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Evaluating The Efficacy of Functional Movement Analysis and Treatment Strategy (F-Mats) in the Enhancement of Trunk Alignment and Postural Control in Individuals with Chronic Stroke

Himanshu Anand[1], Dr. Vishal Sharma[2]

[1]Pacific College of Occupational Therapy, [2]Principal Pacific College of Occupational Therapy
Pacific Medical University, Bhilo ka Bedla, Udaipur

ABSTRACT :

Stroke often results in impaired trunk alignment and postural control, which adversely affect functional independence. This study aimed to evaluate the efficacy of the Functional Movement Analysis and Treatment Strategy (F-MATS) in addressing these challenges in individuals with chronic stroke. F-MATS was conceptualized as a systematic approach integrating detailed movement assessment and task-oriented rehabilitation strategies, emphasizing the role of peripheral demand in influencing central motor programs. Key components included movement analysis, assisted tactile stimuli, dynamic volition stimulation, and functional task practice tailored to enhance trunk alignment and postural control.

The study also compared the effectiveness of F-MATS with conventional treatment in improving trunk alignment and postural control among chronic stroke patients. Results demonstrated the potential of F-MATS to provide a structured and patient-specific framework for motor recovery, showing significant improvements in trunk stability and postural control over conventional methods. These findings highlight F-MATS as a promising approach to rehabilitation, offering a novel pathway to optimize recovery and improve the quality of life for individuals living with chronic stroke.

Keywords: Functional Movement Analysis and Treatment Strategy (F-MATS), Trunk Alignment, Postural Control, Chronic Stroke, Task-Oriented Rehabilitation, Movement Assessment, Stroke Rehabilitation, Motor Recovery, Dynamic Volition Stimulation.

Introduction :

Stroke, a leading cause of adult disability worldwide, often leaves survivors with persistent motor impairments and deficits in postural control. These deficits can significantly hinder activities of daily living (ADLs) and quality of life, particularly due to challenges in trunk alignment and postural stability. The ability to maintain a stable trunk is fundamental to functional independence, as it underpins balance, limb movement coordination, and the execution of complex motor tasks. However, achieving meaningful recovery of trunk and postural control remains a clinical challenge for many individuals with chronic stroke.

Traditional rehabilitation approaches for post-stroke motor impairments have focused on task-oriented training, strength exercises, and balance interventions. While these strategies have demonstrated varying degrees of success, their efficacy in addressing the nuanced and dynamic interplay of trunk alignment and postural control remains limited. There is growing recognition of the need for targeted, evidence-based interventions that holistically address motor dysfunctions in stroke survivors.

Functional Movement Analysis and Treatment Strategy (F-MATS) has emerged as a promising framework for addressing this gap in post-stroke rehabilitation. Rooted in the principles of functional movement patterns, neuromuscular control, and biomechanical alignment, F-MATS aims to assess and treat motor impairments through an individualized and integrative approach. Unlike traditional methods, F-MATS emphasizes the interrelationship between trunk stability, postural alignment, and overall functional performance, providing a comprehensive framework to optimize motor recovery.

Chronic stroke patients often exhibit compensatory movement patterns that further exacerbate postural instability and misalignments. These compensations can lead to secondary complications, including musculoskeletal pain, fatigue, and diminished overall mobility. F-MATS seeks to break this cycle by retraining foundational movement patterns and restoring optimal neuromuscular coordination. By targeting the underlying biomechanical and neurological deficits, F-MATS offers the potential to enhance postural control and trunk alignment in a manner that translates to functional improvements in everyday life.

The efficacy of F-MATS in the context of chronic stroke rehabilitation, however, remains underexplored. Current research on post-stroke motor rehabilitation primarily addresses limb function and gross motor performance, with limited emphasis on the intricate dynamics of trunk and postural control. Furthermore, many conventional rehabilitation paradigms overlook the critical role of individualized assessments and tailored interventions in optimizing outcomes for stroke survivors.

This study aims to evaluate the efficacy of F-MATS in improving trunk alignment and postural control in individuals with chronic stroke. By focusing on these specific dimensions of motor recovery, the research seeks to fill a crucial gap in the current literature and provide a robust evidence base for the adoption of F-MATS in clinical practice. The study hypothesizes that the implementation of F-MATS will lead to significant improvements in postural control, trunk stability, and functional mobility among stroke survivors, thereby enhancing their overall quality of life. In this paper, we present a comprehensive evaluation of F-MATS, beginning with an overview of its theoretical underpinnings and practical applications in stroke rehabilitation. Subsequent sections will detail the study's methodology, analysis of outcomes, and implications for clinical practice. By integrating insights from biomechanics, neuroscience, and rehabilitation science, this research seeks to advance the understanding of targeted interventions for postural recovery in chronic stroke populations.

Background :

Stroke is a clinical syndrome characterized by the rapid onset of focal or global disturbances in cerebral function, lasting more than 24 hours or resulting in death, with no apparent cause other than a vascular origin. One of the key consequences of stroke is muscle weakness, which significantly limits motor recovery. Unlike the extremities, the trunk is bilaterally affected in stroke, making its assessment critical for planning effective rehabilitation strategies.
The trunk's recruitment precedes that of limb joints, initiating movement earlier and continuing even after the limbs have reached their target. This involvement of the trunk impacts balance and functional abilities, which are commonly evaluated using tools such as the Trunk Control Test and the Trunk Impairment Scales (TIS) developed by Verhaegen and Fujiwara.
Poor trunk balance and alignment are prevalent neuromusculoskeletal impairments in stroke patients. To address these issues, various approaches have been developed, focusing on improving trunk alignment and control.

Aim and Objectives :

Aim of Study

The aim of the study is to find out the comparison of Functional movement analysis treatment strategy and conventional to improve trunk alignment and postural control in chronic stroke patient.

Objectives of the Study

1. To contrive F- MATS **(**Functional Movement Analysis Treatment Strategy), which focused on assessment of each and every movement of body and task-oriented rehabilitation strategy in a well-organized way for trunk alignment and postural control post stroke, by engaging patient in functional task as peripheral demand influence the central program.
2. To dispense F-MAT **(**Functional Movement Analysis Treatment Strategy) strategy in movement assessment, assisted tactile stimulus, dynamic volition stimulation and practice of functional task for trunk alignment and postural control post stroke.
3. To compare the effectiveness F-MATS **(**Functional Movement Analysis Treatment Strategy) Approach and conventional treatment on improving Trunk Alignment and postural control in chronic stroke patient.

3.1 Hypothesis

Null hypothesis: There is NO significant impairment in trunk alignment and postural control in post stroke patient after rehabilitating with F- MATS **(**Functional Movement Analysis Treatment Strategy) as compared to conventional method.
Alternate hypothesis: There is a significant recovery in trunk alignment and postural control post stroke patient after rehabilitating with F- MATS **(**Functional Movement Analysis Treatment Strategy) as compared to conventional method.
0PERATIONAL DEFINITION
Stroke "Rapidly developed clinical sign of focal (or) global disturbance of cerebral function lasting more than 24 hours or leading to death with apparent cause other than vascular origin".- WHO (1996)
Postural Assessment Scale for Stroke
PASS is a postural assessment scale specifically designed to assess and monitor postural control after stroke. It contains 12 four-level items of varying difficulty for assessing ability to maintain or change a given lying, sitting, or standing posture.
The PASS was developed in 1999 by Benaim et al. as an adaptation of the Fugl-Meyer Assessment balance subscale (Benaim et al., 1999). It was originally developed in French and has since been translated into English and Swedish (SwePASS). Short forms of the PASS, with fewer items (5-item SFPASS) and/or smaller scoring scales (PASS-3P), have also been developed.
Trunk Impairment scale:
Trunk Impairment scale (TIS) assesses static and dynamic sitting balance and trunk coordination in a sitting position. Verheyden (Verheyden, Nuyens, et al., 2006)
Berg balance scale:
The Berg balance scale is used to objectively determine a patient's ability (or inability) to safely balance during a series of predetermined tasks. It is a 14 item list with each item consisting of a five-point ordinal scale ranging from 0 to 4, with 0 indicating the lowest level of function and 4 the highest level of function. Elderly population with impairment of balance, patients with acute stroke. (Berg et al 1995, Usuda et al 1998).
Functional movement analysis and treatment strategy (F-MATS)

Functional movement analysis and treatment strategy (F-MATS) is a unique holistic and conspicuous functional movement based therapeutic approach to rehabilitate people with neuromuscular dysfunctions. MATS utilizes the knowledge of human's movement sciences and neurophysiology to understand the patho-mechanics of neuro-muscular dysfunctions resulting from various disease and disorders and work upon to find the problem considering the Biomechanics and human physiology, make the therapeutic strategy to solve the problems in best possible ways based upon functional movement analysis.

Methodology :

STUDY DESIGN

An experimental study design consisting of two groups with pre- and post-evaluation.

STUDY METHOD

Subjects were divided into two groups: a control group and an experimental group. The control group consisted of 12 subjects who were treated with the conventional method, while the experimental group consisted of 12 subjects who were treated with the Functional Movement Analysis Treatment Strategy (F-MATS).

SAMPLING TECHNIQUE

Random sampling was conducted using a sealed random envelope generator.

SAMPLE SIZE

A total of 24 subjects participated in the study.

STUDY SETTING / SOURCE OF DATA

The study was conducted at Pacific Hospitals, Udaipur, over a period of 4 months.

SELECTION CRITERIA

Inclusion Criteria:

- Patients diagnosed with ischemic stroke.
- Age range between 40 and 70 years.
- Both male and female participants.
- Patients able to understand instructions.

Exclusion Criteria:

- Post-stroke patients with a history of trauma or injury.
- Post-stroke patients with hip replacements.
- Patients with sensory involvement, cognitive impairment, or Reflex Sympathetic Dystrophy (RSD).
- Patients experiencing unbearable pain or medical instability.
- History of spinal surgery, traumatic injuries, or Prolapsed Intervertebral Disc (PIVD).
- Orthopedic problems affecting their ability to maintain a sitting position or perform tasks with one arm.
- Visual impairments interfering with task execution.

OUTCOME MEASURES

The following tools were used to evaluate outcomes:

1. PASS (Postural Assessment Scale for Stroke)
2. TIS (Trunk Impairment Scale)
3. Berg Balance Scale

STATISTICAL TOOLS

SPSS statistical software was used to compare the mean and p-value between the two groups.

MATERIALS REQUIRED

The materials required for the study included a couch, pillow, ruler, two standard chairs (one with armrests and one without armrests), a footstool or step, and a static bicycle.

PROCEDURE / TREATMENT TECHNIQUES

The study employed two different treatment methods:

1. **Control Group: Conventional Method**
- Stretching exercises to improve flexibility.
- Strengthening exercises targeting specific muscle groups.
- Use of a stationary bicycle for cardio and endurance training.

2. **Experimental Group: F-MATS Technique**
- **Passive Elongation:** Elongated tight fascia and muscles causing neuromuscular-skeletal limitations.
- **Assisted Tactile Stimulation:** Facilitated weak muscles to remap movement patterns in the brain.
- **Dynamic Volitional Stimulation:** Practiced movement tasks in fragments by stabilizing other joints to achieve desired movements or functions at each joint.

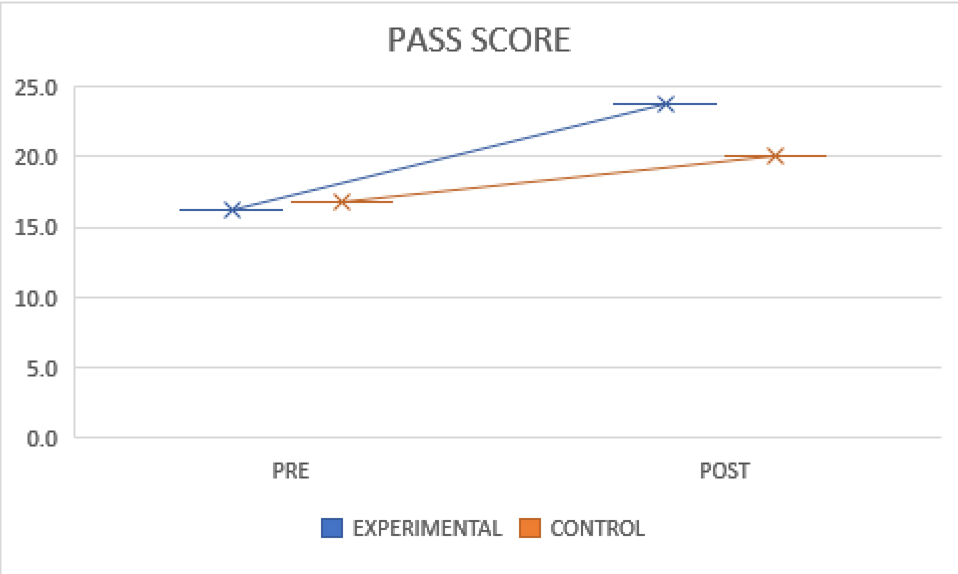
Data Analysis:

TABLE – 1: SHOWING DEMOGRAPHIC CHARECTERISTICS OF SUBJECTS					
SUBJECT -ID EXPERIMENTAL GROUP	GENDER	AGE	SUBJECT -ID CONTROL GROUP	GENDER	AGE
EX-02	M	46	CO-01	M	55
EX-06	F	46	CO-03	M	60
EX-09	F	54	CO-04	F	54
EX-10	M	48	CO-05	F	50
EX-11	M	59	CO-07	F	52
EX-13	M	46	CO-08	F	56
EX-15	F	60	CO-12	F	60
EX-17	F	52	CO-14	M	58
EX-19	F	56	CO-16	M	48
EX-20	F	50	CO-18	M	51
EX-21	F	51	CO-22	F	47
EX-24	F	58	CO-23	F	51
Mean age	F	52.2		F	53.5

TABLE -2: SHOWING THE DATA OF EXPERIMENTAL GROUP								
BASELINE ASSESSMENT					POST INTERVENTION			
SUBJECT	AGE	PASS	TIS	BERG	SUBJECT	PASS	TIS	BERG
EX-02	46	16	11	25	EX-02	24	17	40
EX-06	46	17	10	28	EX-06	21	19	34
EX-09	54	15	11	28	EX-09	23	16	38
EX-10	48	19	10	24	EX-10	26	17	40
EX-11	59	14	12	27	EX-11	28	15	34
EX-13	46	17	10	28	EX-13	24	16	32
EX-15	60	17	13	27	EX-15	21	16	31
EX-17	52	14	11	25	EX-17	28	17	30
EX-19	56	15	11	24	EX-19	23	15	40
EX-20	50	17	10	25	EX-20	21	18	36
EX-21	51	18	10	25	EX-21	23	19	37
EX-24	58	15	12	24	EX-24	23	17	42

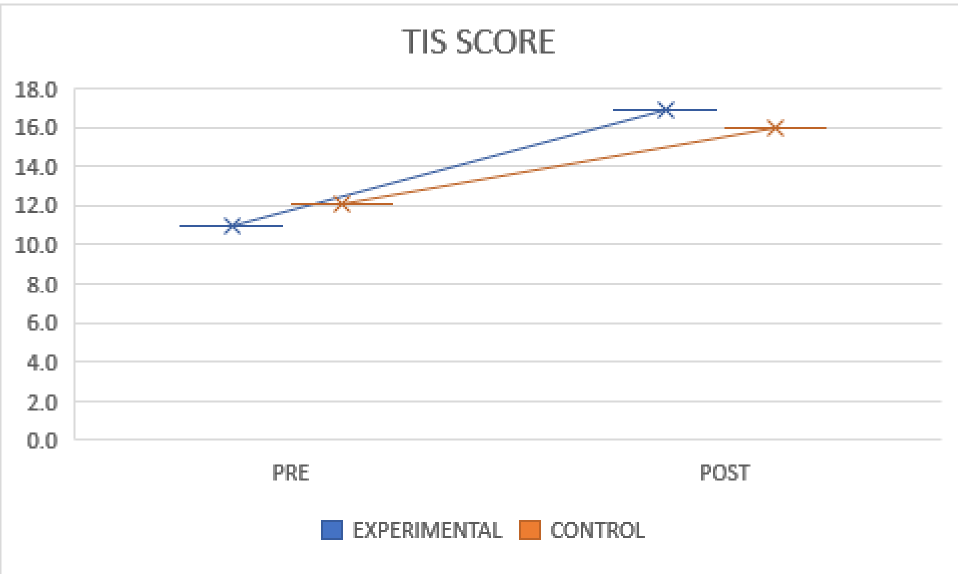
TABLE-3: SHOWING THE DATA OF CONTROL GROUP								
BASELINE ASSESSMENT					POST RX ASSESSMENT			
SUBJECT	AGE	PASS	TIS	BERG	SUBJECT	PASS	TIS	BERG
CO-01	55	17	13	24	CO-01	20	17	37
CO-03	60	18	14	28	CO-03	19	16	32
CO-04	54	14	13	25	CO-04	20	17	33
CO-05	50	15	10	24	CO-05	19	15	35
CO-07	52	19	12	28	CO-07	21	17	36
CO-08	56	16	12	28	CO-08	20	14	37
CO-12	60	19	12	26	CO-12	20	16	33
CO-14	58	14	12	27	CO-14	20	14	34
CO-16	48	18	13	24	CO-16	22	16	33
CO-18	51	15	11	25	CO-18	22	16	36
CO-22	47	19	11	26	CO-22	19	17	36
CO-23	51	17	12	29	CO-23	19	17	30

GRAPH 1



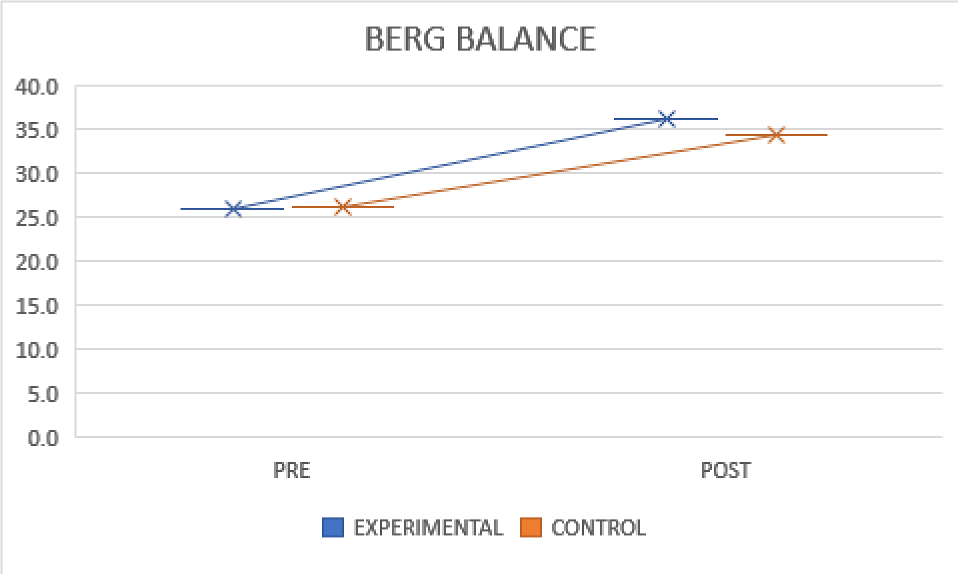
PASS	PRE	POST
EXPERIMENTAL	16.2	23.8
CONTROL	16.8	20.1

GRAPH 2



TIS	PRE	POST
EXPERIMENTAL	10.9	16.8
CONTROL	12.1	16.0

GRAPH 3



BERG	PRE	POST
EXPERIMENTAL	25.8	36.2
CONTROL	26.2	34.3

DATA INTERPRETATION

TABLE 4 SHOWING THE PRE AND POST MEAN AND p_value

		EXPERIMENTAL GROUP			CONTROL GROUP		
	Sample Size	PRE	POST	p_value	PRE	POST	p_value
PASS	12	16.2	23.8	0.2	16.8	20.1	0.1
TIS	12	10.9	16.8	0.3	12.1	16.0	0.9
BERG	12	25.8	36.2	0.0	26.2	34.3	0.5

PASS: Postural assessment Scale for Stroke
TIS: Trunk Impairment Scale
Berg: Berg Balance Scale

Results :

The demographic characteristics of the participants are presented in Table 1, highlighting a relatively balanced representation of genders and ages across both experimental and control groups. The mean age of participants in the experimental group was 52.2 years, while the control group had a slightly higher mean age of 53.5 years.

The pre- and post-intervention scores for the experimental group, shown in Table 2, indicate marked improvements across all outcome measures. The Postural Assessment Scale for Stroke (PASS) improved from a baseline mean score of 16.2 to 23.8 post-intervention. Similarly, the Trunk Impairment Scale (TIS) increased from 10.9 to 16.8, and the Berg Balance Scale (BBS) demonstrated the most notable improvement, rising from 25.8 to 36.2.

In contrast, the control group (as seen in Table 3) also showed improvements, though these were less pronounced. The mean PASS score increased from 16.8 to 20.1, TIS from 12.1 to 16.0, and BBS from 26.2 to 34.3.

Graph 1 underscores these differences, depicting a greater increase in PASS scores for the experimental group compared to the control group. While both groups improved in postural control, trunk impairment, and balance, the experimental group consistently demonstrated larger gains.

Table 4 provides a statistical analysis of the results. Significant improvements were observed in the experimental group for BBS ($p = 0.0$), indicating the intervention's effectiveness in improving balance. The changes in PASS ($p = 0.2$) and TIS ($p = 0.3$) for the experimental group approached statistical significance but did not meet the threshold, suggesting a trend toward improvement. In contrast, the control group showed less significant changes in all measures, with the most notable improvement seen in BBS ($p = 0.5$).

Overall, these results suggest that the experimental intervention had a substantial positive impact on postural control, trunk impairment, and balance compared to standard care in the control group.

Discussion :

The results from this study suggest that the experimental intervention had a more significant effect on improving postural control, trunk impairment, and balance compared to the standard care provided to the control group. As shown in the demographic characteristics, both groups were fairly balanced in terms of gender and age, which helps to ensure that observed differences in outcomes were more likely due to the intervention rather than demographic disparities.

The experimental group exhibited marked improvements across all outcome measures, with the most pronounced change observed in the Berg Balance Scale (BBS). The BBS improvement in this group was statistically significant ($p = 0.0$), underscoring the intervention's effectiveness in enhancing balance. Although the Postural Assessment Scale for Stroke (PASS) and the Trunk Impairment Scale (TIS) showed improvements, these changes did not reach statistical significance, suggesting that while the intervention may have a positive effect, the magnitude of change might require further investigation.

In comparison, the control group showed improvements across all scales, but these changes were less pronounced, and none of the results reached statistical significance. This suggests that while standard care may lead to some improvements, the experimental intervention is likely more effective in fostering postural and balance recovery.

The graphical representation in Graph 1 highlights these differences, providing a clear visual confirmation that the experimental group demonstrated greater improvements. Overall, the findings suggest that the intervention holds promise for enhancing outcomes in postural control, trunk impairment, and balance, and warrants further exploration in future studies to confirm its potential as an effective therapeutic approach.

Conclusion :

In conclusion, this study investigated the efficacy of the Functional Movement Analysis Strategy (F-MATS) technique compared to conventional therapy in improving trunk alignment and postural control in chronic stroke patients. The results, based on statistical analysis using ANOVA, indicate that the experimental group treated with the F-MATS technique showed significant improvements in the PASS, TIS, and Berg Balance Scale scores compared to the control group receiving conventional therapy. Thus, the findings suggest that the F-MATS technique is more effective than conventional treatment in promoting recovery of trunk alignment and postural control in chronic stroke patients.

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