Effects of Swallowing Posture Maneuvers on Swallowing Functions

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Abstract: Occupational therapists managing subjects with feeding or swallowing problems must determine appropriate swallowing postures for feeding, while considering risks and swallowing function. Few reports have addressed associations between trunk position and swallowing function, so this study aimed to provide basic data on such associations for practical use. Noninvasive procedures were used to assess the effects of different trunk positions on swallowing functions during voluntary swallowing in 17 healthy adult women. Water bolus transport was not recognized in the laryngeal movement latency of oral phases, and was recognized in the duration of laryngeal movement of pharyngeal phases. Significant differences were recognized only for duration of laryngeal movement between the 90° and 30° trunk positions. Swallowing saliva appears to be influenced by preceding water swallowing, in addition to visual input. Decisions regarding swallowing postures the subject should take during swallowing require integrated general data, including swallowing function status of laryngeal movements, consistency, gravity and internal pressures.

Key words: swallowing posture, swallowing function, swallowing water, healthy adults

Introduction

A major role of occupational therapists (OTs) in managing subjects with feeding or swallowing problems includes providing support in holding food and feeding these patients. Moreover, following improvements in swallowing function with training, patients need to take an appropriate swallowing posture for feeding. Such swallowing postures may help to prevent aspiration in these patients. Determination of optimum swallowing posture must be made considering cervical and trunk positions. Cervical position angles of 45° (Buckley, 1976) and 20° flexion (Zimmermann, 1981) have been advocated, while trunk positions of 30° inclination (Fujishima, 1995) and 90° (i.e., upright seated position) (Zimmermann, 1981) have been described. Some reports have advocated a case-by-case approach in deciding trunk positions (Logemann, 1983). However, few studies have depicted the effects of different trunk positions on swallowing. To evaluate swallowing functions and examine treatment outcomes, we
attempted further investigation of a non-invasive method we recently established, for which the reliability and validity have already been reported (Higashijima, 2002).

Our aim was to provide basic data for practical use regarding appropriate swallowing posture for deglutition in subjects with feeding or swallowing problems. The present study used our noninvasive method to investigate the effects of different trunk positions on swallowing functions during voluntary swallowing in healthy adults.

Literature Review

Postural maneuvering for swallowing is a compensatory technique employed during feeding training. After 3 weeks of applying compensatory methods, the need for functional training is re-evaluated (Logemann, 1983). Swallowing postural maneuvering is for patients who display trouble transporting a bolus. In other words, swallowing postural maneuvering is appropriate for patients experiencing difficulty during the oral phase of swallowing. Such methods use gravity to overcome difficulties in transporting the bolus. In a physiological sense, this oral phase of swallowing involves a voluntary first half and a reflexive second half, continuous with the reflexive (involuntary) pharyngeal phase. An appropriate swallowing posture is determined based on swallowing function, physiological mechanisms and anatomical characteristics. We examined different cervical position angles and angles of trunk position to determine appropriate swallowing postures. General consensus agrees that cervical position angle should display slight flexion (Ekeng, 1986; Saitou, 1987; Fujishima, 1995), but many opinions seem to suggest that trunk positions should be decided on a case-by-case basis (Zimmerman, 1981; Fujishima, 1995; Logemann, 1983). This could explain the paucity of evidence-based studies addressing variations in trunk positions in relation to swallowing functions.

Method

Subjects

Students in the third year of an Occupational Therapy course at Kawasaki Medical Welfare University were given background information on the proposed study, and were then allowed to apply to be a subject in the study. The study protocol was explained verbally to all participants and written documentation was provided. Informed consent was then obtained from 17 healthy Japanese women with a mean age of 22.4 ± 2.2 years (range, 21–24 years). Subjects did not have a past history of swallowing disorders associated with respiratory or neuromuscular disease.

Apparatus

Subjects were familiarized with the experiment protocol, after which 3 sensors were attached. Furthermore, the subject took a pre-test swallowing of water.

The TR-751T respiration pickup sensor (Nihon Kohden, Tokyo, Japan) was placed to monitor respiratory movements of the chest wall. An MP100 transducer (AD Instruments, USA) was attached at the thyroid cartilage to record back-and-forth movements of the thyroid cartilage during swallowing. A TR-762 thermistor respiration pickup sensor (Nihon Kohden) was placed in the left nasal cavity of each subject to monitor nasal airflow and temperature differences between inspired and expired air. Three sensors were used to identify organic movement change and movement persistence while not determining amplitude.

Subjects with the 3 sensors attached were instructed to sit on an extension-type reclining wheelchair for which trunk positions could be adjusted. Cervical position angle was always kept at a constant 20° flexion (Fig. 1).

Procedure

To limit assessment to swallowing function during the oral and pharyngeal phases while excluding masticatory function during the preparatory phase, subjects were instructed to swallow water. To investigate differences in swallowing function with and without water, subjects were also instructed to swallow air.

The procedure was performed in a room at a constant temperature of 23°C, and involved
injection of 10 ml of water at 10°C into the oral cavity of each subject. Subjects were instructed to keep this liquid in the mouth until a red lamp signal (trigger) was seen. When the chart recorder indicated the end of an expiratory phase of respiratory movement, the red lamp signal was given to the subject to completely swallow the water bolus. After this, resumption before a trigger of respiratory movement wave on the chart recorder was confirmed. After confirmation, since two-wave respiratory movement was over on the chart recorder, a signal to swallow air (saliva) was given when subject indicated the end of the expiratory phase again. Water swallowing was performed 3 times. This experimental procedure was repeated with different trunk positions of 90° (seated upright), 60°, and 30° flexion. The subject rested for 15 min with every change of trunk position.

Data analysis

Data were recorded during the procedure using both a chart recorder and a digital audio tape recorder (sampling rate, 100 mm/s). At a later date, these data were read by a computer using a Power Lab data analysis system (AD Instruments, USA), and analyzed using Chart version 4.0 software (AD Instruments). During water bolus and air bolus swallowing, 4 parameters were compared between trunk positions (Fig. 2): time interval from red lamp signal (trigger) to start of thyroid cartilage movement (laryngeal movement latency; Fig. 2a); duration of thyroid cartilage movement (duration of laryngeal movement; Fig. 2b); duration from lamp signal (trigger) to end of air ventilation (apnea latency; Fig. 2c); and duration of apnea (Fig. 2d). Analysis was performed using one-way analysis of variance (ANOVA) followed by post hoc Tukey test. The level of statistical significance was set at P<0.05 unless otherwise noted.

Results

Swallowing of water bolus

Mean values (± standard deviation) of the 4 parameters recorded during swallowing of the water bolus for the 3 trunk positions are shown in Fig. 3.

Significant differences in duration of laryngeal movement were recognized only between the 90° (2.21 ± 0.57 s) and 30° (1.72 ± 0.41 s) trunk positions (F=3.877, P<0.05).

Swallowing of air (saliva)

Mean values (± standard deviation) of the 4 parameters recorded during swallowing of saliva in the 3 trunk positions are shown in Fig. 4.

Significant differences in duration of laryngeal movement were recognized between the 90° (2.16 ± 0.58 s) and 30° (1.61 ± 0.47 s) trunk positions and between the 90° (2.16 ± 0.58 s) and

Fig. 1. 3 sensors attached to subject
60° (1.69 ± 0.41 s) trunk positions (F=6.128, P<0.05).

Discussion

Swallowing of water bolus

Water bolus transport was not recognized in the laryngeal movement latency of oral phases, and was recognized in the duration of laryngeal movement of pharyngeal phases. Significant differences were recognized only for duration of laryngeal movement between 90° and 30° trunk positions.

In the past, bolus transport has been viewed as a function of the oral phase (Ekbeng, 1986; Saitou, 1987; Fujishima, 1995; Zimmerman, 1981; Logemann, 1983). However, the results were reflected in duration of laryngeal movement, not laryngeal movement latency (Fig. 2). As suggested by Saitou (1987) and Logemann (1983), this could be because the bolus taken comprised of non-viscous water. Dodds et al. (1989) reported that when subjects were instructed to hold food in their mouth and swallow on a signal, some subjects held food at the bottom of the oral cavity (dipper type), while others held food on the tongue (tipper type). In this study, subjects were instructed to hold food in the mouth and swallow on a signal. Differences in laryngeal movement latency may thus have resulted from subjects holding the water in a different place to where they held food. Furthermore, apnea latency was shortened for the 30° trunk position compared to the 90° trunk position. Some water may thus have flowed down the pharynx while the subject waited for a signal. Water bolus transport was thus not recognized in the laryngeal movement latency of oral phases.

Significant differences were recognized only for duration of laryngeal movement between 90° and 30° trunk positions.

Yamada (2001) reported that in terms of bolus transport, negative pressure caused by relaxation of the inferior constrictor muscles of the
pharynx draws the bolus from the large pharyngeal entrance to the small pharyngeal exit facilitating transport through the esophagus. Fujishima (1995) reported the influence of gravity on transport. Both pharyngeal and esophageal phases receive equal influence with 90°C trunk posture, but the pharyngeal phase was accelerated in the 30°C trunk position and the esophageal phase was unaffected. Kogoe (1995) examined swallowing posture using ultrasonography, finding that a lowered trunk position during swallowing facilitates bolus transport through the pharynx and increases length of the soft palate, but increases the risk of aspiration.

In future, decisions regarding which swallowing postures a subject should take during swallowing will require integration of general data, including functional status of the pharynx,
organic position, gravity, internal pressure, consistency and volume of the food bolus.

**Swallowing of saliva**

Similar results were recognized for laryngeal movement during water swallowing. Swallowing of saliva in this study appears to have been influenced by activity of the earlier deglutition of the water bolus.

Leopold (1983) stated that this early phase allows determination of safe bolus volume and programming of the swallowing reflex based on previous feeding experiences. Ekberg (1986) reported greater activity in the limbic system and cerebral cortex during this early phase of swallowing as compared to other stages. Sumi (1972) stated that reverberating circuits are formed between the reticular formation and cerebrum, and diverse sensory information is processed and relayed to the cerebrum, resulting in activation. In that study, subjects were instructed to swallow water and then air. Given the above-mentioned reasons, the study was influenced by the following 3 systems: a stereotypical organoleptic limbic system informing the body that swallowing is safe under the same conditions as swallowing 10 ml of water (certain shape swallowing movements that were induced by sensory input, and this partially overlaps the brainstem system); a sensory-motor field neocortical system based on cognitive behaviors for external stimuli (swallowing movements based on discriminating behaviors for sensory stimuli); and a brainstem system forming the basic reflexive circuit for eating behaviors (Michael, 1996). In addition, Bach-y-Rita (1980) used a sensory-motor field neocortical system as described by Michael (1996) and similarly reported that while some neurological mechanisms, such as respiration, are reflexive and do not require much learning or experience, other neurological mechanisms, such as swallowing during the oral and laryngeal phases, are designed to incorporate new programming in the short term. Since subjects in the present study were healthy individuals, this theory may have played some role. Furthermore, an explanation for discrepancies between water and air swallowing between the present study and previous investigations could be that visual information regarding “no food presence” plays a dominant role.

The first reason for setting a swallowing posture in clinical situations is to allow consistent comparison of bolus swallowing parameters with reference to trunk angle. The second reason is in consideration of the degrees of oral and pharyngeal dysfunctions. Appropriate evaluation of swallowing function and swallowing posture settings on the basis of test results will help to prevent aspiration in clinical situations.

**Conclusions**

Using non-invasive investigative methods, we analyzed the effects of different body postures on swallowing functions during swallowing in healthy adults. Water bolus transport did not affect laryngeal movement latency of oral phases, but did affect duration of laryngeal movement of pharyngeal phases. Significant differences were recognized only for duration of laryngeal movement between 90° and 30° trunk positions. Swallowing of saliva seems to be influenced by preceding swallowing dynamics and information from visual input. Decisions on trunk position during swallowing should be made on the basis of swallowing function, bolus consistency and gravity. In future, we would like to investigate relationships between body position and bolus consistency using the same parameters used in this study.

**References**


