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Effect of Chin Tuck Against Resistance (CTAR) Exercise in Improving Swallowing ability among Stroke patients with Dysphagia: A pilot study

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ABSTRACT

Background: *Stroke remains the second leading cause of mortality and the third most significant contributor to disability globally, accounting for approximately 6.5 million deaths and 113 million disability cases. In India, the burden of ischemic heart disease and stroke has surged by 2.3 times over the past 30 years—from 25.7 million cases in 1990 to 64 million by 2023. Dysphagia affects up to 65% of stroke survivors, posing serious risks such as aspiration and nutritional deficiency. Chin Tuck Against Resistance (CTAR) exercises have emerged as a promising therapeutic approach to address post-stroke dysphagia, aiming to enhance swallowing function and minimize aspiration risks.* ***Aim:*** *This study aimed to evaluate the effectiveness of CTAR exercises in improving swallowing ability among stroke patients experiencing dysphagia.*

Materials and Methods: *A pilot study was conducted at the All India Institute of Medical Sciences (AIIMS), Jodhpur, over a two-month period (February–March 2024), using a non- equivalent control group design. A total of 10 stroke patients with dysphagia (5 in each group) were recruited from the Neurology ward and ICU using purposive sampling. The Gugging Swallowing Screen (GUSS) was used to assess swallowing function, complemented by a direct swallowing test. The intervention group received CTAR exercises as per a standardized protocol—three sessions daily for seven consecutive days. Ethical approval (AIIMS/IEC/2023/5765) was obtained. Data were analyzed using IBM SPSS v20, employing descriptive and inferential statistics, including Repeated Measures ANOVA.*

Results: *At baseline, all participants exhibited severe dysphagia (GUSS score 0–9). By Day 7, 60% of the intervention group improved to mild dysphagia and 40% to moderate, with none remaining in the severe category. In contrast, 60% of the control group continued to exhibit severe dysphagia. Mean swallowing scores in the intervention group rose from 4.80 ± 0.44 on Day 1 to 14.40 ± 1.14 by Day 7, while the control group improved from 4.60 ± 0.89 to 9.00 ±1.00. Statistical analysis revealed significant effects of time ($p < 0.001$, $\eta p^2 = 0.985$), group ($p< 0.001$, $\eta p^2 = 0.717$), and time-group interaction ($p < 0.001$, $\eta p^2 = 0.914$), indicating a more substantial and rapid improvement in the intervention group.*

Conclusion: *The findings underscore the effectiveness of CTAR exercises in significantly enhancing swallowing function in stroke patients. These results support incorporating CTAR into standard post-stroke rehabilitation practices to improve outcomes for patients with dysphagia.*

BACKGROUND

Stroke is the instantaneous death of brain cells due to cessation of blood flow and lack of blood supply which is caused by occlusion or burst of an artery in the brain.[1]. Globally, stroke ranks as the second leading cause of death and the third most significant contributor to disability, which was approximately 6.5 million and 113 million respectively. By 2050, over 80% of the global stroke burden is projected to occur in low- and middle-income countries.[2] The World Stroke Organization reports that more than 12 million individuals worldwide experience a stroke annually and nearly half of these individuals experience complications that impact their quality of life, including dysphagia, or difficulty swallowing.[3]

In 2021, India bore a substantial share of the global stroke burden, contributing to 10% of the worldwide total. Globally, strokes affected 11.9 million people - a 70% rise since 1990.[4] Within India, there were 1.25 million new stroke cases reported in 2021, representing a 51% increase from 1990. This sharp rise in stroke incidence in India plays a significant part in the growing global impact of the disease.[5] By 2023, the occurrence of ischemic heart disease and stroke in India has risen by approximately 2.3 times compared to the past 30 years, escalating from 25.7 million cases in 1990 to 64 million cases in 2023.[6]

Dysphagia can occur in up to 65% of stroke patients, particularly those in the acute and subacute phases.[8] Dysphagia can be improved through exercise based therapy that positively increases the status of swallowing capability like Chin Tuck Against Resistance (CTAR) exercise and shaker exercise can facilitate and improve the physiologic status in the deprived laryngeal musculature.[9]

CTAR is a head-and-neck-based isometric and isotonic exercise that engages the suprahyoid muscles by instructing patients to tuck their chin against resistance, such as an inflatable ball or resistance device. CTAR can be performed while seated, making it more accessible and practical.[10] Several studies have shown promising results with CTAR in enhancing swallowing function. For instance, a study demonstrated that CTAR significantly improved hyoid bone movement and reduced pharyngeal residue in stroke patients. Furthermore, CTAR has been shown to activate the suprahyoid muscles more effectively than traditional exercises, thus contributing to improved swallowing safety and reduced aspiration risk.[11]

Many studies conducted on CTAR exercise showed that it as an alternative remedial strategy to treat post stroke dysphagia.[12] It observed that to improve the difficulty in swallowing ability in post stroke patients. It is very much important that the feeding technique requires modification through CTAR Exercise.[13] CTAR is a rehabilitative therapy that would effective in bring out a positive improvement in laryngeal musculature with compliance to CTAR.[14] Rehabilitative swallowing exercise like CTAR would be effective for improvement of feeding performance and to prevent risk of aspiration in dysphagia patients following stroke. While existing evidence supports CTAR's role in improving swallowing function, there remains a critical need for more focused research assessing its clinical efficacy in stroke-related dysphagia.

This study aims to fill that gap by evaluating CTAR's impact on swallowing ability among stroke patients, with the ultimate goal of informing practice, improving outcomes, and reducing complications associated with dysphagia.

AIMS AND OBJECTIVES

The study was conducted with aim to assess levels of dysphagia among stroke patients. The main aim was to evaluate how effective Chin Tuck Against Resistance (CTAR) exercises are in enhancing swallowing ability among stroke patients in the experimental group, and to compare the improvements in swallowing function between the experimental and control groups.

MATERIAL AND METHODS

The study was conducted at All India Institute of Medical Sciences (AIIMS) Jodhpur, a tertiary care teaching hospital in western Rajasthan, India using Non-Equivalent Control Group Design. This study conducted over a two month period, from February to March 2024. A sample size of 10 stroke patients with dysphagia seeking treatment at the Neurology ward and Neurology ICU, AIIMS, Jodhpur, were selected using nonprobability purposive sampling technique for the pilot study Inclusion criteria included the stroke patients who are admitted with having difficulty in swallowing ability; Conscious, and following commands; Show willingness to participate; Comfortable in sitting position for feeding. Patients with Tracheostomy, Endotracheal intubation or any other neurological problem were excluded for this study. The ethical clearance (AIIMS/IEC/2023 /5765) was received from Institutional Ethical Clearance committees.

Data Collection Tool

The data collection instrument is divided into two sections. Section I was a questionnaire that included Socio-demographic information sheet, Medical condition assessment sheet, Swallowing ability assessment sheet and Nutritional assessment sheet with purpose to collect base line information by interview technique. Section II included a scale to assess swallowing ability of patients. A standardized tool Gugging Swallowing Screen scale (GUSS) was used for preliminary assessment and direct swallowing test data collection. The Gugging Swallowing Screen scale was used to assess the severity of dysphagia, categorizing it as follows: Severe (scores 0–9), Moderate (10–14), Mild (15–19), and No Dysphagia (score of 20)

Data Collection Procedure

Participants fulfilling the inclusion criteria in the Neurology wards and Neurology ICU were selected and recruited for this study. To avoid sample contamination, participants for the control group were selected initially, followed by the selection of participants for the experimental group. Informed written consents were obtained

from the patients for conducting the study and they were informed about the intervention. The interventional group has received the intervention along with the usual care. The Chin Tuck Against Resistance exercise was practiced as per set protocol consecutively for seven days with three sessions each day (morning, afternoon and evening). This exercise was repeated ten times or as tolerated by the patient in each session. The control group were given usual care in that period. After intervention, ability to swallowing was assessed by GUSS scale and the data has been recorded on 1st, 3rd, 5th and 7th day. A short video was recorded for participants for understanding and standardised practice of CTAR Exercise.

Data Analysis

Data analysis was carried out using IBM SPSS version 20. Descriptive statistics such as frequency, percentage, mean, and standard deviation were utilized to present the socio- demographic profile of stroke patients. For evaluating differences in swallowing ability between the intervention and control groups on Days 1, 3, 5, and 7, Repeated Measures ANOVA was applied as an inferential statistical method to determine statistical significance.

RESULT

Section I: Pre-interventional comparison of Baseline Data of study participants

Table 1.1: Baseline Comparison of Demographic Characteristics of Stroke Patients Between Intervention and Control Group. N=10

Demographic Variables	Intervention Group (n1 = 5)		Control Group (n2 = 5)		P value
	f	%	f	%	
Age					
31-40 years	0	0	0	0	
41-50 years	1	20	1	20	0.53
51-60 years	2	40	3	60	
60 or above	2	40	1	20	
Gender					
Male	3	60	4	80	0.47
Female	2	40	1	20	
Education					
Uneducated	2	40	1	20	
Primary	2	40	2	40	0.66
Secondary	1	20	2	40	
Graduation	0	0	0	0	
Occupation					
None	1	20	1	20	
Self Employed	2	40	2	40	
Private Employee	2	40	1	20	1.33
Govt. Employee	0	0	1	20	

Table 1.1 presents the baseline comparison of demographic variables between the intervention and control groups. There were no statistically significant differences between the groups in terms of age, gender, education level, or occupation ($p > 0.05$), indicating they were comparable. The majority of participants were males aged between 51 and 60 years, with most having either no formal education or only primary schooling. Common occupations included self-employed and privately employed individuals.

Table 1.2: Comparison of Medical History of Stroke Patients in Intervention and Control Groups

	N=10				
Medical History	**Intervention Group (n1 = 5)**		**Control Group (n2=5)**		**P value**
	f	%	**f**	%	
Diagnosis					
Right hemiparesis	2	40	1	20	
Right hemiplegia	1	20	2	40	2.00
Left hemiparesis	2	40	1	20	
Left hemiplegia	0	0	1	20	
Cause of the stroke					
Ischemic Stroke	4	80	5	100	1.11
Haemorrhagic Stroke	1	20	0	0	
Associated illness					
Diabetes mellitus	2	40	1	20	
Hypertension	1	20	1	20	
Both diabetes and hypertension	1	20	2	40	0.67
Both diabetes and hypertension with Ischemic heart disease	1	20	1	20	
Both diabetes and hypertension with chronic kidney disease	0	0	0	0	
No associated illness	0	0	0	0	
Duration of stroke					
< 7 days	1	20	1	20	
8 - 14 days	2	40	1	20	0..53
15 - 21 days	2	40	3	60	
> 21 days	0	0	0	0	
Family history of stroke					
Yes	0	0	0	0	NA
No	5	100	5	100	

Table 1.2 outlines the medical history of n the intervention and control groups stroke patients (N=10, 5 in each group). Both groups were similar, with no significant differences has been observed. Most patients had stroke duration of 15–21 days and majority has ischemic stroke.

Table 1.3: Dysphagia Symptoms among Stroke patients in Intervention and Control Group

	N=10				
Dysphagia Symptoms	**Intervention Group (n1 = 5)**		**Control Group (n2=5)**		**P value**
	f	%	**f**	%	
Drooling					
Yes	1	20	3	60	1.23
No	4	80	2	40	
Coughing					

Yes	1	20	4	80	3.60
No	4	80	1	20	
Choking					NA
Yes	0	0	0	0	—
No	5	100	5	100	
Difficulty in Swallowing					
Semisolid	5	100	5	100	NA
Liquid	0	00	0	0	
Solid	0	0	0	0	
Pain on swallowing					
Yes	5	100	5	100	NA
No	0	0	0	0	
Weight loss					
Yes	4	80	5	100	1.11
No	1	20	0	0	
History of aspiration					
Yes	0	0	0	0	NA
No	5	100	5	100	

Table 1.3 displays the frequency and percentage distribution of dysphagia-related symptoms among stroke patients in both the intervention and control groups (n=10). There were no statistically significant differences observed in any of the reported symptoms.

Table 1.4: Diet History among Stroke patients in Intervention and Control Group N=10

Diet History	Intervention Group (n1 = 5)		Control Group (n2=5)		P value
	f	%	f	%	
Current Diet					
Nil per oral (NPO)	5	100	5	100	NA
Liquid diet	-	-	-	-	
Semisolid diet	-	-	-	-	
Alternative Nutrition Method					
Nasogastric Tube Feed	5	100	5	100	
Percutaneous Entero gastrostomy feed	-	-	-	-	
Dependency state of feeding					
Partially dependent for feeding	-	-	-	-	NA
Completely dependent for feeding	5	100	5	100	

Table 1.4 shows the diet history of stroke patients in the Intervention and Control Groups (n=10). Both groups were entirely dependent on alternative nutrition methods, with all patients in both groups receiving nasogastric tube feeding (100%). No significant differences were observed between the two groups in terms of diet history or feeding dependency.

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SECTION II: Findings related to levels of dysphagia among stroke patients.

Table 2.1 displays the comparison of dysphagia levels among intervention and control groups stroke patients (N=10, 5 in each group) based on GUSS scores over seven days. All patients initially had severe dysphagia (score 0-9). By Day 7, the intervention group showed marked improvement, with 40%(2) progressing to moderate dysphagia and 60%(3) achieving mild dysphagia, while no patients

Table 2.1: Assessment of Dysphagia Severity in Stroke Patients Using GUSS Scores – Comparison Between Intervention and Control Groups **N=10**

S.N	GUSS Score	Levels of dysphagia	Intervention Group n1=5 f (%)					Control Group n2=5 f (%)				
			Pre-test	Day-1	Day-3	Day-5	Day-7	Pre-test	Day-1	Day-3	Day-5	Day-7
1	20	No dysphagia	0	0	0	0	0	0	0	0	0	0
2	15 - 19	Mild dysphagia	0	0	0	0	3(60)	0	0	0	0	0
3	10 - 14	Moderate dysphagia	0	0	0	4(80)	2(40)	0	0	0	1(20)	2(40)
4	0 - 9	Severe dysphagia	5 (100)	5(100)	5(100)	1(20)	0	5(100)	5(100)	5(100)	4 (80)	3(60)

SECTION III: Evaluation of Swallowing Ability Progress Based on GUSS Scores Among Stroke Patients Within the Intervention Groups

Table 3.1: Comparison of improvement of Swallowing ability among stroke patients across time points between Intervention group and Control Group. N=10

Days	Interve-ntion Group n=5	Control Group n=5	Repeated Measures of ANOVA								
	Mean (SD)	Mean (SD)	Time Effect	p	(*np2*)	Group Effect	p	(*np2*)	Time* Group Effect	p	(*np2*)
Day1	4.80 (0.44)	4.60 (0.89)	$F^{(1.80)}$ 188.23*	<.001	0.985	$F^{(1.01)}$ 32.12*	<.001	0.717	$F^{(1.80)}$ 21.19*	<.001	0.914
Day3	7.60 (0.89)	4.80 (0.83)									
Day5	11.00 (1.58)	7.00 (1.41)									
Day7	14.40 (1.14)	9.00 (1.00)									

*Significant at the level of p<0.05; SD – Standard Deviation

remained in the severe category. In contrast, the control group had slower progress, with 60%(3) still in the severe category by Day 7. This highlights greater improvement in the intervention group.

Table 3.1 Compares the improvement in swallowing ability instroke patients between the both groups (N=10, 5 in each group) across four time points using repeated measures ANOVA. The intervention group showed a markedly higher increase in mean swallowing ability scores from Day 1 (4.80 ± 0.44) to Day 7 (14.40 ± 1.14) compared to the control
group, which improved from Day 1 (4.60 ± 0.89) to Day 7 (9.00 ± 1.00). Significant effects were observed for time ($p < 0.001$, $\eta p^2 = 0.985$), group ($p < 0.001$, $\eta p^2 = 0.717$), and time*group interaction ($p < 0.001$, $\eta p^2 = 0.914$), indicating faster and more pronounced improvement in the intervention group.

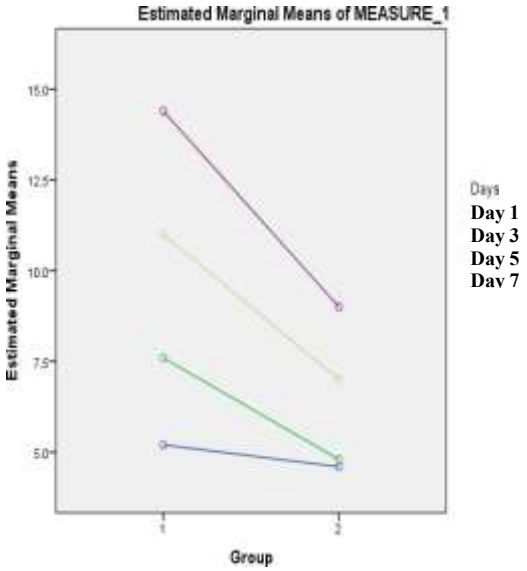

Figure 3.1 Profit Plot Showing mean difference in increase in GUSS score among stroke patients of intervention group (1) and control group (2).

DISCUSSION

The findings indicate that the intervention led to a notable improvement in swallowing ability among stroke patients when compared to the control group, as reflected by changes in both dysphagia levels and GUSS scores. The intervention group showed rapid improvements, particularly from Day 5 to Day 7, suggesting that the treatment or intervention used in this group was effective in promoting recovery of swallowing function. The control group also showed improvement, but the changes were less pronounced and slower.

These findings are consistent with existing research by *Chichero J et al. (2019)* indicating that early and structured swallowing interventions can significantly enhance functional swallowing outcomes post-stroke. A similar study emphasized the effectiveness of individualized therapy in reducing dysphagia severity[16], while another study by *Bath PM et al. (2018)* highlighted that early therapeutic involvement reduces complications like aspiration and malnutrition. The marked improvement in the intervention group underscores the value of proactive management strategies in the rehabilitation of stroke-induced dysphagia.[7]

This improvement aligns with findings from a study by *Martino R et al. (2015)* which established that early intervention in dysphagia rehabilitation is associated with better recovery trajectories and fewer complications.[17] Additionally, the observed pattern supports the clinical assertion that neuroplastic adaptation in swallowing pathways is possible, particularly within the first few weeks post-stroke *by Hamdy et al. (2008)*.[12]

The mean GUSS scores in the intervention group increased from 4.80 (Day 1) to 14.40 (Day 7), while the control group only improved from 4.60 to 9.00. This substantial difference suggests the intervention had a strong and progressive impact. These findings resonate with a study by *Carnaby-Mann GD et al. (2005)* showed that intensive swallowing exercises can significantly accelerate recovery and improve safety of oral intake in dysphagic stroke patients.[18]

These results align with those reported in a study by *Choy J et al.* (2023) where it is found that intensive, targeted swallowing therapy significantly improved functional swallowing outcomes compared to conventional therapy.[19] The results also resonate with study by *Mao L et al. (2024)* that showed that a combination of repetitive oral motor exercises and effortful swallowing significantly improved GUSS scores in stroke patients within a short timeframe.[20]

CONCLUSION

In conclusion, the study demonstrates that the intervention effectively enhanced swallowing ability in stroke patients, with those in the intervention group experiencing quicker and more substantial improvements in dysphagia than those in the control group. This suggests that the intervention could be a valuable addition to clinical practice for managing swallowing difficulties in stroke patients. The findings of the study strongly support

the effectiveness of CTAR exercises in enhancing swallowing ability among stroke patients and suggest their potential integration into routine post-stroke rehabilitation protocols. These results align with existing literature and highlight the importance of early, structured, and evidence-based dysphagia management in stroke rehabilitation. Further research could explore the long-term effects of this intervention and its potential for wider implementation.

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