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Feature Article

Fork test: A new simple and reliable consistency measurement for the dysphagia diet

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ABSTRACT

The objective of this study was to validate fork test which is a simple tool to assess the consistency of food. The consistencies of 27 water and thickener mixtures were measured with a viscometer. These measures were then compared to those obtained with fork test to evaluate the validity of fork test. The inter-observer and intra-observer reliabilities of the fork test were assessed with an intra-class correlation coefficient. The viscometer was used to obtain reference values for three categories (0–300 cP, 300–10,000 cP, and >10,000 cP) in order to categorize water and thickener mixtures into grade 1, grade 2, or grade 3 according to the results of fork test. Our results revealed that the fork test showed excellent validity ($r = -0.889$, $p < 0.05$), intra-observer reliability, and inter-observer reliability. Therefore, fork test may be used as a practical tool to assess food consistency.

Introduction

Oropharyngeal dysphagia is characterized by difficulty in safely transferring a liquid or food bolus from the mouth to the esophagus. It can lead to malnutrition, dehydration, aspiration pneumonia, and death.[1–4] This condition often occurs in patients with neurologic damage due to stroke or progressive neurologic diseases including Parkinson's disease[5] or cancers of the head and neck.[6] Because the incidence of diseases associated with dysphagia increases with age, dysphagia is more common in the elderly.[7]

Food texture modification is fundamental for dysphagia management.[8,9] The fast transit of thin liquids such as water, coffee, or juice can create a high rate of aspiration in some patients, particularly in those with poor motor skills who are unable to contain fluids in their mouths, those with slow or irregular pharyngeal responses, and those with compromised airways. Therefore, studies related to diet modification therapy have been focused on increasing bolus viscosity. It has been reported that increasing bolus viscosity can reduce the rate of food aspiration in patients with neurologic dysphagia.[8–11] When modifying liquids, the objective is to create a consistency that matches patient's capacity for swallowing as much as possible. Commercially available thickeners are usually used to achieve a target level of consistency.

Even though many countries have developed national standards for thickened liquids, recommended methods for fluid modification vary greatly.[12] Assessment for the viscosity of a dysphagia diet is almost universally subjective. Unfortunately, even trained medical practitioners responsible for prescribing a patient's diet have poor repeatability in terms of estimating the viscosity of therapeutic fluids.[13] Recently, a numerical quantification for the ranges of viscosity has been described as part of an effort toward standardization.[12,14] However, widespread quantitative measures of consistency are impractical at present.[15]

Different methods have been introduced to measure the consistency and classify dysphagia diet food. Paik et al[16] have suggested a line spread test as the standard for dysphagia diet categorization and recommend the following reference values for the line spread test: 1) >4 cm, 2) from 3.0 to 3.9 cm, 3) from 1.1 to 2.9 cm, and 4) <1 cm. Similar to the line spread test, Bostwick Consistometer also measures the progress of liquid flow. These methods are simple and inexpensive. However, they require some efforts and particular apparatus, which limit their widespread use.

Fork test was first introduced at the annual meeting of the European Society for Swallowing Disorders in 2011. It is a simple tool

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to measure the consistency of foods. It is based on the flow of food between the tines of a fork and the amount of food that remains on the fork. Grade 1 is used to describe food that can be scooped up with a fork, remain on the fork, and never flow between the tines. Grade 2 is for food that partially remains on the fork and partially flows between the tines. Grade 3 describes food that does not remain on the fork (Fig. 1). We believe that fork test is more convenient and practical than other methods. It will help patients and health care professionals concerned with dysphagia. However, currently there is no data regarding its validity and reliability. Therefore, the objective of this study was to determine whether fork test was valid and reliable enough to test the consistency of different food in dysphagia diet.

Material and methods

Participants

Three health care professionals (one dietitian, one occupational therapist, and one rehabilitation physician) at average age of 26.6 ± 2.1 years were recruited for the intra-observer reliability test in this study, including two males and one female. Another ten health care professionals (three dietitians, two occupational therapists, two rehabilitation physicians, and three nurses (average age of 27.8 ± 2.2 years, 3 males, 7 females)), six caregivers (average age of 53.8 ± 11.1 years, 1 male, 5 females), and four patients (average age of 55.0 ± 10.8 years, 3 males, 1 female) in the rehabilitation unit of university hospital were also recruited for the inter-observer reliability test in this study. All participants received a 5-min educational presentation of the fork test using pictures before they participated in the experiments. They were asked to scoop up the food with a fork, wait for 5 s for the fluid to hang on to the fork, and then rate one of the three grades according to the fork test. This study was approved by the University Hospital Institutional Review Board. Informed consent was obtained from every participant.

Relationship between measures taken with a viscometer and those with the fork test (validity test)

A total of 27 types water and thickener mixtures with different consistencies were prepared by adding 0–13 g of xanthan gum-based thickener (Visco-up, Rheosfood Co., Seoul, Korea) in 0.5 g increments to 300 mL of water. The viscosities of all mixtures were measured three times using a rotatory viscometer (RVDV-II, Brookfield GmbH, Lorch, Germany) at room temperature with a shear rate of 50 s^{-1}. All mixtures were also subjected to fork test one time in a blinded manner under the same environment. The results obtained from both procedures were compared to each other to assess the validity of fork test.

Application to products

Nine kinds of consistency-altering products (mayonnaise, mango pudding, mashed boiled pumpkin, honey, yogurt, tomato ketchup, diluted barium, tomato juice, and a yogurt beverage) that were easy to obtain were prepared. Their consistencies were measured using both the viscometer and the fork test. Their results were evaluated to establish their consistency with the classification system determined during the initial experiment with the 27 water and thickener mixtures described above.

Reliability test

To evaluate the intra-observer reliability of the fork test, ten different foods were prepared and tested three times at 5 min intervals in a random order by three different blinded individuals. The results from the three individuals were compared.

Four kinds of forks with different numbers of fork tines and different materials were used in this study, including a 2-tine stainless-steel fork, a 3-tine stainless-steel fork, a 4-tine stainless-steel fork, and a 4-tine disposable plastic fork. Individuals used each type of fork to test and rate ten different foods provided in random order. The intra-observer reliability in using different types of forks was analyzed.

Ten people with occupations relevant to dysphagia (health professionals) also assessed the consistencies of the ten different foods. Their results were compared to evaluate inter-observer reliability. Another ten people (patients and caregivers) also performed the same experiments. The inter-observer reliability in these patients and caregivers was then determined.

Statistical analysis

Because the measures of viscosity were continuous variables and the measures from the fork test were ordinal variables, Spearman rank correlation coefficients between the viscometer measures and the rankings on the fork test were used to determine the validity of fork test. The intra-observer and inter-observer reliabilities of the fork test were evaluated by calculating intra-class correlation coefficient (ICC). Analyses were performed with SPSS (Version 12.0; SPSS, Inc., Chicago, IL).

Results

Validity test

The relationship between the measurements obtained with the viscometer and the fork test is shown in Fig. 2. Water and thickener mixtures were categorized into grade 3, grade 2, or grade 1 by using

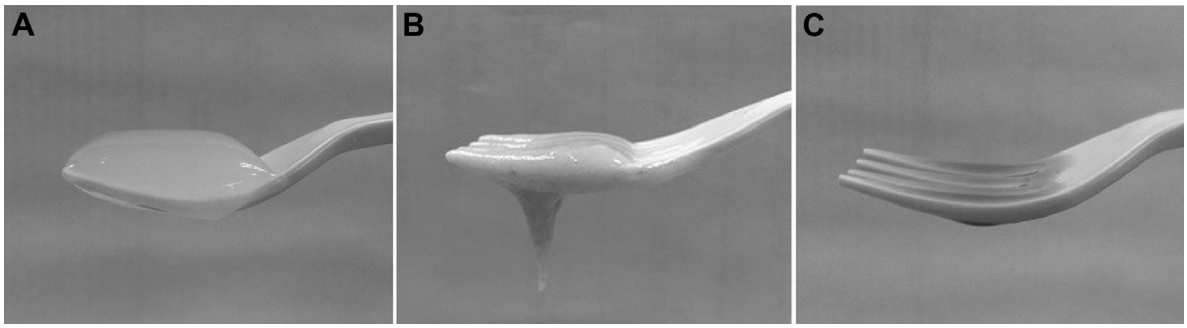

Fig. 1. The fork test. (A) Grade 1, the food remains on the fork and never flows between the tines. (B) Grade 2, some food remains on the fork and some flows between the tines. (C) Grade 3, nothing remains on the fork.