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Effect of Modified EMST protocol on Dysphagia in Degenerative Parkinsonism

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Introduction

This study aimed to investigate the comparative effects of training intensity on adherence and patient-reported outcomes to establish the optimal balance between intensity and long-term compliance for modified Expiratory Muscle Strength Training (EMST) protocol in patients with degenerative Parkinsonism. The research compared the efficacy of a conventional high-intensity protocol (75% of maximal expiratory pressure) versus a modified low-intensity protocol (50% of MEP) on swallowing function and coughing ability.

Methods

Thirty participants diagnosed with degenerative Parkinsonism (Age over 50, Hoehn & Yahr stages 1–3, MMSE score ≥ 24) were randomly assigned to either a high-intensity (n=15) or low-intensity (n=15) group. Participants performed a 6-week home-based EMST program using the EMST150™ device, consisting of five sessions per day, five days per week (Each session consisted of five, 25 total breaths per day). (Figure 1)

Primary outcomes were measured via Video Fluoroscopic Swallowing Study (VFSS) using the Penetration-Aspiration Scale (PAS) and residue severity, alongside Maximal Expiratory Pressure (MEP) and Peak Cough Flow (PCF).

Secondary outcomes included the Korean Swallowing-Quality of Life (K-SWAL-QOL) questionnaire and training adherence. Quantitative adherence was calculated as: Adherence rate (Number of completed sessions/ Number of prescribed sessions) x 100.

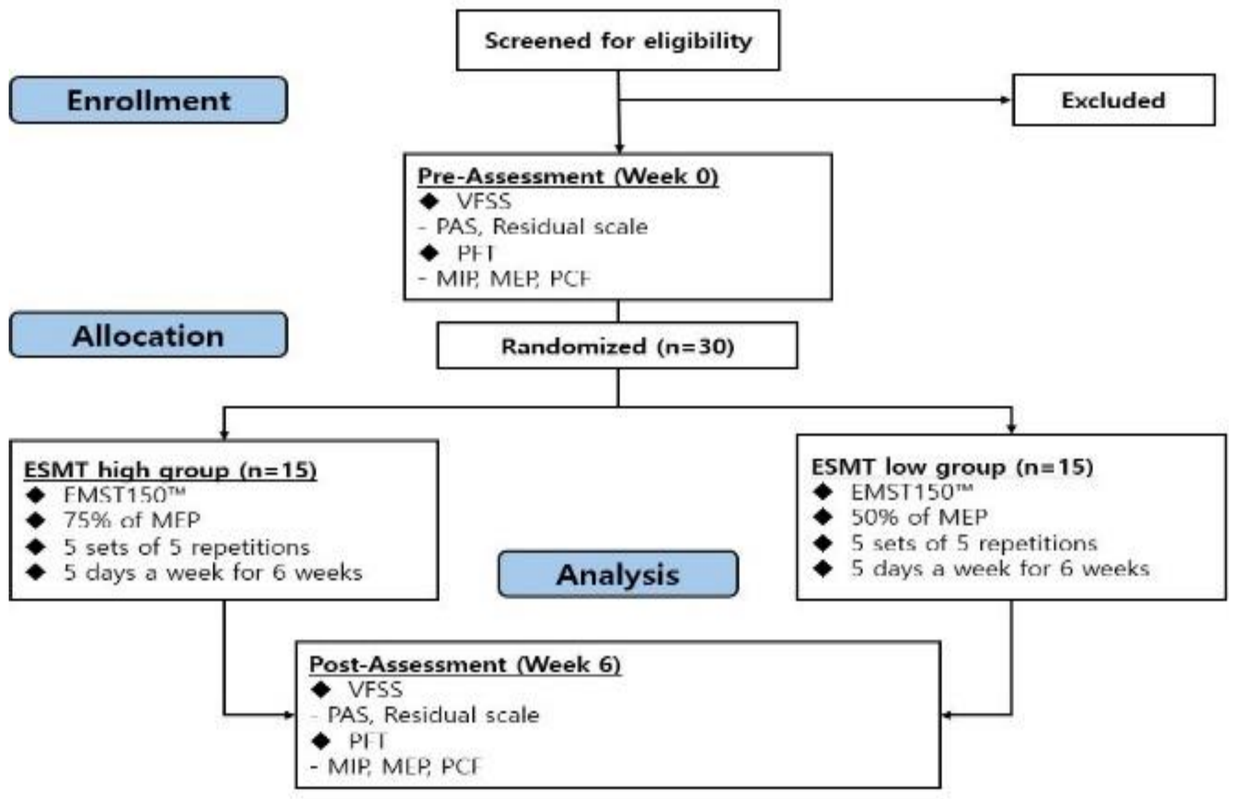

Fig 1. Flow diagram of the study

*abbreviation; VFSS; videofluoroscopic swallowing study, PAS; penetration aspiration scale, MIP; maximal inspiratory pressure, MEP; maximal expiratory pressure, PCF; peak cough flow, EMST; expiratory muscle strengthening training

Results

Both groups demonstrated high adherence rates exceeding 90% (high-intensity: 93.33%; low-intensity: 97.53%), with no significant difference between groups. Post-intervention, both groups showed significant improvements in swallowing function, including reduced PAS scores and vallecular residue. However, only the high-intensity group demonstrated significant increases in MEP and PCF, indicating enhanced airway clearance capacity. SWAL-QOL improved significantly in both groups, with broader domain improvements observed in the high-intensity group. (Table 1)

Variable	High-intensity group (n=15)				Low-intensity group (n=15)				p-value (between)
	Pre	Post	Δ (95% CI)	p-value	Pre	Post	Δ (95% CI)	p-value	
MIP (cmH2O) (SD)	41.80 (22.42)	42.53 (19.87)	0.73 (-4.87, 6.33)	0.172	47.21 (23.25)	49.21 (27.15)	2.00 (-6.37, 10.37)	0.950	0.726
MEP(cmH2O) (SD)	59.73 (21.41)	72.73 (35.50)	13.00 (0.19, 25.81)	0.047*	73.21 (24.45)	81.07 (41.79)	7.86 (-6.63, 22.34)	0.262	0.407
PCF (L/min) (SD)	272.33 (145.81)	325.67 (128.33)	53.33 (19.65, 87.01)	0.016*	302.14 (113.54)	332.14 (144.47)	30.00 (-18.94, 78.94)	0.233	0.382
PAS (SD)	3.07 (2.60)	2.00 (1.69)	-1.07 (-1.94, -0.19)	0.035*	3.43 (3.13)	2.36 (2.06)	-1.07 (-2.10, -0.05)	0.035*	0.756
Valleculae residue (SD)	3.67 (1.18)	2.60 (1.12)	-1.07 (-1.60, -0.53)	0.003*	3.36 (1.45)	2.93 (1.69)	-0.43 (-0.73, -0.13)	0.020*	0.048
PS residue (SD)	1.93 (1.33)	1.60 (1.24)	-0.33 (-0.68, 0.01)	0.089	2.29 (1.44)	2.07 (1.27)	-0.21 (-0.55, 0.12)	0.371	0.458

Table 1. Within and between group comparison of changes in swallowing and respiratory muscle strength and cough flow

*Significant difference (P<0.05), Abbreviation : EMST; expiratory muscle strengthening training, RMST; respiratory muscle strengthening training, MIP; maximal inspiratory pressure, MEP; maximal expiratory pressure, PCF; peak cough flow, PAS; penetration aspiration scale, PS; pyriformis sinus

Correlation analyses showed that improvements in respiratory muscle strength were significantly associated with better swallowing outcomes only in the high-intensity group. Overall, while both intensities improved swallowing, high-intensity EMST yielded superior respiratory and cough-related benefits, which are critical for airway protection. (Figure 2)

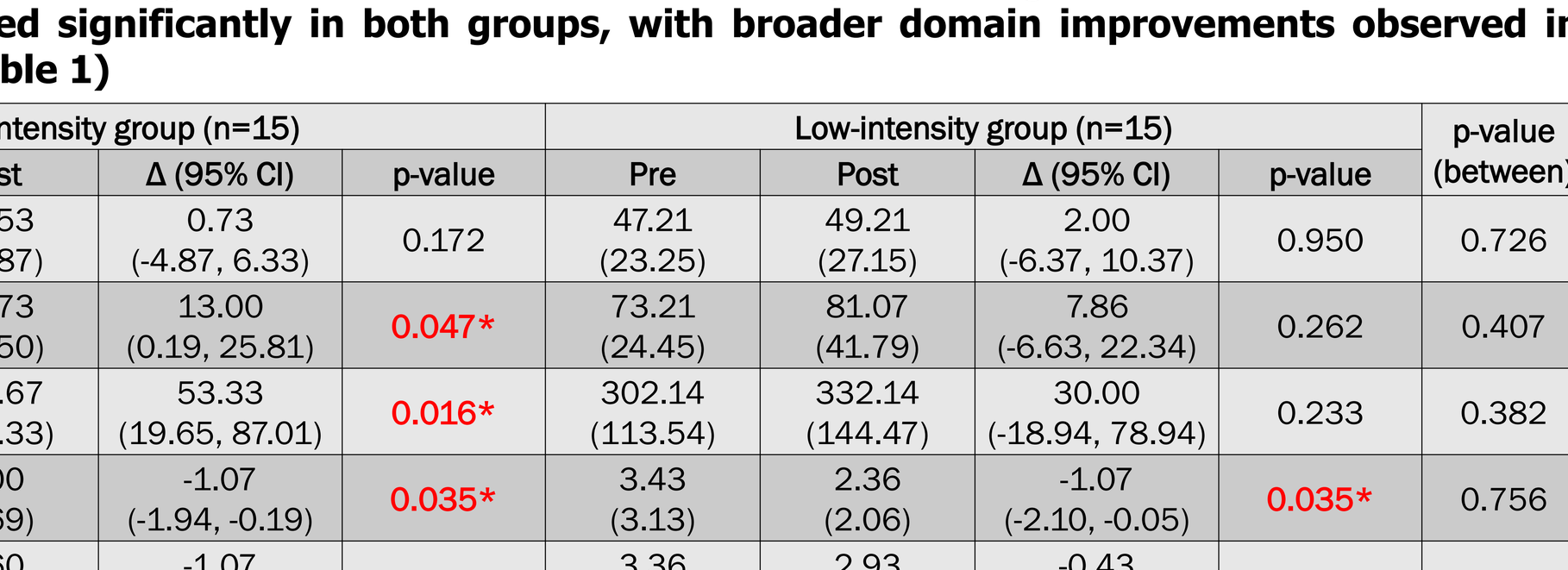

Fig 2. Scatter plot between improvement of respiratory and swallowing function of (a) high intensity group, (b) low intensity group

*Significant difference (P<0.05), Abbreviation : diff; difference, MIP; maximal inspiratory pressure, MEP; maximal expiratory pressure, PCF; peak cough flow, PAS; penetration aspiration scale, PS; pyriformis sinus, R1; valleculae residue, R2; pyriform sinus residue

Conclusion

High-intensity EMST produced broader and more consistent improvements in degenerative Parkinsonism. These findings indicate that a high-intensity protocol may be preferentially considered when developing respiratory muscle training strategies for dysphagia rehabilitation in this population. However, given that adherence, fatigue, and individual tolerance may vary among patients with neurodegenerative conditions, adjusting training intensity to a lower but still structured regimen may represent a feasible alternative without compromising clinical participation.