



EFFECTIVENESS OF RESPIRATORY MUSCLE TRAINING ON SWALLOWING CAPACITY, RESPIRATORY MUSCLE STRENGTH AND SEVERITY OF DYSPHAGIA IN ACUTE STROKE SUBJECTS WITH DYSPHAGIA

Physiotherapy

K. Naga Anil Reddy*

MPT, Neurology. *Corresponding Author

Dr. G. Kameswari MPT(NEUROLOGY), Faculty, College Of Physiotherapy, SVIMS, Tirupati.

Dr. V. Srikumari MPT (NEUROLOGY), PH.D. Associate Professor, College Of Physiotherapy, SVIMS University.

Dr. K. Madhavi MPT(CT), Ph.D., Professor & Principal, College Of Physiotherapy, SVIMS University.

ABSTRACT

Dysphagia is a common and serious complication following stroke, increasing the risk of aspiration pneumonia, malnutrition, and dehydration, which can impair recovery and QOL. Respiratory muscle training (RMT), particularly combined (cRMT), has shown in improving swallowing function by strengthening respiratory and swallowing muscles. 30 acute stroke patients with dysphagia, assigned to either the experimental group (receiving a 4-week cRMT protocol) or control group (receiving standard care). The study followed a pre-post design, with the experimental group undergoing supervised cRMT, targeting both inspiratory and expiratory muscles. Outcomes - FOIS, SNIP, and DSS. The objective of this study was FOIS, SNIP, DSS in patients with acute stroke-related dysphagia. It's statistical significance $p < 0.05$. This study concluded that cRMT significantly improved swallowing capacity, respiratory muscle strength, and severity of dysphagia in acute stroke patients.

KEYWORDS

Dysphagia, Stroke, Respiratory Muscle Training (RMT), Functional Oral Intake Scale (FOIS)

INTRODUCTION

Stroke, as defined by the World Health Organization (WHO), is a clinical syndrome characterized by "rapidly developing clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than of vascular origin". It is a major global health concern and ranks as the second leading cause of death and a leading cause of disability-adjusted life years (DALYs) worldwide.⁽¹⁾

The prevalence of stroke-associated dysphagia (SAD) is particularly high, affecting up to 50%-70% of stroke survivors in the acute phase.⁽¹⁾

Respiratory Muscle Training (RMT) has emerged as a promising intervention for addressing swallowing impairments post-stroke. RMT strengthens submental muscles, elevates the hyolaryngeal complex, and facilitates anterior-superior movement of the hyoid bone.⁽²⁾

Common signs of dysphagia include delayed swallowing reflex, reduced pharyngeal peristalsis, poor tongue control, and incomplete laryngeal closure.⁽³⁾

Advanced diagnostic tools, such as video fluoroscopic swallowing studies (VFSS) and fiberoptic endoscopic evaluation of swallowing (FEES), are essential for comprehensive evaluation and management planning. Interventions like RMT, in combination with traditional dysphagia therapies, have shown promise in improving swallowing efficiency, reducing complications, and enhancing overall quality of life.⁽⁴⁾

NEED OF THE STUDY

- Dysphagia is a frequently observed complication in individuals with stroke. A higher risk of pneumonia or chest infections is linked to aspiration. After a stroke, aspiration is one of the most dangerous respiratory complications that can be fatal. But given the severity of post-stroke respiratory complications, appropriate and timely interventions for dysphagia are essential.⁽⁵⁾
- Dysphagia can lead to weight loss, dehydration, malnourishment, and an increased risk of respiratory and cardiac problems.^(5,6)
- As per the research gaps found in the previous study, the present study is emphasized on the treatment protocol with a duration of 4 weeks of combined respiratory muscles training under supervision as more number of comprehensive studies were recommended to confirm the efficacy and establish optimal protocol for dysphagia management.⁽⁷⁾

AIM OF THE STUDY:

To find the effectiveness of respiratory muscle training on swallowing capacity, respiratory muscle strength and severity of dysphagia in

acute stroke subjects with dysphagia.

OBJECTIVES

- To know the effectiveness of inspiratory and expiratory muscle training on dysphagia by using Dysphagia severity scale (DSS) in experimental group subjects with acute stroke.
- To know the effectiveness of inspiratory and expiratory muscle training on dysphagia by using Functional oral intake scale (FOIS) in experimental group subjects with acute stroke.
- To know the effectiveness of inspiratory and expiratory muscle training on dysphagia by using Sniff nasal inspiratory pressure (SNIP) in experimental group subjects with acute stroke.
- To know the effectiveness of conventional dysphagia exercises on dysphagia by using Dysphagia severity scale (DSS) in control group subjects with acute stroke.
- To know the effectiveness of conventional dysphagia exercises on dysphagia by using Functional oral intake scale (FOIS) in control group subjects with acute stroke.
- To know the effectiveness of conventional dysphagia exercises on dysphagia by using Sniff nasal inspiratory pressure (SNIP) in control group subjects with acute stroke.
- To compare the effectiveness of inspiratory and expiratory muscle training in experimental group and conventional dysphagia exercises on dysphagia by using Dysphagia severity scale (DSS), Functional oral intake scale (FOIS), Sniff nasal inspiratory pressure (SNIP) subjects with acute stroke.

MATERIALS AND METHODS

MATERIALS:

Materials For Evaluation: Spiro filter

Materials For Intervention: A Resistive inspiratory and expiratory muscle training device (Model.no: BOB3D7DNQ), High Couch

Materials For Intervention: a. breather, high couch.

METHODS:

- Study setup:** Neurology ward- SVIMS hospital, Ayurvedic hospital, Tirupati
- Study design:** A Randomized control trail
- Sample size:** 30
- Sampling type:** Purposive sampling
- Randomization technique:** by lottery method
- Duration of study:** 5 months
- Treatment duration:** Twice a day, 5 days a week for a total period of 4 weeks (40 sessions).
- Ethical code:** 1748, Date: 11.9.2024.

Inclusion Criteria:

- Subjects without prior neurological history of stroke, bulbar palsy
- Subjects with no history of swallow deficits prior to CVA
- Subjects with no surgical interventions
- Functional oral intake scale (FOIS) <4 in subject with acute stroke.
- Subjects with no other therapy for swallowing during the study period.
- Subjects with stable cognition i.e., MMSE >26
- Subjects who are able to do independent breathing.

Exclusion Criteria:

- Subjects who were failure to meet one or more of the inclusion criteria.
- Oral, neck and chest-wall related diseases.
- Subjects with Facial palsy

Outcome Measures

- Dysphagia severity by Dysphagia severity scale
- Swallowing capacity by Functional oral intake scale
- Respiratory muscle strength by Sniff nasal inspiratory pressure.

METHODOLOGY:

- The study was performed after getting approval form from IEC which registration number 1748
- The subjects who met inclusion criteria were informed about the and consent was taken to participate in the study.
- All subjects meeting the inclusion criteria were included in the study after receiving a through explanation of the procedure by both parents and subjects. Written consent was then obtained from the parents. The subjects were then into two groups, experimental and control group, using lottery method.
- Experimental group = 15 subjects.
- Control group = 15 subjects.

Statistical Analysis:

- The statistical analysis was performed using SPSS software version 26.0, IBM Chicago. The data was first entered into a Microsoft excel spread sheet, Tabulated, and then subjected to statistical analysis.
- All 30 participants completed this study protocol with in four weeks of treatment session the demographic data was analysed using the Chi-square test. Paired t-test were used for with in experimental, control group analysis whereas unpaired t-test were used for between group analysis.

RESULTS:

The study consists of 30 participants divided into two groups an experimental group (n=15) and control group n=15. The mean age of experimental group was 46.60 ± 11.45 years where the control group had a mean age of 53.47 ± 5.28 years.

Within the group analysis of experimental group :

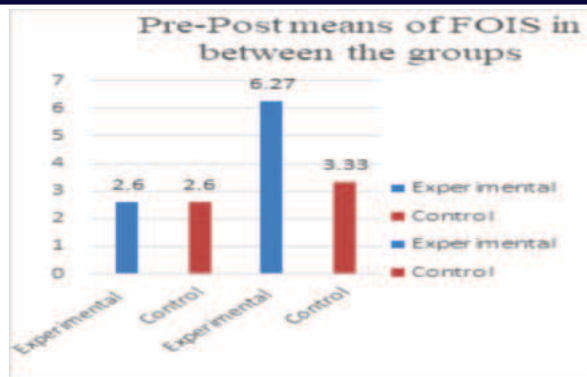
In the control group, the pre-test mean score for the Functional Oral Intake Scale (FOIS) was 2.6 ± 0.507 , which increased to 3.33 ± 0.617 in the post-test. The mean difference was 0.73, with a t-value of 3.54, and the results were statistically significant, with a p-value of 0.003.

		Mean	SD	Mean difference	T value	P value
FOIS	Pre	2.6	0.507	3.67	16.4	0.00
	Post	6.27	0.703			
SNIP	Pre	89.54	2.93	16.72	11.94	0.00
	Post	106.26	4.56			
DSS	Pre	2.74	0.458	3.66	16.35	0.00
	Post	6.4	0.737			

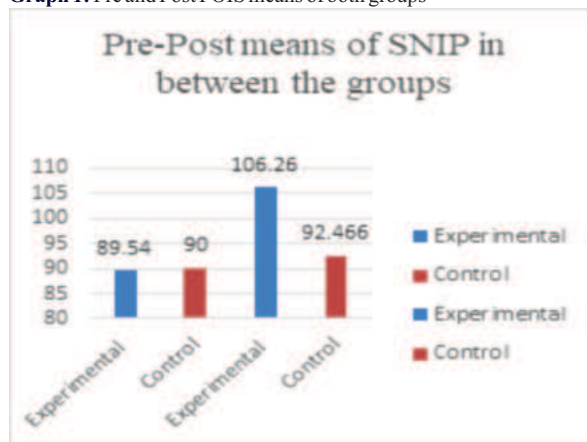
Table : Pre and post mean values of FOIS, SNIP, DSS scales with in the experimental groups

In the control group, the pre-test mean value for Sniff Nasal Inspiratory Pressure (SNIP) was 90 ± 2.138 , which increased to 92.47 ± 1.922 in the post-test. The mean difference was 2.47, with a t-value of 3.32, and the results were statistically significant, with a p-value of 0.0054.

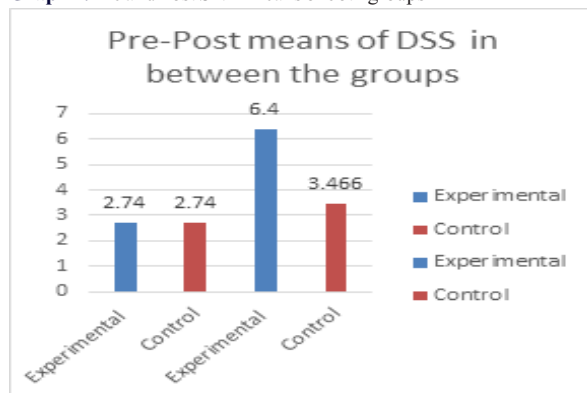
In the control group, the pre-test mean score for the Dysphagia Severity Scale (DSS) was 2.74 ± 0.457 , which increased to 3.47 ± 0.516 in the post-test. The mean difference was 0.73, with a t-value of 4.11, and the results were statistically significant, with a p-value of 0.001.



Graph 1: Pre and Post FOIS means of both groups



Graph 2: Pre and Post SNIP means of both groups



Graph 3: Pre and Post DSS means of both groups

DISCUSSION

The present study found that the training with the breather device was found to be significant with a mean difference of 3.67 in FOIS, 16.72 in SNIP and 3.66 in DSS when compared to traditional; dysphagia management and the underlying physiology that can be attributed to the improvement in experimental group is as follows:

Respiratory muscle training (RMT) improves swallowing by enhancing inspiratory and expiratory muscles, promoting increased intrathoracic pressure, and preventing aspiration (Rosenbek et al., 1996)59. This enhances neuromuscular coupling, allowing normal swallowing timing without disrupting breathing or causing aspiration (Swayne et al., 2008)60. RMT may cause neuroplastic changes in the brain, affecting swallowing and respiration motor control. Improved respiratory muscle strength can improve laryngeal closure during swallowing, reducing the risk of aspiration pneumonia, a common complication in dysphagic stroke patients (Zhao et al., 2020)61. RMT also enhances the functional capacity of pharyngeal and laryngeal muscles, enhancing their tone and endurance. (Troche et al., 2014)^(9,10)

A study by Smith, T., Johnson, M., & Miller, B. (2018) was done on Combined effectiveness of traditional dysphagia management

techniques in stroke rehabilitation. The study concluded that traditional dysphagia management with other intervention modalities can be considered as a treatment option that provide improvement in dysphagia, respiratory muscle strength, and swallowing function in patient after stroke^(11,12,13)

A study by Choi et al. (2020) investigated the impact of combined respiratory muscle training using the **Breather device** in stroke patients with dysphagia. The device provides **inspiratory and expiratory resistance**, strengthening key respiratory muscles like the **diaphragm** and **intercostals**. He concludes that cRMT training improves **lung capacity, swallowing coordination, and laryngeal elevation**, while increasing **respiratory muscle strength**, measured by **maximal inspiratory pressure (MIP)** and **sniff nasal inspiratory pressure (SNIP)**. Enhanced respiratory function improves **breathing-swallowing coordination**, resulting in safer swallowing and reducing **aspiration risk**. Overall, the Breather device significantly aids in both **swallowing safety** and **respiratory health** in stroke patients.⁽¹³⁾

CONCLUSION:

This study shows that combining inspiratory and expiratory respiratory muscle training (RMT) helps improve swallowing function, respiratory strength, and reduces the severity of dysphagia in acute stroke patients. The experimental group experienced significant improvements in swallowing ability, respiratory strength, and overall dysphagia severity, highlighting RMT as a promising rehabilitation approach for better muscle coordination and airway protection.

Limitations And Recommendation:

1. As the sample size was relatively small (n = 30), which may limit the generalizability of our findings.
2. The 4-week duration even though showed significant results, the long-term sustainability of these improvements remains unclear.
3. Larger studies with more diverse stroke populations, including different severities of stroke, are needed to validate these results.
4. Future studies could incorporate follow-up assessments to determine whether the effects of cRMT are maintained beyond the intervention period.
5. More research is needed to compare the effectiveness of different cRMT devices (the Breather device), or training protocols, particularly in terms of long-term outcomes.

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