

*Original Article***Value of the Hyodo score in predicting dysphagia severity, recommended diet, and liquid consistency**

**Kaori Kikumura, MD,^{1,2} Hitoshi Kagaya, MD, DMSc,¹ Seiko Shibata, MD, DMSc,¹
Koichiro Matsuo, DDS, PhD,³ Fumi Toda, MD, DMSc,¹ Mao Ogawa, MD, DMSc,¹
Yuriko Ito, DDS, DMSc,¹ Megumi Ozeki, MD, DMSc,⁴ Yohei Otaka, MD, PhD¹**

¹Department of Rehabilitation Medicine I, School of Medicine, Fujita Health University, Toyoake, Aichi, Japan

²Department of Rehabilitation, Okinawa Kyodo Hospital, Naha, Okinawa, Japan

³Department of Dentistry and Oral-Maxillofacial Surgery, School of Medicine, Fujita Health University, Toyoake, Aichi, Japan

⁴Faculty of Rehabilitation, School of Health Sciences, Fujita Health University, Toyoake, Aichi, Japan

ABSTRACT

Kikumura K, Kagaya H, Shibata S, Matsuo K, Toda F, Ogawa M, Ito Y, Ozeki M, Otaka Y. Value of the Hyodo score in predicting dysphagia severity, recommended diet, and liquid consistency. *Jpn J Compr Rehabil Sci* 2020; 11: 109–115.

Objective: To define whether the Hyodo score can be used to predict dysphagia severity and determine the appropriate diet and liquid consistency in a retrospective observational study.

Methods: A total of 741 patients with suspected dysphagia were enrolled. The median patient age was 77 years, and the major primary diseases were respiratory disease and cerebrovascular disease. The results of a videoendoscopic evaluation of swallowing were used to determine the Hyodo score, dysphagia severity, and recommended diet and liquid consistency. Dysphagia severity was rated using the Dysphagia Severity Scale (DSS). There were seven choices of recommended staple food, eight choices of side dish, and six choices of liquid intake.

Results: The median DSS score was 4, and the median Hyodo score was 4. Ordinal logistic regression analysis revealed that resting, swallowing, and the total Hyodo scores were significantly correlated to the DSS score, recommended staple food, side dish, and liquid intake ($p < 0.001$).

Conclusion: The Hyodo scores are useful to predict the dysphagia severity as well as determine the

recommended diet and liquid consistency.

Key words: dysphagia, videoendoscopic evaluation of swallowing, Hyodo score, Dysphagia Severity Scale

Introduction

With population aging in Japan, dysphagia is increasingly becoming a public health problem. Dysphagia can cause undernutrition, dehydration, and aspiration pneumonia; further, it reduces the quality of life [1–3]. The gold standards used for assessing dysphagia are videoendoscopic evaluation of swallowing (VE) and videofluoroscopic examination of swallowing. VE does not require the patient to be exposed to radiation and can be performed at the bedside [4, 5]. In VE, dysphagia is assessed by introducing an endoscope via the nasal cavity, observing the pharynx and larynx, and then administering a bolus and observing the swallowing function; however, quantitative assessment is generally difficult.

A qualitative scale called the fiberoptic endoscopic dysphagia severity scale (FEDSS) has been developed for assessing dysphagia in patients with acute stroke. The FEDSS is a six-level ordinal scale; when using the scale, patients are not given an oral diet if they display aspiration or laryngeal penetration when swallowing saliva or a teaspoon of puree, or if they display laryngeal penetration or aspiration without protective reflex when swallowing a teaspoon of colored water [6, 7]. The qualitative scale commonly used in Japan to assess dysphagia is the Hyodo scoring system [8]. A resting score is assigned for salivary pooling at the vallecula and piriform sinuses, and for glottal closure reflex at rest. In addition, induction of the swallowing reflex and pharyngeal clearance when swallowing 3 mL of colored water are evaluated. Each element has a

Correspondence: Kaori Kikumura, MD
Department of Rehabilitation, Okinawa Kyodo Hospital,
4–10–55 Kohagura, Naha, Okinawa 900–8558, Japan.
E-mail: haisai8131k@yahoo.co.jp

Accepted: September 17, 2020.

Conflict of Interest: The authors declare no conflict of interest.

score of 0–3 (on a four-point scale) (Table 1). Higher Hyodo scores indicate more severe dysphagia. A total Hyodo score of ≤ 4 indicates that the patient can safely eat an oral diet; a score of ≥ 9 typically contraindicates an oral diet [8–11]. To the best of our knowledge, no study has shown which diets and liquids are recommended based on each score. It is usually necessary to administer many different boluses of varying types and quantities while performing VE to determine which diets and liquids are appropriate. However, it is sometimes challenging for a non-expert to determine the optimal boluses to be used. Given that the Hyodo score is easy to calculate while performing VE, it would be clinically useful if it could be used to determine to a certain extent which diets and liquids are indicated. The objective of this study was to determine whether the Hyodo scores can be used to predict the severity of dysphagia and the ideal diet and liquid intake levels, as assessed using various boluses by VE.

Method

This study was approved by our institution's Ethics Committee. At this institution, patients with suspected dysphagia are screened by a certified dysphagia nurse or a physiatrist. If a more detailed examination is required, written informed consent is obtained from the patient or a proxy, and swallowing rounds are performed with VE [12]. VE has been performed for a

long time at our institution using 4-mL boluses of liquid, so we used 4-mL boluses to determine the Hyodo scores. VE was performed on 1,435 patients from April 2017 to January 2020. We excluded 487 patients who were not administered 4-mL thin liquid bolus during the examination and 207 patients for whom insufficient data were available because the study was retrospective and observational; finally, 741 patients were enrolled. Of these, 503 were men and 238 were women, and the median age was 77 years (69–84 years). The major primary disease was respiratory disease in 192 patients, cerebrovascular disease in 151 patients, cancer in 108 patients, cardiovascular disease in 79 patients, gastrointestinal disease in 56 patients, orthopedic disease in 27 patients, neuromuscular disease in 24 patients, and other diseases in 104 patients.

Swallowing rounds are conducted at this institution by a transdisciplinary team that includes physiatrists, dentists, speech-language-hearing therapists, nurses, dietitians, dental hygienists, and other specialists. The team collaborates across disciplines to reach a consensus on each patient, such as the patient's dysphagia severity as well as recommended diet and liquid consistency. For the VE, first, the pharynx and larynx are observed; thereafter, salivary pooling is studied, and then, the endoscope tip is touched against the epiglottis to assess the sensation in the pharynx. A variety of boluses, such as 4-mL thick liquid, 10-mL thick liquid, 4-mL thin liquid, 10-mL thin liquid, a cup

Table 1. Hyodo score (quoted from reference 8).

	Score	Number of cases
1 Salivary pooling at vallecula and piriform sinuses		
No pooling	0	290
Slight pooling	1	307
Moderate pooling without penetration	2	116
Severe pooling and penetration into larynx during inspiration	3	28
2 Glottal closure reflex induced by touching the epiglottis with the endoscope		
Prompt reflex	0	370
Weak reflex	1	243
Occasionally	2	61
No reflex	3	67
3 Induction of swallowing reflex (Leading edge of bolus at the initiation of swallowing reflex by thin liquid)		
Before vallecula	0	138
Vallecula	1	173
Piriform sinuses	2	258
After piriform sinuses	3	172
4 Pharyngeal clearance after swallowing thin liquid		
No residues	0	370
Pharyngeal residues remain but they are washed out after 2–3 swallows	1	305
Pharyngeal residues remain after multiple swallows	2	64
Much pharyngeal residues and penetrate into larynx	3	2

of thin liquid, rice gruel, a pureed food, and a two-phase mixture of soft rice and liquid, are administered as required, and penetration, aspiration, induction of the swallowing reflex, and pharyngeal clearance are observed. The Hyodo scores were calculated based on the observations of the pharynx and larynx and the results of administering the 4-mL thin liquid bolus. Dysphagia severity was assessed using the Dysphagia Severity Scale (DSS) [13]. The DSS is a seven-level ordinal scale wherein 1 denotes saliva aspiration; 2, food aspiration; 3, water aspiration; 4, occasional aspiration; 5, oral problems; 6, minimal problems; and 7, within normal limits. Lower numbers indicate more severe dysphagia. The recommended staple foods were rice, soft rice, rice gruel, thickened rice gruel, gelled rice gruel, or no staple food (forbidden); the recommended side dish was a regular diet, a soft diet, a mechanical soft diet, a mechanical soft diet with thickened liquid, a modified thickened diet, a pureed diet, a jelly diet, or no side dish (forbidden). The recommended liquids were thin liquid, 0.5% thick liquid, 1% thick liquid, 1.5% thick liquid, 2% thick liquid, and no liquid (forbidden).

We used the partial correlation coefficient and Spearman rank correlation coefficient to assess the correlation among the four elements of the Hyodo score. We conducted an ordinal logistic regression analysis using the Hyodo resting scores, liquid swallowing scores, and total scores as explanatory variables, with the DSS score, recommended diet, and recommended liquid consistency as objective variables. Statistical significance was set at 5%. Median values were displayed, and interquartile ranges were displayed in parentheses. The statistical software used was JMP 12 (SAS Institute Japan Inc., Tokyo), except for the regression coefficient, odds ratio, 95% confidence interval, and *p* value by ordinal logistic regression analysis which were calculated by BellCurve for Excel (Social Survey Research Information Co., Ltd., Tokyo).

Results

The median time between hospitalization and VE was 16 days (9–32 days). The DSS score was 2 in 50 patients, 3 in 261 patients, 4 in 176 patients, 5 in 63 patients, 6 in 141 patients, and 7 in 50 patients. The median DSS score was 4 (3–6), and a DSS score of 1, the most severe level, was not observed. Of the 741

patients, 97 aspirated the 4-mL liquid bolus, and 644 did not.

The median resting score was 1 (0–1) for salivary pooling at the vallecula and piriform sinuses and 1 (0–1) for glottal closure reflex at rest; the median swallowing score was 2 (1–2) for induction of swallowing reflex and 1 (0–1) for pharyngeal clearance (Table 1). The median total score was 4 (2–5) (Figure 1). The partial correlation coefficients were the minimum ($\rho = 0.047$) between glottal closure reflex and induction of swallowing reflex, while salivary pooling and pharyngeal clearance was the maximum ($\rho = 0.217$). All partial correlation coefficients showed significant differences (Table 2).

The recommended staple food, side dish, and liquid intake are shown in Table 3. For the analysis, given the relatively small patient population, we combined the patients who were recommended thickened rice gruel and gelled rice gruel and those recommended pureed and jelly diets. We also created a patient group that comprised patients who were recommended thin liquids, those recommended 0.5–1% thick liquid, those recommended 1.5–2% thick liquid, and those who were given no liquids orally. Ordinal logistic regression analysis revealed that the resting and total of the Hyodo scores were significantly associated with the DSS score, recommended staple foods, recommended side dish, and recommended liquid consistency ($p < 0.001$) (Table 4). Figure 2 shows the likelihood of a given DSS score, recommended diet, and liquid consistency at a given Hyodo resting score and total score outputted by JMP 12. The probability that a patient would score

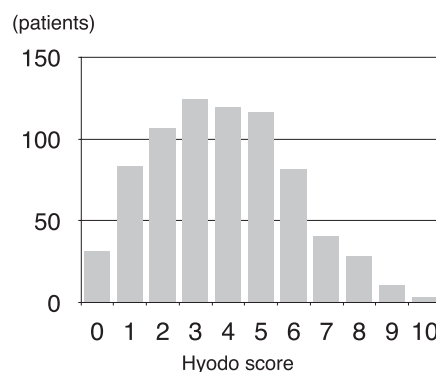


Figure 1. Distribution of Hyodo score. The median total score was 4, while the mode was 3. Higher Hyodo scores indicate more severe dysphagia.

Table 2. Partial correlation coefficients in Hyodo score.

	Salivary pooling	Glottal closure reflex	Induction of swallowing reflex	Pharyngeal clearance
Salivary pooling		0.168 ($p < 0.001$)	0.089 ($p < 0.001$)	0.217 ($p < 0.001$)
Glottal closure reflex	0.168 ($p < 0.001$)		0.047 ($p = 0.001$)	0.102 ($p < 0.001$)
Induction of swallowing reflex	0.089 ($p < 0.001$)	0.047 ($p = 0.001$)		0.163 ($p < 0.001$)
Pharyngeal clearance	0.217 ($p < 0.001$)	0.102 ($p < 0.001$)	0.163 ($p < 0.001$)	

Table 3. Recommended diet and liquid consistency.

		Number of cases
Staple food	rice	35
	soft rice	212
	rice gruel	350
	thickened rice gruel	6
	gelled rice gruel	104
	none	34
Side dish	regular diet	35
	soft diet	131
	mechanical soft diet	109
	mechanical soft diet with thickened liquid	178
	modified thickened diet	149
	pureed diet	105
	jelly diet	4
	none	30
Liquid intake	thin	309
	0.5% thick	28
	1% thick	370
	1.5% thick	15
	2% thick liquid	6
	none	13

Table 4. Ordinal logistic regression analysis.

Objective variables	Explanatory variables	Regression coefficient	Odds ratio	95% Confidence interval	p Value
Dysphagia Severity Scale (DSS)	Hyodo resting score	-0.503	0.605	0.545-0.671	<0.001
	Hyodo total score	-0.487	0.614	0.577-0.655	<0.001
Staple food	Hyodo resting score	-0.467	0.627	0.575-0.684	<0.001
	Hyodo total score	-0.408	0.665	0.621-0.712	<0.001
Side dish	Hyodo resting score	-0.466	0.627	0.570-0.690	<0.001
	Hyodo total score	-0.423	0.655	0.620-0.692	<0.001
Liquid intake	Hyodo resting score	-0.466	0.628	0.566-0.696	<0.001
	Hyodo total score	-0.460	0.632	0.580-0.688	<0.001

2 on the DSS when the resting score and total score were both 0 was very small. However, dysphagia became more severe as the scores increased, and when the total score was 10, the probability of having a DSS score of 2 was approximately 50%. When the total score was 0, the probability of having a DSS score of 7 (within a normal range) was > 25%. As the Hyodo scores increased, the more difficult to aspirate staple foods and side dishes were recommended and one quarter of those with a total score ≥ 9 were not given any food. Although about 60% of patients with a resting score of 0 and 80% of those with a total score of 0 were permitted thin liquids, as these scores increased, thick liquids became increasingly necessary; a higher proportion of thickener was recommended, and more patients were forbidden oral liquids.

Discussion

The present results showed that there was a significant relationship between the Hyodo score and the DSS score, recommended diet, and recommended liquid consistency. In VE, the conditions in the pharynx and larynx are observed before the boluses are administered. In the Hyodo scoring system, a resting score is assigned for salivary pooling at the vallecula and piriform sinuses, and glottal closure reflex at rest. If there is no salivary pooling and good pharyngeal sensation, the resting score will be 0, the probability of thin liquid being permitted will be > 50%, and we can predict that the DSS score will be ≥ 3 and that water and food will not be forbidden. If the resting score is 6, then it is highly probable that the DSS score will be 2 or 3, the recommended staple food will be rice gruel or

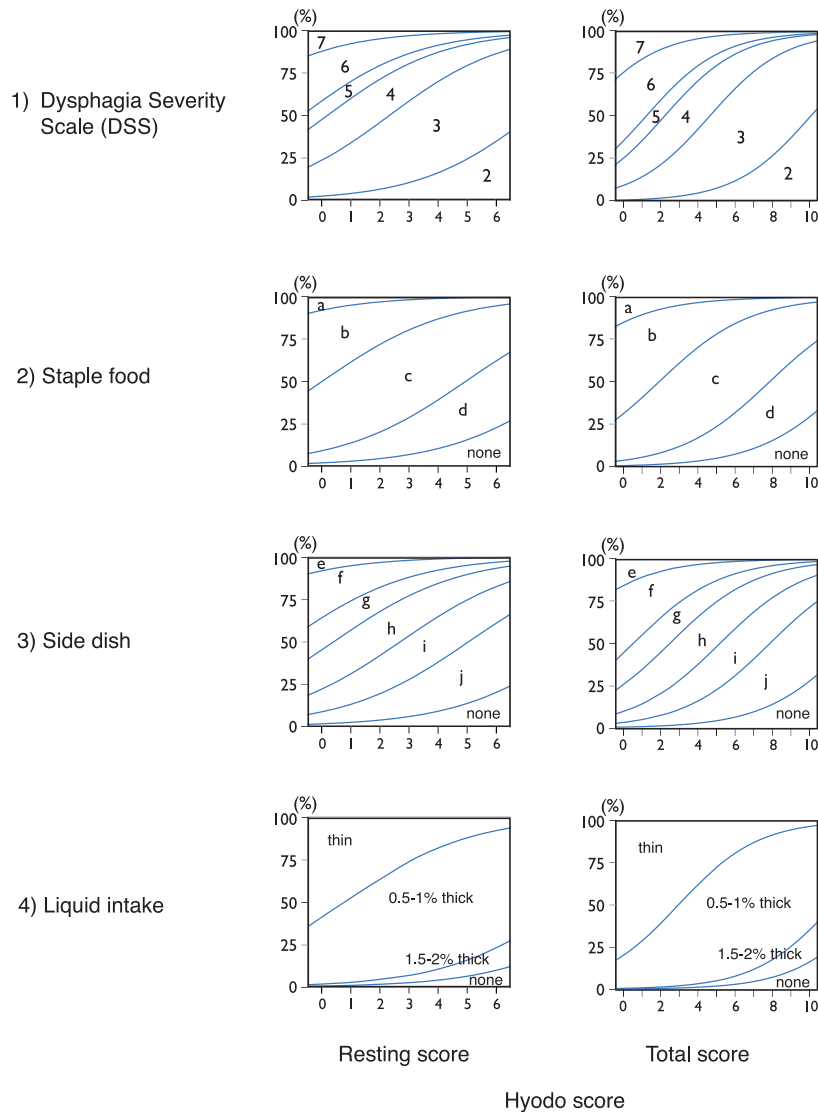


Figure 2. Probability of dysphagia severity and recommended diet and liquid consistency by Hyodo resting score and total score.

Ordinal logistic probability plots are shown. As the Hyodo scores increased, dysphagia deteriorated, while the recommended staple foods and side dishes became softer and contained thickener. The necessity of thick liquids also increased.

a: rice, b: soft rice, c: rice gruel, d: thickened or gelled rice gruel, e: regular diet, f: soft diet, g: mechanical soft diet, h: mechanical soft diet with thickened liquid, i: modified thickened diet, j: pureed or jelly diet.

gelled rice gruel, and the side dish will be a modified thickened diet, a pureed diet, or forbidden. In such cases, the liquids will usually require a thickener. Considering these facts, we can determine which boluses will be appropriate when performing VE. Nevertheless, it should be noted that there is a limit to predicting DSS from the Hyodo score, because DSS is a comprehensive assessment that contains anticipatory stage and food processing in the oral cavity, while the Hyodo score measures the status and functions of the pharynx and larynx.

Previous studies have reported that safe oral ingestion was possible with a Hyodo total score of ≤ 4 ,

was difficult with a total score of ≥ 9 , and that there was a high risk of aspiration with a total score of ≥ 7 [8–11]. Figure 2 shows that food and drink were rarely forbidden when the total score was ≤ 4 and that there was a high probability that thick liquid was required when the total score was ≥ 7 . However, the present results show that there was only about a 25% chance of food and drink being forbidden, even with a total score ≥ 9 . The various types of boluses should be used as needed in VE, and the staple food, side dish, and liquid after examination can be adjusted to achieve reasonable oral intake.

The present study had certain limitations. The

original method for assessing the Hyodo score recommends the use of a 3-mL bolus of liquid to be swallowed, but 4-mL boluses were administered in this retrospective study. Care must be taken in interpreting the results as they were obtained by not exactly the same method. However, when severe dysphagia is suspected, there is a higher risk of liquid aspiration, and in some cases a jelly is used [14]. An assessment scale using gelatin jelly called the Hyodo-Komagane score has been developed [15]. Thin liquids are more easily aspirated than thick liquid [16–18]; therefore, when performing VE at our institution, we generally administer a thick liquid bolus first, and in case of aspiration, a thin liquid bolus is not typically administered. In our previous study wherein VE was performed on 998 hospitalized patients, 7% of the patients had a DSS score of 1, and 31% had a score of 2 [12]; thus, the cases in the present study were clearly less severe. Thin liquids are not administered in more severe cases of dysphagia; therefore, we believe that further research is necessary to determine the Hyodo scores assessed using thick liquids or jelly. The present study was a retrospective observational study that investigated the food and drink recommended based on the VE results. Given that the diets and liquid consistencies were ultimately decided by the physician in charge at the time, they were affected by the patient's overall condition, complications, and comorbidities and do not necessarily correspond to the diets and liquid consistencies that would have been recommended based on a diagnosis of dysphagia alone. Moreover, many patients in the present study had respiratory or cerebrovascular disease, and we must consider the effects that the differences in the primary disease would have had on the results. Furthermore, the present study was only conducted at a single institution; therefore, further studies at multiple institutions are needed to standardize the results.

In conclusion, the Hyodo scores consist of observing the pharynx and larynx, and assessing the ability to swallow colored water was useful to predict the dysphagia severity as well as determine the recommended diet and liquid consistency. Further studies in multiple facilities are needed.

Acknowledgements

The authors thank Yuki Nagashima, DDS, Hidetaka Tsuzuki, DDS, PhD, Shigeru Tamura, RN, Miyo Yamasaki, RN, Ayumi Inagaki, RN, and Mayumi Ikeda, RN for their cooperation in swallowing rounds.

References

1. Sura L, Madhavan A, Carnaby G, Crary MA. Dysphagia in the elderly: management and nutritional considerations. *Clin Interv Aging* 2012; 7: 287–98.
2. Jones E, Speyer R, Kertscher B, Denman D, Swan K, Cordier R. Health-related quality of life and oropharyngeal dysphagia: a systematic review. *Dysphagia* 2018; 33: 141–72.
3. Akahori R, Kagaya H, Ozeki M, Shibata S, Aoyagi Y, Onogi K, et al. Dysphagia associated with acute-phase brainstem cerebrovascular disorder. *Jpn J Compr Rehabil Sci* 2018; 9: 43–51.
4. Colodny N. Interjudge and intrajudge reliabilities in fiberoptic endoscopic evaluation of swallowing (FEES[®]) using the penetration-aspiration scale: a replication study. *Dysphagia* 2002; 17: 308–15.
5. Giraldo-Cadavid LF, Leal-Leaño LR, Leon-Basantes GA, Bastidas AR, Garcia R, Ovalle S, et al. Accuracy of endoscopic and videofluoroscopic evaluations of swallowing for oropharyngeal dysphagia. *Laryngoscope* 2017; 127: 2002–10.
6. Dzierwas R, Warnecke T, Ölenberg S, Teismann I, Zimmermann J, Krämer C, et al. Towards a basic endoscopic assessment of swallowing in acute stroke — development and evaluation of a simple dysphagia score. *Cerebrovasc Dis* 2008; 26: 41–7.
7. Warnecke T, Ritter MA, Kröger B, Oelenberg S, Teismann I, Heuschmann PU, et al. Fiberoptic endoscopic Dysphagia severity scale predicts outcome after acute stroke. *Cerebrovasc Dis* 2009; 28: 283–9.
8. Hyodo M, Nishikubo K, Hirose K. New scoring proposed for endoscopic swallowing evaluation and clinical significance. *Nihon Jibiinkoka Gakkai Kaiho* 2010; 113: 670–8.
9. Fukuda A, Tsubuku T, Matsumura M, Furuta Y. A videoendoscopic swallowing examination using a scoring system for prediction of successful oral intake after discharge from an acute care hospital. *Nihon Jibiinkoka Gakkai Kaiho* 2014; 117: 1087–92.
10. Chiba Y, Sano D, Ikui Y, Nishimura G, Yabuki K, Arai Y, et al. Predictive value of the Hyodo score in endoscopic evaluation of aspiration during swallowing. *Auris Nasus Larynx* 2018; 45: 1214–20.
11. Kumai Y, Miyamoto T, Matsubara K, Samejima Y, Yoshida N, Baba H, et al. Determining the efficacy of the chin-down maneuver following esophagectomy with fiberoptic endoscopic evaluation of swallowing. *Arch Phys Med Rehabil* 2019; 100: 1076–84.
12. Toda F, Kagaya H, Baba M, Shibata S, Ozeki Y, Kanamori D, et al. Effect of swallowing rounds on the outcome of dysphagic patients. *Jpn J Compr Rehabil Sci* 2015; 6: 50–5.
13. Pongpipatpaiboon K, Inamoto Y, Aoyagi Y, Shibata S, Kagaya H, Matsuo K, et al. Clinical evaluation of dysphagia. In: Saitoh E, editor. *Dysphagia Evaluation and Treatment*. Singapore: Springer Nature Singapore Pre Ltd. 2018. p. 35–98.
14. Takebayashi S, Ishimaru M, Nara K, Kasai Y, Yabuuchi S, Miyoshi T, et al. Scoring by the videoendoscopic evaluation of swallowing with plural test foods. *Deglutition* 2013; 2: 220–7.
15. Sakamoto T, Horiuchi A, Makino T, Kajiyama M, Tanaka N, Hyodo M. Determination of the cut-off score of an endoscopic scoring method to predict whether elderly patients with dysphagia can eat pureed diets. *World J*

- Gastrointest Endosc 2016; 8: 288-94.
16. Ogawa M, Kagaya H, Ozeki M, Kikumura K, Shibata S, Saitoh E. The risk of laryngeal penetration or aspiration among discrete, sequential, and chew-swallowing. *Jpn J Compr Rehabil Sci* 2019; 10: 77-81.
17. Kagaya H. Differences between drinking and eating from the viewpoint of dysphagia rehabilitation. *Jpn J Compr Rehabil Sci* 2020; 11: 49-51.
18. Kuhlemeier KV, Palmer JB, Rosenberg D. Effect of liquid bolus consistency and delivery method on aspiration and pharyngeal retention in dysphagia patients. *Dysphagia* 2001; 16: 119-22.