Voice change after Neuromuscular Electrical Stimulation to laryngeal muscles

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Abstract. This study investigated the effect of Neuromuscular Electrical Stimulation (NMES) on the loudness, pitch and quality of the voice of the males diagnosed with dysphagia by stroke. NMES was conducted on experimental group of 15 patients for 2 month repeatedly while compensatory strategies for dysphagia were performed on control group of 15 patients. As the result of analysis of covariance (ANCOVA), NMES and compensatory strategies had significant difference in intensity, jitter and shimmer (p<0.05) while they did not in pitch and NNE. After the intervention of NMES, voice loudness of the subjects was enhanced and periodicity of vocal cord vibration (Jitter, Shimmer) was stabilized.

Keywords: Dysphagia, VitalStim, Stroke, Voice

1 Introduction

Recently, Neuromuscular Electrical Stimulation (NMES) is practiced in the swallowing rehabilitation of stroke patients and there have been reports that it has significant rehabilitation effect [1-2]. Also, Freed & Wijting(2003) reported that NMES not only has positive effect on the rehabilitation of swallowing function but changes loudness and pitch of the voice [3]. Although the relationship between Neuromuscular Electrical Stimulation (NMES) and the voice has not been clearly verified, there have been reports on cases of change in loudness of dysphagia patients' voice in the process of NMES [4].

This study investigated the effect of repeated NMES on the loudness, pitch and quality of voice of the dysphagia patients from stroke by using acoustic-phonetic analysis.

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2 Methods

2.1 Subjects

The study subjects were 30 dysphagia patients hospitalized from August 2011 through October 2012 in rehabilitation hospital located in Incheon due to stroke. Among these 30 patients, 15 patients in experimental group received NMES intervention while 15 patients in contrast group received compensatory strategies.

2.2 Material

For the treatment of dysphagia, NMES treatment equipment VitalStim (Chattanooga Group, Tennessee, USA) [4] was used (Figure 1). For measurement of Loudness, pitch, and quality of the voice, Vocal Assessment for Voice (Version 4.5, Tiger Drs, Inc, USA) [5] were used (Figure 1).

Fig. 1. Vocal Assessment for Voice
2.3 Measurement

NMES was conducted in the same time period using 2-channel electric stimulant for 25 minutes per session until the completion of the study and all the subjects received the treatment 5 times a week except weekends for 2 months, which is 40 times in total.

For compensatory strategies, chin tuck, head rotation, Mendelsohn maneuver, supraglottic swallow technique, super-supraglottic swallow technique and effortful swallow were used [6].

Voice analysis was performed in the method of directly recording subjects' prolonged phonation of vowels in acoustic analysis program in a noiseless voice test room.

2.4 Statistical Analysis

The treatment was defined as explanatory variable while voice loudness, pitch and quality (Jitter, Shimmer, NNE) were defined as outcome and baseline was defined as covariance, and difference of change in outcome was compared after the treatment using one-way analysis of covariance (ANCOVA). Statistical test was analyzed using IBM SPSS version 22.0 (IBM Inc., Chicago, Illinois).
3 Results

As the result of one-way ANCOVA which controlled pretest with covariance, NMES and compensatory strategies have significant difference in intensity, jitter and shimmer (p<0.05). As the result of estimation of parameter, NMES significantly raised intensity by 2.0dB higher than compensatory strategies on average while it significantly lowered jitter and shimmer by 0.3% respectively. Especially, in the case of NMES group, jitter declined from average 1.1 dB(%) in pretest to average 0.5 dB(%) in posttest (p<0.01), reaching within 0.5 dB(%) which is normal in the standard of Vocal Assessment for Voice, and shimmer declined from average 3.4 dB(%) in pretest to average 2.5 dB(%) in posttest (p<0.01), reaching normal standard of within 3.0 dB(%).

4 Conclusion

The result of this study implies that NMES intervention may have effect on the enhancement of voice loudness and stabilization of periodicity of vocal cord vibration.

References