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Effect Of Bilateral Thenar Muscle Stimulation In Improving Swallowing Function And Swallowing Muscles Activity In Post Stroke Dysphagia.

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ABSTRACT

NMES (Neuromuscular electrical stimulation) is the most widely recognized technique utilized as physiotherapy intervention to treat post-stroke dysphagia. Pharyngeal muscles stimulation is the usual strategy as of now for post-stroke dysphagia. The present study was undertaken to determine the effect of Bilateral Thenar muscle stimulation in improving swallowing function and swallowing muscles activity in post-stroke dysphagia. A total of 55 post-stroke dysphagia participants were selected according to the inclusion and exclusion criteria by convenient sampling technique. All the selected participants received Bilateral Thenar muscle stimulation for 4 weeks duration. Pre and post intervention FOIS (functional oral intake scale) sEMG (surface electromyography) for bilateral masseter, submental and infrahyoid muscles was taken as an outcome measure. There was a significant difference between pre and post value in the amplitude of sEMG activity of left and right side masseter, submental and infrahyoid muscle of $P<0.001$. There was a significant difference between pre and post values of FOIS (functional oral intake scale) with $P<0.001$. The present study results suggest that bilateral thenar stimulation was an effective intervention in improving swallowing function and swallowing muscle activity.

Keywords: Thenar stimulation, sEMG, FOIS, dysphagia.

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INTRODUCTION

Swallowing, a sensorimotor activity helps moving or to ingest bolus from the mouth through the pharynx into the throat. It is a perplexing procedure included by the coordinated and programmed activity of brainstem, neural system, and innervations of muscles related with the oral cavity, pharynx and esophagus. Swallowing is executed as a state of neuromuscular cooperative energy driven function by the skeletal (tongue) muscles and smooth muscles of the pharynx and throat [1].

Literature shows that more than 50 % of stroke survivors are affected from dysphagia [2] with mortality for dysphagic stroke patients being 27% and 37%.3This Mortality rate was more than 30 % in stroke survivors with Dysphagia compared to stroke subjects without dysphagia. Dysphagic stroke patients recover swallowing function within 7 days and approximately 11–13 % remain dysphagic even after 6 months. [3,4] In 80 % of patients with prolonged dysphagia there is a requirement of alternative means of enteral feeding as per the studies conducted.[5] It is proved that Dysphagia is an independent predictor for respiratory morbidity and mortality in stroke.[6] The most alarming complication of dysphagia after stroke is aspiration pneumonia. It is also reported that 49 % of malnutrition was prevalent in stroke survivors admitted to a rehabilitation unit which was associated with dysphagia. [7] Dehydration was reported in approximately 58 % of acute stroke survivors with dysphagia (urea concentration of 10 mmol/l or higher) compared to 32 % of those that were not dysphagic. [8]

NMES, the most widely recognized technique utilized as of late for the physiotherapy intervention may result in the difference in neuroplasticity through prompting substantial sense development of the laryngeal muscle. A huge volume of studies have been directed to show the viability of NMES treatment strategies for dysphagia, which is a demonstrated best treatment.[9,10,11]

The pharyngeal muscles have a bilateral representation in the brain. As such in injury, the tone can potentially be compensated by the injured brain leads to functional recovery which is the main reason for poor swallowing and as well as for recovery process of dysphagia. It is proved that transcortical stimulation of the motor cortex results in excitation of both the pharyngeal and bilateral thenar musculature.[12] Di Lazzaro et al in 2002 have shown that 5 Hz sub threshold rTMS (repetitive transcranial stimulation) over the hand area of motor cortex leads to a long-term reduction in excitability of cortical inhibitory circuits. rTMS may be an alternate method for dysphagic stroke patients with the sensory cortex damage.[13] Hence, from the above literature, it is proved that the stimulation of the efferent pathway by transcranial stimulation influence both thenar and pharyngeal muscles. With this idea as fulcrum in this current study, a novel effort was taken to prove that the stimulation of the afferent pathway by encouraging bilateral thenar muscle activation will excite the swallowing centers in the cortex.

METHODS

Study design

The present study was a Quasi-experimental study. Bilateral thenar stimulation was the intervention given to post stroke dysphagia participants for 4 weeks duration. After which, the corresponding pre-test and post-test FOIS and sEMG values were collected for bilateral massator, submental and infrahyoid muscles and compared.

Study setting

The study was done at the department of Physiotherapy, Saveetha Institute of Medical and Technical Sciences (SIMATS), Chennai, Tamil Nadu, India.

Study population

A total of 55 post stroke dysphagia participants were selected according to the inclusion and exclusion criteria by convenient sampling technique. The following criteria were used in the selection of the participants.

Inclusion and exclusion criteria

Inclusion criteria: Age group: 35-70 years, Both genders, Post stroke dysphagia participants who were labeled as dysphagic after assessment using MANN assessment of swallowing ability scoring sheet, post stroke subjects who had dysphagia due to first time stroke (ischemic and hemorrhagic), subjects with good cognitive function (comprehending and good attention span) and Exclusion criteria: Subjects who had recurrent stroke, stroke due to traumatic causes, other neurological problems that may influence swallowing function, subjects with metal implants in the forearm, hand region. The selected participants received Bilateral thenar stimulation for 4 weeks duration.

Intervention: Thenar stimulation- The patient position was sitting with upper extremity elbow ninety degree flexed position, forearm supinated, wrist and fingers extended. Neuromuscular electrical stimulation equipment was used. The electrode placement was active electrode over the thenar eminence and the inactive electrode over the lateral aspect of wrist crease. Active electrode over the motor point of abductor pollicis brevis, flexor pollicis brevis and opponens pollicis with electrical stimulation with the frequency of 30 Hz, duration of 100ms, intensity was increased till minimal palpable observable contraction interrupted direct current was used to stimulate the thenar eminence. The same interventional Parameters were given to bilateral thenar eminences. One session per day for 5 days /4 weeks.

Outcome variables- Surface electromyography recording

The Patient position was sitting and three muscle groups were investigated and muscle activity recorded. Three muscle locations were examined in the study: (1) masseter (2) submental (3) Infrahyoid. All EMG recording was made using a surface electrode which was made up of silver chromium. Allengers Scorpio Emg Ep NCS, computer-based EMG system with software. The Electrodes have wide bandpass filter band with (RMS) - of 30 to 500 Hz and a 60 Hz Notch filter. It consists of two bipolar electrodes and a ground electrode. Specific electrode positions were as follows the interelectrode distance was 10 mm in all locations except sub mental. For massator muscle, two bipolar electrodes were placed parallel to the massator muscle fibers on the left side of the face. Submental muscle, two surface electrodes were attached to the skin beneath the chin on the right side of midline to record submental myoelectrical activity over the platysma. And two electrodes were placed on the left side of the thyroid cartilage to record from the infrahyoid muscle group.[14,15,16,17]

Functional oral intake scale is a seven tiered scale ranging from 1 to 7(1- no oral intake 2- tube dependent 3- tube supplements with consistent oral intake 4- total oral intake of a single consistency 5- total oral intake of multiple consistencies requiring special preparation 6- total oral intake with no special preparation, but must avoid specific foods or liquid items 7- total oral intake with no restrictions). The patient's were scores were marked according to the type of oral intakes in the pre test and post test.[18]

Ethical consideration:

The study was approved by the Institutional Ethics Committee and done in accordance with the Ethical Guidelines for Biomedical Research on Human Participants, 2006 by the Indian Council of Medical Research and the Declaration of Helsinki, 2008.The study protocol was approved by institutional ethical committee. Informed consent was obtained from all the participants. Confidentiality of data was maintained.

Data analysis:

Data analysis was done using SPSS version 20.0. All data were expressed as mean (SD). Paired t test was used to assess the significance of difference before and after intervention. P value less than 0.001 was considered extremely statistically significant.

RESULTS

Results were presented in table no 1-2. The mean age of participants was 57 years +/- 1.373. There was a significant difference between pre and post value in amplitude of sEMG activity of left and right side massator, submental and infrahyoid muscle of($P<0.001$).(table no 1)There was a significant difference between pre and post value of FOIS(functional oral intake scale)of Group A ($P<0.001$).(table no.2)

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Table 1: Electrical Muscle activity of Massator, submental and infrahyoid value of before and after intervention.

Side	Muscle	Test	Pre intervention	Post intervention	t value	P value
Left	Massator	Pre	17.50±0.22	75.82±0.60	101.259	<0.001
	Submental	Pre	25.414±	128.84±0.63	153.780	<0.001
	Infrahyoid	Pre	22.75±0.25	1.93±0.58	109.892	<0.001
Right	Massator	Pre	17.54±0.22	75.73±0.60	101.043	<0.001
	Submental	Pre	25.44±0.27	128.24±0.61	183.260	<0.001
	Infrahyoid	Pre	22.64±0.26	83.85±0.59	107.443	<0.001

(*P<0.0s is significant, **P<0.01 is significant, ***P<0.001 is significant).

Table 2: FOIS values of before and after intervention. (*P<0.0s is significant, **P<0.01 is significant, ***P<0.001 is significant).

Parameter	Pre-intervention	Post-intervention	t value	P value
FOIS	1.80±0.86	4±0.65	12.60	0.001***

DISCUSSION

Dysphagia once was not considered part of physiotherapist source of problem as it was perceived to be related to cognitive and perceptual problems. Later as motor control theories evolved and progressed, it was understood that swallowing difficulty is also a problem related to motor programming which needs to be re-educated and relearned. Conventionally electrical stimulation was provided to the pharyngeal muscles only through afferent pathways if affected, which is true in case of most of the dysphagia following stroke, it becomes almost difficult to stimulate the cortex. We perceived that the valuable work done in the past will guide us find a solution to this issue with afferent pathways.

The purpose of this study is to determine the effect of stimulation of bilateral thenar muscles to improve the amplitude of swallowing muscles activity. Right median nerve electrical stimulation has been reported to improve outcomes for traumatic comatose cases as per literature.19 Several earlier studies have been directed to show the viability of NMES treatment strategies for dysphagia.9,11 and hence this was chosen for bilateral thenar stimulation.

It was predicted that the repeated neuromuscular electrical stimulation on the bilateral thenar muscles would reduce the excitability of GABAergic inhibitory networks in the motor cortex acting on the muscles of deglutition. This was based on a previous study on Short-term reduction of intracortical inhibition in the human motor cortex induced by repetitive transcranial magnetic stimulation.13 The reduction in the inhibitory effect on the contra lateral swallowing muscles will thereby, in turn, increase the amplitude of swallowing muscles activity.

The sEMG data collected supported this hypothesis. Return of swallowing after dysphagic stroke is not only associated with the recovery of function of the affected side cerebral hemisphere it's found to be associated with increased pharyngeal representation in the unaffected hemisphere as well, suggesting a role for intact hemisphere reorganization in recovery.12

The results of the current study showed a significant increase in the amplitude of muscle activity and swallowing function. These results obtained were similar to that of the Short-term reduction of intracortical inhibition in the human motor cortex induced by repetitive transcranial magnetic stimulation study where 5 Hz sub threshold rTMS over the hand area of motor cortex leads to a long-term selective modification of the excitability of cortical inhibitory networks.

CONCLUSION

The study concluded that bilateral thenar muscle stimulation was an effective tool in improving swallowing function and swallowing muscles activity in post stroke Dysphagia.

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