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Effect of Clinical Pilates on Core Muscle Strength, Balance and Posture Control of a Recurrent Lacunar Stroke Patient – A Single Case Study

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ABSTRACT

Introduction: Balance and postural impairments evolve directly out of stroke or from the core instability, leading to difficulty in activities of daily living. Literature has shown evidence that training the core muscles using the Pilates exercises has shown improvements in functional ability, balance and posture in normal, geriatric, multiple sclerosis and Parkinson's patients.

Objective: To investigate the effects of clinical Pilates in balance, posture, and core stability of a recurrent lacunar stroke patient.

Methods: The participant was a 59-year-old male with recurrent stroke along with uncontrolled hypertension and type 2 Diabetes, came with Left hemiparesis, poor trunk control and reduced static and dynamic balance.

Results: The 3 weeks of clinical Pilates along with conventional physiotherapy showed significant improvements in the Trunk Impairment Scale and Postural Assessment Scale for Stroke of a recurrent lacunar Stroke patient.

Conclusion: Pilates is known as an exercise program to restore physical function effectively after stroke. Although, Pilates training has more beneficial effects on physical rehabilitation in stroke patients; the evidence to imply pilates exercises in the clinical practice is lacking in research.

Key Words: Pilates-based Exercises, Stroke, Balance, Posture

INTRODUCTION

Stroke is a neurological condition caused by sudden loss or disruption of the blood flow to the brain. When a clot blocks or impairs blood flow, depriving the brain of oxygen and nutrients is called Ischemic stroke and it is most common. Paralysis (hemiplegia) or Weakness (hemiparesis) are the typical features present on the contralateral side of the body following a stroke.¹

Lacunar infarct occurs in small penetrating arteries in deep structures of the brain, is one of the commonest ischaemic strokes, causing dysfunction of the areas supplied by that vessel; results in hemiparesis, ataxia, dysarthria, and mixed sensorimotor signs. Lacunar stroke recurs mostly among patients with diabetes, hypertension, smoking and advancing age. Strength deficits, poor balance, and postural impairments were remarkable symptoms of a stroke. Muscle weakness can be present in the extremities as well as the trunk musculature (Diaphragm, Transversus Abdominis, Multi-

fidus, and Pelvic floor). Balance and postural impairments evolve directly out of stroke or due to the core instability, leading to difficulty in activities of daily living (ADLs).²

Pilates, core stabilization exercises with feedback, Tai Chi and plank exercises were the interventions used for core strengthening in the previous literature. Joseph H. developed Pilates to strengthen the body using relaxed exercises aimed to improve flexibility, endurance, muscular control, and balance by strengthening the core muscles.³ Presently, literature has shown evidence that training the core muscles has shown improvements in functional ability, balance, and postural in normal, geriatric, multiple sclerosis, and Parkinson's disease, however, pilates studies in stroke patients were limited.⁴⁻⁶

This single case study uses the technique of clinical pilates in a recurrent lacunar stroke patient with uncontrolled hypertension and types 2 diabetes mellitus. Consequently, this study aims to investigate the effects of clinical Pilates on balance, posture and core stability of a recurrent lacunar stroke patient.

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CASE DESCRIPTION

Subject: A 59 years old male was referred to the Neuro physiotherapy department with complaints of Left upper and lower limb weakness, Unable to stand on his own, Unable to walk even with support, Difficulty in speech and swallowing. Further history taken from the patient revealed that he was a Retired Lawyer with Right-hand dominance, came to the Emergency Department with a history of giddiness 5 days before referring to the physiotherapy department. No history of LOC, Seizures, Vomiting, ENT bleed, Abdominal Pain were present at the time of admission and the Vitals during admission showed severe hypertension (PR: 98/min, SPO₂: 98%, BP: 200/120mmhg, RR: 18/min, TEMP: 98.6 F). On assessing the past medical history, the patient had a similar history 3 months back and diagnosed with Right PCA Infarct stroke which was medically managed. The patient was a known case of Type 2 Diabetes Mellitus and systemic hypertension on regular medication for the past 3 months. Also, he had an unclear history of Left hip fracture 15 years ago managed conservatively. Based on his personal history, he was a non-alcoholic, non-smoker and he was on a diabetic diet for 3 months. His family history, socioeconomic history, and occupational history were unremarkable.

Objective examination

Vital signs were measured on each session before the therapy and after the therapy. The vital signs ranged between (Respiratory Rate: 20-26/min), (Blood Pressure: 140-200/90-110 mmHg), (Temperature: 96-98 F), (SpO₂: 96-100%), and (Pulse Rate: 70-82/min).

On observation

Mesomorphic, Abdomino-thoracic pattern of Respiration, presented with IV line on left metacarpal vein and Urinary Condom Catheter. Both upper and lower limbs on the left side were extended, adducted, and externally rotated on supine lying. The patient laterally flexes towards the affected side in sitting and stoops forward with incomplete knee extension in standing with 2 person support. No significant oedema, Muscle Wasting, or Deformity was present.

Outcome measures

The initial examination was done using the National Institutes of Health Stroke Scale (NIHSS) ⁷ and the patient is interpreted as moderate stroke based on his scores. The interpretation of NIHSS scores was shown in Table 1. NIHSS is a valid and reliable tool used to quantify stroke severity with 11 items scoring between 0 and 4.

The core muscle strength, static and dynamic sitting balance, as well as coordination of trunk movement, were assessed using the Trunk Impairment Scale (TIS): 8/23 (total static sitting balance: 4/7, total dynamic sitting balance: 2/10, and

total coordination: 2/6). The TIS is a valid, consistent, and reliable tool, where the total scores range from 0 to 23 representing minimal performance and perfect performance, respectively ⁸.

Posture Assessment Scale for Stroke (PASS) is a reliable and valid assessment tool used to assess the balance in different postures (lying, sitting, and standing). ^{9, 10, 11} The patient scored 3/15 on maintaining posture and 6/21 on changing posture component.

Investigations

CT-Brain & MRI Brain results of the patient showed Ischemic hypodensity area in the Right frontal region and left occipital white matter, chronic lacunar infarct in Left occipital region, acute infarct in the right frontal region, corona radiata and corpus callosum, and Age-related diffuse atrophic ischemic changes. The ECHO report of the patient diagnosed with Left ventricular Hypertrophy, mild aortic regurgitation, and left ventricular diastolic dysfunction. Also, mild atherosclerotic disease in the bilateral common carotid arterial system was diagnosed by USG Carotid DOPPLER.

Physical Diagnosis

Left hemiparesis, Poor sitting and standing balance, reduced trunk control, mild facial asymmetry, reduced proprioception on the left ankle and Postural abnormality as a result of recurrent left Posterior Circulation stroke and Right ACA infarct stroke.

The goals were fixed to improve muscle power in the left upper and lower limb, facial muscle retraining, Enhance trunk control, Facilitate proprioception in the Left Lower limb, Improve sitting and standing balance, Postural correction, and gait training with Quadruped Cane.

INTERVENTIONS

The patient was treated for 30 sessions twice a day for 3 weeks. One session followed standard physiotherapy management and the other session followed clinical pilates exercises.

1st week

After framing the long-term goals, standard physiotherapy exercises, such as Bed Mobility exercises, Muscle strengthening Exercises, Self-assisted range of Motion Exercises, Facial muscles retraining, weight-bearing exercises to facilitate Tone and Proprioception, reaching activities in sitting, and Wall-mounted standing with 2 person support was performed with regular intervals for the first 2 days of therapy. On the 3rd day, as the patient seemed uninterested in the regular exercises and since no improvements were noted, a pilates exercise program was tried in which the patient felt it

was a comfortable and easy exercise. From the 5th day, the patient is made to walk 5-10 steps with 2 person support.

2nd week

Following the improved Balance and Posture after the 1st week, wall-mounted standing with 2 persons supported was progressed to standing with the walker and 2 persons supported as the affected side hand had intact hand grip and further to one person support with the walker. The Pilates exercises were continued with proper progressions in repetitions and sets. Reaching activities in standing was also initiated from the middle of the second week. Improvements in the Trunk Impairment scale (12/23) and PASS (20/36) were also documented.

3rd week

Gait duration increased day by day and the patient made to walk 200 feet at the end of the second week. Progression on TIS (18/23) and PASS (25/36) were assessed. The patient's standing balance improved in-between the third week, gait training started with quadruped cane and 1 person support. The patient's endurance improved and achieved 1000fts by the end of the 3rd week and started stair climbing with 1 person supported.

The weekly progression of Trunk Impairment scale (TIS) scores and PASS scores were shown in Table 2 and Table 3 respectively. The progression of each clinical pilates exercise was tabulated in Table 4.

DISCUSSION

The present study aimed at investigating the effect of Clinical Pilates on balance, posture, and core stability of a recurrent lacunar stroke patient. National Institutes of Health Stroke Scale (NIHSS) is used to assess the severity of the stroke. The Trunk Impairment Scale (TIS) is used to assess the core stability, the Posture Assessment Scale for Stroke (PASS) assessed balance and postural control. Among various core stability exercises, pilates plays a major role in maximizing function and minimizing dysfunction while doing various activities of daily living.

The clinical pilates along with the conventional physical therapy program improved core stability, balance, and posture in this study similar to the previous studies.¹² Besides, the results showed that improved muscle power in hemiparetic limbs, increased trunk function, improved balance in sitting and standing positions. Pilates-based Core stability training achieved similar results to the trunk training that has been previously reported, particularly for improvement of dynamic sitting balance.

Eight weeks of Pilates exercises enhanced cardiovascular

functions thereby, increases functional ability.¹³ Similar to that, it is also noted that pilates training along with the pharmacological treatment influenced the Blood pressure levels, Hence the Pilates training program resembles aerobic exercise at a low intensity that is appropriate for the patient with uncontrolled hypertension, unlike high-intensity muscle exercises.

Pilates training has a strong influence on flexibility, muscle endurance, core strength, posture improvement, and dynamic balance.¹⁴ Core strengthening exercise alone for 4 weeks showed significant improvements.¹⁵ Thus, Pilates is known as an exercise program to restore physical function effectively after stroke.¹⁶ Although, Pilates training has more beneficial effects on physical rehabilitation in stroke patients; the evidence of implying pilates exercises in clinical practice is lacking in research.

Clinical Pilates training not only improves physical function in stroke patients but also provides mental relaxation and maintains blood pressure as shown within the current study results. This single case study assessed the reliable and valid outcomes only before and after the therapy, it is also suggested that future follow-up studies, RCTs and studies with large sample size will be beneficial to verify the effect of Pilates training and other intervention methods for evidence-based practice.

CONCLUSION

The 3 weeks of Clinical Pilates along with conventional physiotherapy showed significant improvements in core strength, balance, and postural control of a recurrent lacunar Stroke patient. Pilates training was found to effectively improve the Trunk Impairment Scale (TIS) scores and Posture Assessment Scale for Stroke (PASS scores in this recurrent stroke patient with hypertension and diabetes mellitus. Therefore, it can be concluded that clinical Pilates will be beneficial in stroke patients and further studies have to declare evidence-based practice. Clinical Pilates involves low intensity, relaxed exercises and repetition can be altered according to the patient's physical ability and can be a remedial exercise program that can improve physical ability and restore muscle strength for stroke and other neurological conditions.

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Study conception and design	✓	✓	✓
Acquisition of data	✓		
Analysis and interpretation of data	✓	✓	✓
Drafting of manuscript	✓		
Critical revision		✓	✓

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Table 1: NIHSS interpretation

Score o	No stroke symptoms
1-4	Minor stroke
5-15	Moderate stroke
16-20	Moderate to severe
21-42	Severe stroke

Table 2: Trunk Impairment scale (TIS) scores of the patient studied

	Initial assessment	1 st week	2 nd week	3 rd week
static sitting balance	4/7	4/7	5/7	6/7
dynamic sitting balance	2/10	2/10	4/10	6/10
Coordination	2/6	2/6	4/6	4/6

Table 3: Posture Assessment Scale for Stroke (PASS) scores of the patient

	Initial assessment	1 st week	2 nd week	3 rd week
Maintaining posture	3/15	3/15	8/15	10/15
Changing posture	6/21	8/21	12/21	15/21

Table 4: Clinical Pilates Exercises

	Instructions	1 st week	2 nd week	3 rd week
Hundreds	Keep your low back fixed and raise your upper trunk with arms extended	Therapist or caregiver assisted for 5 reps x 2 sets	Therapist or caregiver assisted for 5 reps x 3 sets	Assistance was removed 5 reps x 3 sets
One leg kick	Lie on your stomach, raise your head with elbow support and bend your knee	5 reps x 2 sets Without assistance	5 reps x 3 sets Without assistance	5 reps x 4 sets Without assistance
One leg circle	Raise one leg straightly and draw a circle in the air	5 reps x 2 sets With assistance on the affected side	5 reps x 3 sets Assistance On the affected side	5 reps x 3 sets Assistance reduced
Shoulder bridge	With both the knees bent and ankle placed on the floor, try to raise your hip with shoulder support	5 reps x 2 sets With assistance	5 reps x 3 sets With assistance	5 reps x 2 sets Assistance reduced
Hip twist	With both the knees bent and ankle placed on the floor, try to rotate your lower body	5 reps x 2 sets With assistance	5 reps x 3 sets Without assistance	5 reps x 4 sets Without Assistance
Sidekick	Lie on your side, kick your leg forward and backwards without bending your knees	5 reps x 2 sets With minimal assistance	5 reps x 3 sets Without assistance	5 reps x 4 sets Without assistance
Swimming pose	Lie on your stomach, raise your right hand and left leg alternatively followed by the left hand and right leg.	5 reps x 2 sets With mild assistance	5 reps x 3 sets With mild assistance	5 reps x 4 sets With mild assistance
Spine twist	Sit erectly with your legs apart, arms at 90 degrees of abduction and rotate upper body	5 reps x 2 sets With assistance	5 reps x 3 sets With mild assistance	5 reps x 4 sets With mild assistance
Shoulder circles	Sit erectly with your knees bent, draw a circle with your fingers	5 reps x 2 sets With assistance	5 reps x 3 sets With assistance	5 reps x 4 sets With mild assistance
Modified leg lifts	Sit in a chair with back support, raise your leg straightly	5 reps x 2 sets With assistance	5 reps x 3 sets Without assistance	5 reps x 4 sets Without assistance
Seated hip marches	Sit in a chair with back support, raise your leg with bent knees	5 reps x 2 sets With assistance	5 reps x 3 sets With assistance	5 reps x 3 sets Without assistance
Sit and stands	Sit in a chair with back support, try to stand up and sit again.	5 reps x 2 sets With 2 personal assistance	5 reps x 3 sets With 2 personal assistance	5 reps x 4 sets With 1 person Assistance