

Influence of Manual Facilitation Technique on Swallowing Disorder and Aspiration Pneumonia Caused by Severe Dysphagia with Stroke

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Abstract. [Purpose] The aim of this study was to examine the effects of the manual facilitation technique (MFT) on swallowing and prevention of aspiration pneumonia in patients with severe dysphagia following stroke, who receive tube feeding because of their inability to respond to verbal commands. [Subjects] The subjects were three patients diagnosed with quadriplegia and severe dysphagia as well as a history of aspiration pneumonia. [Methods] MFT to the larynx after oral sensory treatment was performed for 20 minutes, daily, for the two weeks. For MFT to the larynx, the Mendelsohn maneuver after deep sense stimulation of the larynx was performed. To find out the effect of the MFT, saliva swallowing frequency and the development of aspiration pneumonia were recorded. [Results] None of the subjects were able to perform saliva swallowing before the treatment, but all were able to during the treatment. Also, saliva swallowing frequency was increased in the treatment period (Subject 1: 3.79 times on average, Subject 2: 4.93 on average, Subject 3: 5.71 times on average). [Conclusion] Our results show that MFT to the larynx after oral sensory treatment improved the function of saliva swallowing and had a positive effect on preventing aspiration pneumonia relapse in severe dysphagia patients with inability to respond to verbal commands. **Key words:** Dysphagia, Aspiration pneumonia, Manual facilitation technique

(This article was submitted Apr. 12, 2012, and was accepted May 15, 2012)

INTRODUCTION

The frequency of dysphagia developing in stroke patients is variously reported to be between 51–73%, 20–30% of these patients have severe dysphagia patients, who must receive tube feeding^{1, 2)}. Especially, patients who cannot swallow successfully suffer frequent relapse of aspiration pneumonia among those with severe dysphagia³⁾. Research into dysphagia treatments has mainly been conducted on patients capable of responding to verbal commands, and has focused on the swallowing reflex facilitation techniques, sensory stimulation techniques, and techniques to strengthen the functions of the tongue, pharynx and larynx³⁾.

The swallowing reflex has successfully been facilitated by simultaneously applying cold stimulation to the anterior faucial arch, and 10% ReaLemon on the anterior faucial arch and tongues of patients capable of obeying verbal commands⁴⁾. Also, the simultaneous application of cold stimulus, 100% ReaLemon and dynamic stimulus to the anterior faucial arch has facilitated the swallowing reflex successfully⁵⁾.

Regarding the sensory stimulation technique, electrical stimulation at the motor level applied to the suprahyoid muscle and infrahyoid muscle of stroke patients capable of responding to verbal commands to enhance the swallowing responses⁶⁾. The swallowing response was also improved by providing the same regions with electrical stimulation at a

level at which sensory stimulation could be felt (80 Hz, 700 μ sec)⁷⁾.

There have been reports of techniques that reduce aspiration by strengthening the pharyngeal and laryngeal functions, which play an important role in the process of swallowing, and the Mendelsohn maneuver. Lazarus et al. performed the Mendelsohn maneuver, and supraglottic swallowing and super-supraglottic swallowing techniques for laryngeal cancer patients capable of responding to verbal commands, and reported that the Mendelsohn maneuver was more effective at aspiration reduction than the supraglottic swallowing and super-supraglottic swallowing techniques⁸⁾.

However, these studies of the swallowing reflex facilitation technique, laryngeal sensory stimulation and Mendelsohn maneuver technique were performed with cognitive subjects who were capable of responding to verbal commands, and appropriate techniques to facilitate the swallowing reflex of patients suffering from severe dysphagia who are incapable of responding to verbal commands have not yet been developed⁹⁾.

Won and Jung performed the manual facilitation technique (MFT) on the larynx, deep sense stimulation of the larynx and the Mendelsohn maneuver, after 20 minutes of thermal-tactile stimulation for 1 subject with severe dysphagia who was incapable of responding to verbal commands. After the intervention, the saliva swallowing frequency increased 7.2 times compared to before the inter-

vention¹⁰⁾. However, information regarding the recurrence of aspiration pneumonia in patients with severe dysphagia was not provided in their study.

The purpose of this study was to investigate whether it is possible to prevent relapse of aspiration pneumonia in patients with severe dysphagia by inducing successful saliva swallowing through the application of MFT to the larynx after oral sensory treatment.

SUBJECTS AND METHODS

Three stroke inpatients of a hospital in Bucheon, South Korea, were recruited. The inclusion criteria were as follows: less than 3 month history of dysphagia; receiving tube feeding; inability to respond to verbal commands; ability to respond to oral sensory stimulation applied through laryngeal mirror or tongue depressor; no history of sensory stimulation of the larynx; at least 2 occurrences of aspiration pneumonia; and currently without aspiration pneumonia. The study was performed after informing the patients' guardians of the research methods and obtaining their consent. All subjects were receiving occupational and physical therapy 6 times a week, such as functional electrical stimulation, tilt table, sensory stimulation treatment and passive range of motion treatment.

This study was a single subject design with multiple baseline measurements. The experiment was divided into two phases: baseline phase and treatment phase. In the baseline phase, subjects were seated in the correct posture in wheelchairs and the postural tone of the neck was adjusted. The saliva swallowing frequency was measured for 20 minutes by one therapist and two observers and diagnosis of aspiration pneumonia was made by a doctor based on the nursing record and observation by guardians and nurses. Subject 1 was measured once a day everyday for three days; subject 2 was measured once a day for four times during a 5-day period; and subject 3 was measured once a day, four times, during a 7-day period in accordance with the multiple-probe design. In the treatment phase, subjects were seated in the correct posture in wheelchairs and the postural tone of the neck was adjusted. The saliva swallowing frequency was measured for 20 minutes by one therapist and two observers and diagnosis of aspiration pneumonia was made by a doctor based on the nursing record and observation by guardians and nurses. Subjects 1, 2 and 3 were all observed once a day, everyday, for 14 days.

Oral sensory stimulation and MFT to larynx were performed in parallel. The Mendelsohn maneuver was performed after deep sense stimulation of the larynx through performance of the MFT on the larynx as follows. The researcher applied strong palpitation (patients should not feel pain) on the digastric muscle-anterior belly and the thyrohyoid muscle from the back using the index, middle and ring fingers of both hands, and stimulated from the bottom to the top for 20 seconds. The frequency of saliva swallowing was measured. If swallowing did not occur during the 20 seconds stimulation, the pooled saliva was removed by suction. If swallowing did occur, swallowing was allowed for a few seconds using the Mendelsohn

maneuver and then the larynx was slowly lowered⁸⁾. As the subjects cannot use the Mendelsohn maneuver on their own to continue swallowing, the researcher held the subject's thyroid cartilage with his fingers to allow the swallowing process to continue for 3 seconds. A break was taken for 1 minute before providing stimulation again. The treatment procedure was as follows: correct posture in the wheelchair; postural tone control – neck; oral sensory treatment (simultaneous cold sour stimulation with 50% ReaLemon at 4 °C and thermal-tactile stimulation on the tongue base with a tongue depressor, which had been frozen after being dipped in 50% ReaLemon; manual facilitation technique performed on the larynx (Mendelsohn maneuver performed after deep sense stimulation of the larynx).

To assess the swallowing and aspiration pneumonia, salivary swallowing frequency and aspiration pneumonia development were recorded. For saliva swallowing frequency, the therapist recorded the frequency of successful swallowing out of 13 attempts during 20 minutes, and he was observed by 2 observers with more than 3 years of experience in dysphagia therapy. Proper saliva swallowing was designated as hyolaryngeal excursion occurring without choking during 20 seconds of deep sense stimulation to the larynx. Hyolaryngeal excursion refers to the upper and frontal movement of the hyoid and pharynx during saliva swallowing, which causes the cricopharyngeal muscle to open and allow saliva to enter the esophagus³⁾. To guard against the development of aspiration pneumonia, abnormal findings (phlegm, cough, respiration problem) discovered in the body temperature test (4 measurements taken in the course of a day at 5:00 a.m., 11:00 a.m., 5:00 p.m., and 11:00 p.m.), performed by nurses and during the 24 hours observation by guardians and nurses, were investigated by chest X-ray and a doctor gave the final diagnosis¹¹⁾.

In this study, the findings of the research were compared and analyzed using through graphs and mean values. The saliva swallowing frequency was analyzed by comparing the values of the baseline and the treatment periods, and aspiration pneumonia development during the baseline and treatment periods was also analyzed.

Before conducting this research, in order to increase the reliability of the records, 2 observers with more than 3 years of experience in dysphagia therapy and the therapist recorded the saliva swallowing of a patient who was not a subject of this study. Training was complete only after the therapist and the 2 observers were in at least 90% agreement regarding the saliva swallowing of the patient.

The three observers showed an average of 91% agreement in the measurements recorded during the 3 observations before participating in this study. During the baseline phase of the study, they showed 91% agreement for subject 1, 90% agreement for subject 2 and 94% agreement for subject 3, and showed 93% agreement for subject 1, 91% for subject 2 and 90% for subject 3 during the treatment period.

RESULTS

The general characteristics of the subjects are shown in Table 1. The saliva swallowing frequency of the subjects

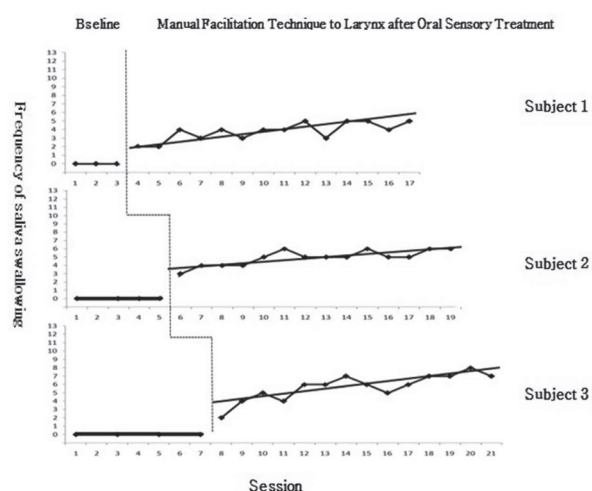


Fig. 1. Changes in the frequency of saliva swallowing in the baseline and treatment periods

out of 13 attempts during 20 minutes in the baseline period is shown in Table 2. The changes in the saliva swallowing frequency showed an accelerating trend during treatment, and the improvement in the saliva swallowing continued in the later period (Fig. 1). There was no saliva swallowing observed in a total of 13 attempts prior to treatment; however, there was an improvement in the frequency of saliva swallowing during the treatment to an average of 3.79 among the first 13 trials, and from the 14th attempt, an average of over 4 saliva swallowings was maintained.

None of the subjects developed aspiration pneumonia

during the baseline and treatment periods (Fig. 2). All subjects had signs of phlegm, coughing and difficulty in breathing as observed by nurses in the initial period of treatment; however, no abnormal findings were found in the body temperature tests, therefore chest X-rays were not taken. In the later period, there were no abnormal findings detected in the body temperature tests or observation records.

DISCUSSION

In this study, oral sensory treatment, using thermal-tactile stimulation, and MFT to the larynx were performed for 3 patients with severe dysphagia who were incapable of responding to verbal commands, and induced swallowing successfully as well as preventing aspiration pneumonia development in these patients.

When MFT was performed on the larynx after oral sensory treatment, the subjects who could not swallow prior to treatment able to swallow during the treatment period (Subject 1, 3.79 times on average; Subject 2, 4.93 on average; Subject 3, 5.71 times on average), and showed improvement in the frequency of saliva swallowing in the later period with the frequency of successful swallowing reaching 5–7. These results support the findings of the Hamdy's study, which concluded that performing both thermal-tactile stimulation and cold, sour stimulation techniques can modulate the speed and amount of swallowing⁴, and Ostry's study, which concluded that stimulation of the muscle spindle and the stretch reflex can facilitate muscle contraction¹².

Unlike Freed et al. and Ludlow et al. who stimulated the digastric and thyrohyoid muscles by electrical stimulation, in this research, the researcher applied quick and strong palpitation using his fingers on the digastric muscle-anterior belly

Table 1. General characteristics of subjects

	Subject 1	Subject 2	Subject 3
Gender	Male	Male	Female
Age	65	63	59
Type of Stroke	Infarction (Pontine)	Hemorrhage (Midbrain)	Infarction (Middle cerebral artery)
Diagnosis	Quadriplegia	Quadriplegia	Quadriplegia
Onset Period (Month)	2	2	2
G C Sa	8	8	9
MMSE-K b	0	0	0
Feeding Type	NG tube	NG tube	NG tube
Frequency of aspiration pneumonia prior to the study	2	2	2

^a Glasgow Coma Scale, ^b Mini Mental State Examination (Korea)

Table 2. Saliva swallowing frequency in the baseline period

Subject	Baseline	Treatment
	Average (range)	Average (range)
1	0 times / 13 attempts	3.79 times / 13 attempts (2~5)
2	0 times / 13 attempts	4.93 times / 13 attempts (3~6)
3	0 times / 13 attempts	5.71 times / 13 attempts (2~8)

(unit: # of times)

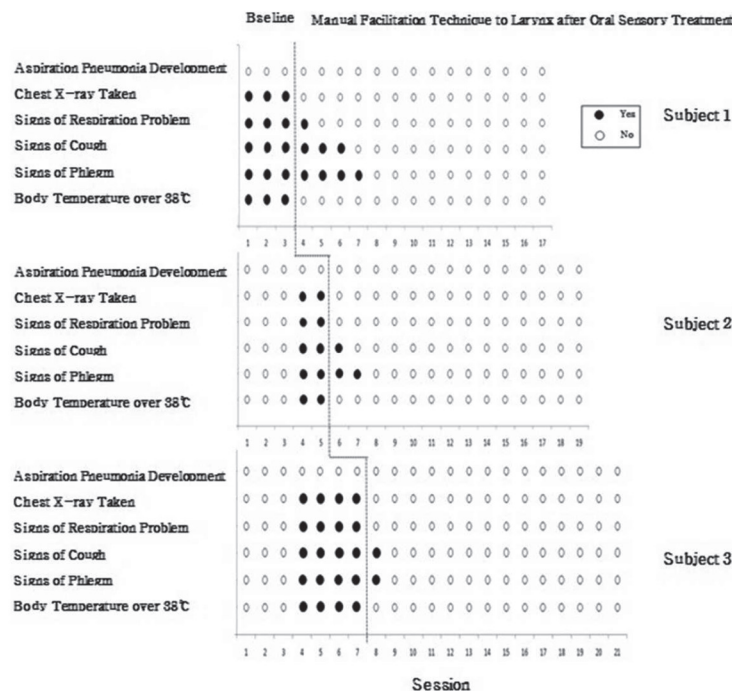


Fig. 2. Development of aspiration pneumonia in the baseline and treatment periods

and the thyrohyoid muscle to induce saliva swallowing^{6, 7)}. Under the assumption that weak stimulation, such as electric stimulation, of the laryngeal muscles cannot induce saliva swallowing in patients with severe dysphagia who are incapable of responding to verbal commands, the researcher allowed the patients to feel movement through deep sense stimulation of the larynx, and induced saliva swallowing by stimulating the primary phasic stretch reflex through quick up and down movements^{12, 13)}.

Deep sense stimulation of the larynx was done to allow the patient to feel the movement by stimulating the proprioception of the joint capsule, and the primary phasic stretch reflex was induced to stimulate the digastric muscle-anterior belly and the Ia afferent fiber of the thyrohyoid muscle into saliva swallowing^{12, 13)}.

It has been reported that aspiration pneumonia develops regularly in 44% of dysphagia patients; however in our study, aspiration pneumonia did not recur in any of the three subjects with severe dysphagia before and during treatment. Our success in preventing aspiration pneumonia relapse is owed to the fact that successful saliva swallowing was induced by the Mendelsohn maneuver after inducing swallowing through oral sensory treatment and deep sense stimulation of the larynx. These results support the findings of the Boden's and Lazarus's studies^{8, 14)}, which concluded that the Mendelsohn maneuver is effective at reducing aspiration, and Hardy's and Meningaud's studies^{3, 15)}, which concluded that aspiration pneumonia develops when patients with severe dysphagia cannot properly swallow the produced saliva.

Phlegm, cough and respiration problems reported in the

nurses' observation records before and in the initial period of treatment did not occur in the later period. Phlegm, cough and respiration problems seen prior to treatment are thought to have occurred because the saliva that was not swallowed penetrated the laryngeal vestibule. Phlegm, cough and respiration problems seen in the initial period of treatment are thought to have occurred because even if saliva was swallowed through deep sense stimulation of the larynx, the pharyngeal and laryngeal muscles were too weak and the saliva remaining in the pharynx refluxed into the larynx resulting in penetration of the laryngeal vestibule. However, the pharyngeal and laryngeal muscles were strengthened through continuous application of the Mendelsohn maneuver and penetration is thought to have no longer occurred in the later period of treatment.

Hardy et al. reported that a delay in swallowing can cause saliva to accumulate leading to penetration of the laryngeal vestibule or aspiration, and even if saliva swallowing does occur, weak pharyngeal and laryngeal muscles can cause saliva to accumulate in the pharynx leading to penetration of the laryngeal vestibule or aspiration³⁾. Also, the reason signs of phlegm and cough in Subjects 2 and 3 were less significant than in Subject 1 in the initial treatment period is thought to be because the potential swallowing abilities of Subjects 2 and 3 were higher than that of Subject 1 from the fact that the frequencies of saliva swallowing of Subjects 2 and 3 were higher than that of Subject 1.

The findings of this study suggest the possibility of treatment for the prevention of aspiration pneumonia relapse in patients with severe dysphagia who are incapable of responding to verbal commands. They show that a

combination of oral sensory treatment and deep sense stimulation of the larynx can improve the success rate of saliva swallowing in patients with severe dysphagia who are incapable of responding to verbal commands and this in turn prevents relapse of aspiration pneumonia. Considering that 44% of patients with severe dysphagia who receive tube feeding suffer from aspiration pneumonia, we think that aspiration pneumonia in such patients could be prevented by a combination of oral sensory treatment and MFT to the larynx.

This study had some limitations in terms of selection criteria, saliva swallowing evaluation and research methods. First, one of the selection criteria required severe patients with a history of at least 2 occurrences of aspiration pneumonia; thus, the experiment was conducted with severe stroke patients within two months of onset of stroke, before the initial functional recovery. Therefore, there is a need to conduct a research on subjects whose onset of stroke is over 6 months and increase the number of subjects. Second, the saliva swallowing evaluation was observed with the naked eye based on an operational definition, and the effects of the treatment were not verified through objective assessments such as sonography or MRI. If the hyoid bone movement is analyzed using sonography, and verification techniques such as plasticity checks with MRI are added to future studies of swallowing treatment and prevention of aspiration pneumonia, it is expected there will be active research in this field.

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