transport of gruel in a patient. Residual gruel( arrow )was seen.

Table 1 VFSS findings of patients

Case #	Age	Sex	Underlying disease	Swallowing gruel		Aspiration of other foods
				Residue	Aspiration	
1	5	M	cerebral palsy	Slight	None	Slight aspiration of custard pudding
2	75	F	stroke	Severe	None	Slight aspiration of custard pudding and fluid
3	83	M	stroke	None	None	None
4	9	F	cerebral palsy	Severe	None	Aspiration of fluid
5	93	F	dementia	Severe	None	Slight aspiration of custard pudding and fluid
6	9	F	cerebral palsy	Slight	None	Aspiration of fluid
7	81	M	Parkinson's disease	Slight	None	Slight aspiration of fluid
8	7	M	cerebral palsy	Severe	None	None

be reduced, so sticky food is advantageous. The results from our clinical and in-vitro simulation study revealed that modification of food consistency might be useful to reduce the rate of the food bolus reaching the tongue base<sup>7,8)</sup> as regular gruel showed high consistency. On the other hand, in dysphagic patients with weak and slow movement of the tongue and pharynx for active transport of foods, sticky foods may adhere to the pharyngeal wall. The sticking and residue of higher consistency foods may provoke further aspiration<sup>5)</sup>. It is possible for residual foods in the pharyngeal cavity to be inhaled into the larynx after deglutition apnea. High stickiness and low cohesiveness properties can be deemed a risk factor of this aspiration; therefore, it is important to identify an appropriate diet consistency for each patient. In our reviewed VFSS images, the adhesion of gruel to and residue in the oral and pharyngeal cavity were frequently seen, suggesting that gruel has a risk for the latter type of aspiration. In this study, we cooked gruel using an electric rice cooker and a cooking pot. It should be noted that the texture of gruel changes not only with the rice to water ratio but also according to the cooking device. It was considered that making gruel using an electric rice cooker would give a more consistent texture. In addition, rice processed in a food processor should not be used for patients with dysphagia because of its high stickiness. As a matter of convenience, care-givers of dysphagia patients prefer processed rice, which may be why the gruel used in VFSS showed higher stickiness than gruel made correctly. Another factor concerning texture is the time between when the food was prepared and eaten. Our next task is to identify how the time after gruel preparation and the change in texture relates to aspiration.

## CONCLUSION

The gruel as an invalid food for patients with swallowing disorders should have less residue to the pharynx. In order to achieve this, the meal should be cooked without it getting to sticky. Checking with VFSS or endoscopic study in conjunction with food texture analysis for the best texture for each patient has a big meaning in clinical examination.

## REFERENCES

- 1) Katsumata A, Iida Y, Fujishita M, Progress of videofluoroscopic swallowing examination(VF)in dental school hospital. *The Journal of Gifu Dental Society* 2003; 30( 1 ) 37-43.
- 2) Logemann JA. Evaluation and treatment of swallowing disorders. Second edition. Texas: PRO-ED:1998; pp.197-201.
- 3) Larnert G, Ekberg O. Positioning improves the oral and pharyngeal swallowing function in children with cerebral palsy. *Acta Paediatr.* 1995; 84: 689-692.
- 4) Dantas RO, Dodds WJ, Massey BT, Kern MK. The Effect of High- vs Low- Density Barium Preparations on the Quantitative Features of Swallowing. *AJR.* 1989; 153: 1191-1195.
- 5) Kendall KA, McKenzie S, Leonard RJ, Goncalves MI, Walker A. Timing of events in normal swallowing: A videofluoroscopic study. *Dysphagia.* 2000; 15: 74-83.
- 6) Leder SB, Karas DE. Fiberoptic endoscopic evaluation of swallowing in the pediatric population. *Laryngoscope.* 2000; 110( 7 ) 1132-6.
- 7) Iida Y, Katsumata A, Fujishita M. A simulation system for dynamic videofluoroscopic swallow examination. *Dental Radiology* 2004; 44: 152-160.
- 8) Iida Y, Katsumata A, Fujishita M. VF evaluation of the speed of bolus flow on the tongue base. *The Japanese Journal of Dysphagia Rehabilitation.* 2005; 9: 255-264.

## 嚥下障害患者に対する食品としてのお粥の特性

岡 澤 仁 志<sup>1)</sup> 小 西 宏 和<sup>1)</sup> 吉 田 智 洋<sup>1)</sup>  
勝 又 明 敏<sup>2)</sup> 飯 田 幸 弘<sup>2)</sup> 藤 下 昌 己<sup>2)</sup>

お粥の食品テクスチャ解析を試みた。また、お粥を検査食として用いたビデオ嚥下造影検査（VFSS）の所見を検討した。その結果、お粥のテクスチャ特性は、米と水の比率、用いた調理器具、および他の因子により変化する事が示唆された。臨床VF所見では、口腔および咽頭腔への、お粥の著明な附着・残留が認められた。

キーワード：粥，食品テクスチャ，嚥下障害，嚥下造影

<sup>1)</sup>朝日大学歯学部5年生

<sup>2)</sup>朝日大学歯学部口腔病態医療学講座歯科放射線学分野  
〒501-0296 岐阜県瑞穂市穂積1851

本論文の要旨は、岐阜歯科学会第160回例会（平成20年2月）において発表した