



Original Article

# Effect of simultaneous application of postural techniques and expiratory muscle strength training on the enhancement of the swallowing function of patients with dysphagia caused by parkinson's disease

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**Abstract.** [Purpose] This study aimed to investigate the effect of simultaneous application of postural techniques and expiratory muscle strength training on the enhancement of the swallowing function of patients with dysphagia caused by Parkinson's disease. [Subjects and Methods] The subjects of this study were 18 patients who received simultaneous application of postural techniques and expiratory muscle strength training and 15 patients who received expiratory muscle strength training only. Postural techniques were conducted in the order of chin tucking, head rotation, head tilting, bending head back, and lying down, while expiratory muscle strength training was conducted at a resistance level of about 70% of the maximal expiratory pressure. Swallowing recovery was assessed by using the Functional Dysphagia Scale based on videofluoroscopic studies. [Results] The mean value obtained in the videofluoroscopic studies for both groups decreased after the treatment. In the postural techniques plus expiratory muscle strength training group, the decrease was significantly greater than that in the expiratory muscle strength training-only group. [Conclusion] The results imply that simultaneous performance of postural techniques and expiratory muscle strength training is more effective than expiratory muscle strength training alone when applied in the swallowing rehabilitation for patients with dysphagia caused by Parkinson's disease.

**Key words:** Parkinson's disease, Expiratory muscle strength training, Dysphagia

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## INTRODUCTION

From a functional perspective, the swallowing process is composed of 3 phases, namely the oral, pharyngeal, and esophageal phases. In general, dysphagia caused by neurological disorders is frequently caused by problems in the pharyngeal phase<sup>1)</sup>. The pharyngeal phase is defined as the process from pharyngeal swallowing to complete passage of food boluses through the upper esophageal sphincter.

In cases of epiglottal folding, the closure of the vocal cord and laryngeal vestibule is incomplete in the esophageal phase; thus, aspiration or penetration, which is the passage of food boluses through the pharynx, can occur. Severe cases can lead to aspiration pneumonia. Thus, in order to prevent aspiration pneumonia and achieve safe swallowing, optimum intervention strategies that consider the symptoms of dysphagia are required.

Especially, as unlike stroke, neurodegenerative diseases such as Parkinson's disease worsen dysphagia with disease progression, regular diagnosis and rehabilitation are required for the rest of the patient's life. Hence, for successful rehabilitation of swallowing function in Parkinson's disease, a transdisciplinary approach is critical, in which physicians, nurses, physical

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therapists, speech pathologists, and nutritionists make decisions in a cooperative manner<sup>1</sup>.

Compensation techniques such as postural techniques and maneuver have been generally conducted as swallowing rehabilitation interventions<sup>2</sup>. These compensation techniques (e.g., postural techniques) have been verified to be significantly effective for the enhancement of swallowing function by many studies<sup>3, 4</sup>.

Recently, expiratory muscle strength training (EMST) was reported to be effective for swallowing rehabilitation in patients with Parkinson's disease<sup>5, 6</sup>. EMST is a treatment intervention for patients with functional disorders of the respiratory system that are caused by weakening of respiratory muscles. It not only enhances respiratory functions but also postpones the outbreak of complications of the respiratory system<sup>5</sup>.

Respiration is an essential condition for optimum swallowing. The respiratory system is composed of the respiratory tract, lungs, expiratory muscles, and thoracic cage, and plays a role in the inhalation of oxygen from the air and exhalation carbon dioxide produced by energy metabolism<sup>7</sup>. In particular, both inspiration and expiration are performed by the movements of the diaphragm, respiratory muscles, and thoracic cage. Inspiration is performed by active movement, while expiration is performed by passive elastic recoil<sup>8</sup>. The elderly generally not just emit less amount of air because of decreased lung capacity but also have to inspire more often to supply adequate amount of oxygen for the body<sup>7</sup>.

In addition, in old age, the possibility of ultimate decline in the function of closure of the vocal cord is high owing to crevice in the larynx or "distinct glottal arrowhead," which is the bending of the vocal cords<sup>9</sup>. As structural changes such as these can have adverse effects on the swallowing function in old age, strengthening of respiratory function in swallowing rehabilitation is crucial<sup>10</sup>.

Especially in patients with Parkinson's disease, respiratory problems stand out because of gradual rigidity of expiratory muscles<sup>11</sup>. With the progression of Parkinson's disease, the movements of the diaphragm and abdominal muscles become abnormal<sup>12</sup>, which eventually affects both expiration and inspiration<sup>13</sup>. Therefore, strengthening of the expiratory muscle is required for optimum swallowing rehabilitation. Nevertheless, studies on the respiration in Parkinson's disease have mainly focused on the characteristics of respiration in the disease<sup>14</sup>, while only a few studies have been conducted on the relationship between the strengthening of expiratory muscle and swallowing function.

This study investigated the effect of simultaneous application of postural techniques and EMST on the enhancement of the swallowing function of patients with dysphagia caused by Parkinson's disease.

## SUBJECTS AND METHODS

The participants of this study were 33 patients with dysphagia caused by Parkinson's disease who attended the rehabilitation departments of 2 general hospitals in Seoul and Incheon between September 2014 and February 2015. The criteria for subject selection were as follows: first, those who had aspiration or penetration discovered in the pharyngeal phase; second, those without problems in the oral phase, such as chewing; third, those without respiratory diseases such as pneumonia or asthma; fourth, those without cognitive problems with Mini-Mental State Examination-Korean version scores of >24; fifth, those who can communicate; sixth, those without facial paralysis; seventh, those without moderate or severe hypertension (systolic hypertension of  $\geq 160$  mm Hg and diastolic hypertension of 100 mm Hg). This study was approved by the institutional review board and was conducted in accordance with the ethical standards of the Declaration of Helsinki. The subjects were given sufficient explanation regarding the purpose and experimental method of this study before participation and provided voluntary consent. All the subjects were randomly assigned into a EMST-only (n=18) and a "postural techniques plus EMST" group (n=15) by using the table of random numbers. The characteristics of the participants are presented in Table 1.

Postural techniques were conducted in the order of chin tucking, head rotation, head tilting, bending head back, and lying

**Table 1.** Characteristics of the study participants

Variables	EMST (n=18)	EMST+PT (n=15)
Age (years)	63.8 $\pm$ 8.2	65.1 $\pm$ 9.5
Gender, n (%)		
Male	16 (88.8)	15 (100)
Female	2 (11.2)	0 (0)
H-Y stage, n (%)		
$\leq 3$	15 (83.3)	11 (73.3)
$> 4$	3 (16.7)	4 (26.7)
VFS	35.1 $\pm$ 13.5	33.5 $\pm$ 12.8

Data are presented as mean  $\pm$  SD.

\*p<0.05

EMST: expiratory muscle strength training; PT: postural techniques; H-Y stage: Hoehn and Yahr stage; VFS: functional dysphagia scale based on videofluoroscopic studies

down straight for 30 minutes per session and 5 days a week for 4 weeks<sup>15, 16</sup>).

EMST 150 (Aspire Products, Gainesville, USA) was used as the EMST device. By referring to preceding studies<sup>6</sup>), the procedure was conducted as follows: first, in order to block air passage through the nasal cavity of the subject, the nasal cavity was closed by tweezers; second, the subject held a mouthpiece in the mouth, and performed inspiration and expiration as fast and strong as possible through the oral cavity; third, after performing maximum inspiration followed by maximum expiration 8 times in succession, the subject rested for 30 seconds; fourth, this procedure was conducted for 20 minutes. By referring to preceding studies, the threshold value of resistance of EMST was set at 75% based on maximum expiratory pressure. EMST was conducted 20 minutes a day and 5 days a week for 4 weeks.

Swallowing recovery was assessed by rehabilitation physicians who did not participate in the study by using the Functional Dysphagia Scale and based on videofluoroscopic studies (VFS)<sup>17</sup>. The VFS scale is used to identify overall swallowing problems such as aspiration observed in videofluoroscopic swallowing studies (VFSS) and is composed of a total of 100 points. The higher the VFS scale score, the more severe the problem in swallowing function. At the time of its development, the VFS test had a sensitivity of 82–81% and a specificity of 70.7–92%<sup>17</sup>).

For analysis, first, a preliminary homogeneity test was conducted with the independent sample t test or chi-square test and, second, pre-post efficiency test was conducted with a paired-sample t test. SPSS 23.0 (IBM Inc., Chicago, IL, USA) was used for the analysis, with a significance level of 0.05.

## RESULTS

The results of the independent t test and chi-square test for homogeneity of age, gender, Y-H stage, and mean VFS scale scores in the EMST-only and combined intervention groups indicated no significant difference in all the items (Table 1).

The result of the paired t test showed a decrease in mean VFS scale score for both groups after the treatment. The decrease in the combined intervention group was significantly greater than that in the EMST-only group (Table 2).

## DISCUSSION

In this study, EMST significantly enhanced the swallowing function of dysphagia caused by Parkinson's disease. Like this study, preceding studies verified the enhancement of swallowing functions, such as reduction of aspiration and opening of the upper esophageal sphincter that result from EMST for patients with Parkinson's disease<sup>6</sup>). Especially EMST positively affected the vitalization of the suprahyoid muscle<sup>18</sup>).

The suprahyoid muscle protects the airway by raising the hyoid bone and plays the role of supporting safe swallowing by the opening cricopharyngeus muscle. Dysphagia caused by neurological problems such as Parkinson's disease weakens the suprahyoid and cricopharyngeus muscles. EMST was verified to enhance the pharyngeal swallowing function by strengthening swallowing muscles such as the suprahyoid muscle<sup>18</sup>).

In this study, the combined intervention group had a significantly higher enhancement of swallowing function than the EMST-only group, which is deemed to be the result of the synergic effect of the two treatment modalities. Postural techniques such as lowering the chin are performed to complement structural and physiological defects by changing the direction of food boluses going down or the area of the pharynx by adjusting posture rather than strengthening the muscles themselves<sup>1</sup>). These postural techniques have been reported to be effective for the swallowing rehabilitation of patients with dysphagia who have limited movements of the tongue base or have weakened laryngeal raise<sup>2</sup>). On the other hand, EMST is a muscle training method that uses resistance and is effective for vitalization of swallowing muscles and raising the larynx<sup>18</sup>). In summary, simultaneous application of postural techniques and EMST is presumed to have a stronger effect on the enhancement of swallowing function by complementing safe swallowing and strengthening of swallowing muscles. In order to investigate the vitalization of the swallowing muscles in greater detail, studies that use surface electromyography are required in the future.

The limitations of this study are as follows: First, as the number of subjects was small, generalization of the study results is difficult. Second, as most of the subjects were male patients, analysis of treatment effects according to gender is required in the future. Third, effects based on the duration of intervention were not analyzed. Studies that analyze the effect of the intervention duration of EMST and postural techniques are required in the future.

The results of this study imply that simultaneous performance of postural techniques and EMST is more effective than EMST alone when applied in the swallowing rehabilitation for patients with dysphagia caused by Parkinson's disease.

**Table 2.** Results of the assessment using the VFS based on videofluoroscopic studies

Test	EMST (n=18)	EMST+PT (n=15)
Baseline	35.1 ± 13.5	33.5 ± 12.8
Post-training*	22.5 ± 11.3	16.2 ± 8.1

\*p<0.05

## REFERENCES

- 1) Logemann JA: Evaluation and treatment of swallowing disorders. Austin: Pro-ed, 2002, pp 148–153.
- 2) Logemann JA: Update on clinical trials in Dysphagia. *Dysphagia*, 2006, 21: 116–120. [[Medline](#)] [[CrossRef](#)]
- 3) Bülow M, Olsson R, Ekberg O: Videomanometric analysis of supraglottic swallow, effortful swallow, and chin tuck in patients with pharyngeal dysfunction. *Dysphagia*, 2001, 16: 190–195. [[Medline](#)] [[CrossRef](#)]
- 4) Won YS: Influence of manual facilitation technique on swallowing disorder and aspiration pneumonia caused by severe dysphagia with stroke. *J Phys Ther Sci*, 2012, 24: 909–913. [[CrossRef](#)]
- 5) Silverman EP, Sapienza CM, Saleem A, et al.: Tutorial on maximum inspiratory and expiratory mouth pressures in individuals with idiopathic Parkinson disease (IPD) and the preliminary results of an expiratory muscle strength training program. *NeuroRehabilitation*, 2006, 21: 71–79. [[Medline](#)]
- 6) Troche MS, Okun MS, Rosenbek JC, et al.: Aspiration and swallowing in Parkinson disease and rehabilitation with EMST: a randomized trial. *Neurology*, 2010, 75: 1912–1919. [[Medline](#)] [[CrossRef](#)]
- 7) Levitzky MG: Pulmonary physiology. McGraw-Hill Medical Publishing, 2003, pp 73–141.
- 8) Yi SJ, Kim JS: The effects of respiratory muscle strengthening exercise using a sling on the amount of respiration. *J Phys Ther Sci*, 2015, 27: 2121–2124. [[Medline](#)] [[CrossRef](#)]
- 9) Honjo I, Isshiki N: Laryngoscopic and voice characteristics of aged persons. *Arch Otolaryngol*, 1980, 106: 149–150. [[Medline](#)] [[CrossRef](#)]
- 10) Sasaki M: The effect of expiratory muscle training on pulmonary function in normal subjects. *J Phys Ther Sci*, 2007, 19: 197–203. [[CrossRef](#)]
- 11) Mikaele H, Arami MA, Marandi MY, et al.: Respiratory problems in parkinson disease. *Clin Pulm Med*, 2009, 16: 139–143. [[CrossRef](#)]
- 12) Solomon NP, McKee AS, Larson KJ: Effects of pallidal stimulation in Speech in three men with severe Parkinson's disease. *Am J Speech Lang Pathol*, 2000, 9: 241–256. [[CrossRef](#)]
- 13) Sadagopan N, Huber JE, Huber E: Effects of loudness cues on respiration in individuals with Parkinson's disease. *Mov Disord*, 2007, 22: 651–659. [[Medline](#)] [[CrossRef](#)]
- 14) Weiner P, Inzelberg R, Davidovich A, et al.: Respiratory muscle performance and the Perception of dyspnea in Parkinson's disease. *Can J Neurol Sci*, 2002, 29: 68–72. [[Medline](#)] [[CrossRef](#)]
- 15) Ertekin C, Keskin A, Kiylioglu N, et al.: The effect of head and neck positions on oropharyngeal swallowing: a clinical and electrophysiologic study. *Arch Phys Med Rehabil*, 2001, 82: 1255–1260. [[Medline](#)] [[CrossRef](#)]
- 16) Terré R, Mearin F: Effectiveness of chin-down posture to prevent tracheal aspiration in dysphagia secondary to acquired brain injury. A videofluoroscopy study. *Neurogastroenterol Motil*, 2012, 24: 414–419, e206. [[Medline](#)] [[CrossRef](#)]
- 17) Han TR, Back NJ, Park JW: The functional dysphagia scale using videofluoroscopic swallowing study in stroke patients. *Ann Rehabil Med*, 1999, 23: 1118–1126.
- 18) Wheeler KM, Chiara T, Sapienza CM: Surface electromyographic activity of the submental muscles during swallow and expiratory pressure threshold training tasks. *Dysphagia*, 2007, 22: 108–116. [[Medline](#)] [[CrossRef](#)]