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Effect of Electrical Stimulation along with Mendelsohn Maneuver in Muscles of Swallowing Function and Cognitive Function on Post-Stroke Dysphagia

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ABSTRACT

Aim & Objectives: To find out the Effect of electrical stimulation along with Mendelsohn maneuver in muscles of swallowing function and cognitive function on post stroke dysphagia subjects. To analyze the characteristics of cognition through MMSE in patients with sub-acute post-stroke dysphagia subjects and to evaluate laryngeal elevation and closure during swallowing muscle activity by Surface EMG.

Methodology: In this study, 30 subjects with stroke were selected as per inclusion and exclusion criteria. All samples under pre measures were assessed by therapist using sEMG (surface electromyography) for masseter, infrahyoid, suprahyoid muscles and MMSE (mini mental state examination) for cognition. After the pre-test measures all samples were reviewed for electrical stimulation. These were performed in supine lying on treatment table. Mendelsohn maneuver is taught to the patient and they are requested to do for every 2hrs. This protocol consists of 1 session/day; 6days/week for 2 weeks. Similarly outcome measures were re assessed for post test measurements of movement for swallowing recovery after 12 sessions.

Results: Statistical analysis of pre-test and post test values of group showed the significant changes with the p values of FOIS, MMSE and Surface EMG were $p \leq 0.001$, $p \leq 0.001$ and $p \leq 0.001$ respectively.

Conclusion: This study shows the significant improvement by using electrical stimulation with mendelsohn maneuver can improve the function of swallowing muscles and cognitive function was improved by treating dysphagia in subjects with post stroke dysphagia. Patient with severe dysphagia and decreased cognition had been improved when compared to the pre test assessment.

Keywords: *electrical stimulation; cognition; mendelsohn maneuver; post stroke dysphagia; surface EMG; deglutation.*

Introduction

Dysphagia is the common symptom in patients with stroke, with up to 50-70% of all cases of swallowing problems in their acute phase[1]. Impaired swallowing is a common complication with the prevalence to be approximately between 42 and 67% after stroke[2]. Dysphagia can lead to a deterioration of activities of daily living (ADL) and quality of life, leading to malnutrition, dehydration, aspiration pneumonia and increased mortality. Therefore, it is important to assess the presence of dysphagia in the early stages of post-stroke rehabilitation[3-4]. Stroke is one of the leading causes of death and disability in India. The estimated adjusted prevalence rate of stroke range, 84-262/100,000 in rural and 334-424/100,000 in urban areas. The incidence rate is 119-145/100,000 based on the recent population based studies[5]. The swallowing muscles are asymmetrical in both motor cortex[6,7]. Swallowing is defined as the semi-automatic motor action of the muscles of the respiratory and gastrointestinal tract that propels food from the

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oral cavity into the stomach. Swallowing is also a complex phenomenon involving breathing, phonation and swallowing occurring at the same anatomical location requiring coordination between them, for a safe swallow and appropriate gas exchange[8-9]. Although many stroke patients recover swallowing spontaneously, 11–50% still have dysphagia at six months[10]. Patients have significant facial weakness, a high arched palate, micrognathia, and weak masseter and pterygoid muscles. The pharyngeal and laryngeal muscles may be affected such as palatopharyngeus muscle, superior constrictor muscle, middle constrictor muscle and inferior constrictor muscle, levator veli palatini[11]. However, it is still controversial as to which of the two hemispheres plays a more important role in swallowing, and which injured hemisphere is more likely to cause the specific patterns of dysphagia seen in stroke patients [12-14]. Both hemispheres play a larger role in swallowing, and which wounded hemisphere is more likely to cause specific patterns of dysphagia in stroke patients, the left hemisphere is associated with the oral phase, and the right hemisphere is the pharyngeal phase[15]. The entirely voluntary oral phase is mainly controlled by the medial temporal lobes and the limbic system of the cerebral cortex with contributions from the motor cortex and other cortical areas where cognition is affected[16]. Several studies have shown that dysphagia is associated with other neurological conditions related to stroke, such as cognitive dysfunction and neglect[17]. However, most of these studies investigated the relationships between post-stroke dysphagia and cognitive deficits by using simple cognitive screening tests, such as the Mini-Mental State Examination (MMSE)[18]. Although MMSE is commonly used in clinical practices, it does not assess frontal lobe functions and mainly evaluates. The left hemisphere involves cognitive functions, including language, verbal memory, and calculation[19-21].

The FOIS is an ordinal scale reflects the functional oral intake of patients with dysphagia is levels (1 to 7) Although a standard clinical examination of dysphagia in stroke patients has recently been published,[22-23]. Electrical stimulation, when applied in this way, accelerates muscle building, accelerates cortical reorganization (especially after stroke), and increases the effectiveness of exercise therapy[24]. The Mendelsohn maneuver, or the voluntary extension of the hyolaryngeal elevation to the swallow's spike, has been used to treat patients with pharyngeal dysphagia for many years - sometimes as a compensatory strategy to help the bolus pass more efficiently in the pharynx. Some studies provide data on dysphagic patients who used the Mendelsohn maneuver as part of a series of exercises to rehabilitate them, but none used the maneuver alone and reported a change in the physiology of swallowing[25-26]. Surface electromyography (sEMG) provides information on the temporal and amplitude characteristics of muscle contraction during swallowing[27]. It is a non-invasive and inexpensive technique for studying muscle activity. It has been used to study the function of swallowing[28]. Surface electromyography (sEMG) is useful for monitoring performance of the effortful swallow and can be used to collect and display information regarding performance of these maneuvers in treatment; such performance-contingent information can enhance motivation, compliance and task performance[29].

Methodology

Participants: The sample will be drawn from Physiotherapy department OPD and IP at Saveetha Medical hospital. The subjects will sign an informed consent form after elaborate education about the study purpose, duration and other aspects by the researcher. The subjects who fulfill the criteria's of inclusion will be selected for the study. Inclusion criteria**:** Age group: 30-75 years, both genders, Patients must be conscious and comprehensive, Ischemic/haemorrhagic stroke patients leading to admission to the SMCH, Post stroke subjects with difficulty in swallowing. Subjects confirmed swallowing difficulty with Functional oral intake scale. Exclusion criteria**:** Individuals with current/history of tracheotomy or other structural alteration to the swallowing mechanism, Individuals with unconsciousness, Patients with histories of diseases related to swallowing, severe cognitive impairment (MMSE≤9), or severe aphasia preventing thorough evaluation of neurocognitive function, Recent trauma, unstable vital signs, recent surgeries around the neck.

Procedure: Subjects who are willing to participate in this study were screened for inclusion and exclusion criteria. They were explained about the safety and simplicity of the procedure and informed consent were obtained. Thirty post stroke dysphagia patients were selected from Saveetha Physiotherapy and rehabilitation centre (SPARC), Saveetha Institute of Medical and Technical Sciences (SIMATS) after concern referral for the study by using convenient sampling method. Informed consent was been obtained from each patient before the intervention. All the 30 samples were taken for confirmatory test FOIS (Functional oral intake scale) level of 1-4 to assess the level of swallowing inability and were selected for the study. The subjects under pre measures were done by using two scales as an outcome measure they are Semg by placing 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 its frequency, amplitude and duration are noted and MMSE scale (mini mental state examination) for cognition it is a diagnostic test to assess the cognition.

After the pre-test measures all 30 samples reviewed for electrical stimulation. Patient position is in supine lying and pillow is placed under the head, inactive electrode placed on the nape of neck and active pen electrode over the pharyngeal muscles and the current is surged faradic, intensity is minimum. Palpable, observable, contractions of minimum of 90/session and should be done as 1 session/day; 6days/week for 2 weeks. Mendelsohn maneuver is taught to the patient by asking the patient to take a small bit of food or sip of water then hold it in mouth, position index finger and thumb around Adams apple and swallow, and make them to feel the upward movement (elevation) of Adams apple (thyroid notch) when they swallow and when the adams apple reaches the highest point of elevation then made to hold it with muscles for 5 seconds, then release. And make them to repeat it with each swallow. This was advised to do for every 2 hours in ward.

Result

Results of this study show that electrical stimulation with mendelsohn maneuver to swallowing muscles improves the muscle activity and simultaneously cognition also improves along with it in subjects with post stroke dysphagia.

In FOIS Pre-test and Post-test values mean and standard deviation within the group are 1.93(0.82), and 5.96 (1.06), t value-32.904. In MMSE Pre-test and Post-test values mean and standard deviation within the group are 22.26(1.43) and 28.43(1.81), t value-38.633. In SURFACE EMG of right Masseter the Pre-test and Post-test values mean and standard deviation within the group are 15.98(0.93) and 65.79(2.33), t value-142.309. Left Masseter Pre-test and Post-test values mean and standard deviation within the group are 15.87(0.01) and 65.49(1.46), t value-131.668. Right submental Pre-test and Post-test values mean and standard deviation within the group are 24.58(1.86) and 115.63(2.46), t value-331.590. Left submental Pre-test and Post-test values mean and standard deviation within the group are 24.16(2.23) and 114.75(2.86), t value-195.467. Right infrahyoid Pre-test and Post-test values mean and standard deviation within the group are 18.87(0.97) and 77.30(2.21), t value-212.430. Left infrahyoid Pre-test and Post-test values mean and standard deviation within the group are 18.83(0.86) and 75.71(2.94), t value= -137.203. Wilcoxon Signed Rank Test for FOIS and MMSE are t value-32.904, and t value-38.63 statistically significant. Hence within the group analysis of pre test and post test values of outcome such as FOIS, MMSE and Surface EMG shows that the values are significant with p ≤0.001, ≤0.001, ≤0.001 respectively (Table 1).

Table 1: Pre-Test and Post-Test Values FOIS, MMSE and SURFACE EMG right and left (masseter, submental and infrahyoid)

			Mean	Standard Deviation	T Value	P Value
Functional Oral Intake Scale (FOIS)		Pre Test	1.93	0.82	-32.904	≤0.001
		Post Test	5.96	1.06		
Minimental State Examination (MMSE)		Pre Test	22.26	1.43	-38.633	≤0.001
		Post Test	28.43	1.81		
Surface Electro Myography (S EMG)	Masseter Right Side	Pre Test	15.98	0.93	-142.309	≤0.001
		Post Test	65.79	2.33		
	Masseter Left Side	Pre Test	15.87	1.01	-131.668	≤0.001
		Post Test	65.49	1.46		
	Submental Right Side	Pre Test	24.58	1.86	-331.590	≤0.001
		Post Test	115.63	2.46		
	Submental Left Side	Pre Test	24.16	2.23	-195.467	≤0.001
		Post Test	114.75	3.83		
	Infrahyoid Right Side	Pre Test	18.87	0.97	-212.430	≤0.001
		Post Test	77.30	2.21		
	Infrahyoid Left Side	Pre Test	18.83	0.86	-137.203	≤0.001
		Post Test	75.71	2.94		

Discussion

The purpose of the study is to determine the effect of electrical stimulation with Mendelsohn maneuver in swallowing function muscles and Cognitive function on Post-stroke dysphagia. To investigate characteristics of the post-stroke dysphagia and to determine the relationships between swallowing dysfunction and cognitive functions in patients with stroke[29] and to determine whether any lasting physiologic changes in swallowing function can occur from utilizing the Mendelsohn maneuver as an exercise.

One of the aims of the present study was to evaluate the long-term effect of electrical stimulation on swallowing performance, including involuntary and voluntary swallowing. Cognitive function tests revealed lower performance in all measured subtests for the dysphagia. Earlier work for example revealed that low MMSE scores and neglect were associated with dysphagia[30]. For the current investigation, we hypothesized that duration of superior and anterior maximal hyoid movement would be prolonged, as well as duration of UES opening[31].

Over a period of 4 weeks of treatment session, the result of the present study found that there is an extremely significant improvement in swallowing muscles and cognition with mendelsohn maneuver and electrical stimulation.

Conclusion

The study result showed that electrical stimulation with mendelsohn maneuver is effective to effective in promoting the activity of palatopharyngeal muscles during swallowing and cognitive functions might contribute to the severity of dysphagia in stroke patients.

Limitations & Recommendations

Limitations are less number of RCT's was enrolled in the study. The study did not use dysphagia severity scale to assess the severity of stage. In this study only qualitative outcomes were performed. Recommendations are Further studies including a larger patient cohort were needed to fully verify the results. Dysphagia severity can be used for the assessment. Quantitative outcome can be used to assess for the effectiveness of cortical reorganization.

Ethical Clearance: The study was approved by Institutional Ethics Committee (Number 020/15/2018/ IEC/SU on 15/02/2018) and was done in accordance with Ethical Guidelines for the Human Participants. This study protocol was approved by institutional ethical committee.

Conflict of Interest: Nil

Sources of Funding: Self

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