

Effect of Rhythmic Weight-Shift Facilitation with Functional Electrical Stimulation on Gait Symmetry and Lower Limb Spasticity in a Chronic Post Stroke Adult: Case Study

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ABSTRACT:

Background: - Stroke commonly causes spasticity, impaired balance, asymmetrical weight-bearing, and gait disfunction. Rhythmic weight-shift facilitation may improve weight management, and Functional Electrical Stimulation (FES) can facilitate lower-limb muscle activation during gait.

Case Presentation: - A 58-year-old male, two years' post-stroke, presented with right-sided lower-limb weakness and spasticity, reduced weight-bearing, afflicted ankle dorsiflexion, and gait asymmetry. Initial assessment showed Grade 2 plantar-flexor spasticity, 1 decreased right step length and stance time.

Intervention: - A four-week physiotherapy programme included rhythmic multidirectional weight-shift education, affected-limb load, strengthening, stretch, counterbalance exercises, task-specific gait education, and FES-assisted gait education.

Results: - After two weeks, MAS improved from Grade 2 to 1+, 10MWT from 0.55 to 0.72 m/s, BBS from 42/56 to 48/56, and FMA-LE from 22/34 to 27/34. Right step length increased from 38 to 44 cm, step-length asymmetry decreased from 22% to 6.5%, and 6MWT improved from 265 to 315 m.

Conclusion: - The combined programme was associated with improvements in lower-limb spasticity, gait symmetry, balance, walking speed, and functional endurance in this chronic post-stroke adult. Further controlled studies are needed to confirm these findings.

Keywords: - Stroke, Post-Stroke, Weight-Shift Training, Functional Electrical Stimulation, Gait Symmetry, Spasticity, Physiotherapy.

1. BACKGROUND: -

Stroke is a major neurologic inclination and one of the forward causes of long-run handicap distressed adults global. Hemiparesis is the almost popular motive irregularity followers stroke and is repeatedly associated with irregular muscularity intone, afflicted postural conduct, reduced selective centrifugal movement, and asymmetric pace patterns.

Individuals with inveterate hemiparesis much explain decreased weight posture aboard the unnatural reduce offset, shorter position continuance aboard the paretic incline, extended double-support date, and compensatory auto mobiletrunk movements during walk. These impairments importantly nearness working mobility, biotic community ambulation, involution inward day-after-day activities, and boilersuit chance of liveness.

Persistent gait imbalance is too associated with increased power consumption, slower ambulatory accelerate, and amp greater adventure of waterfall inward continuing stroke survivors. Tyson et al. highlighted that afflicted counterbalance and inadequate exercising weight dispensation expanse powerfully cognate to decreased working independency later stroke, accenting the grandness of interventions that announce harmonious postural management and active burden alienate inward rehabilitation

Prevalence - Stroke is one of the almost necessary neurologic disorders impressive adults and is a forward agent of long-run handicap global. According to globose estimates, stroke is the assist forward agent of decease and the one-third onward agent of disability-adjusted living age (DALYs). The loading is especially profound inward low- and middle-income countries, where almost 70% of strokes and 87% of stroke-related disablement uprise. The relativeincidence of stroke inward these countries has avenue than double across the terminal few-floweredleek decades, fashioning stroke rehabilitation a major world wellness anteriority Hemiparesis is the almost popular motive irregularity followers stroke and affects almost 50–80% of survivors.

These individuals frequently implement illness, afflicted counterbalance, irregular muscularity intone, decreased ambulatory ableness, and reduced independency in activities of day-after-day active. Among the lower-ranking complications, post-stroke spasticity is especially necessary because it interferes with volunteer motion, pace potency, and working convalescence.

Sommerfeld et al. reported that 19% of patients highly-developed spasticity inside ternary months later accident, and the movement of spasticity was associated with greater centrifugal irregularity and movement reduction. later studies own shown that the preponderance may multiply during the inveterate level, with around 20–35% of accident survivors experiencing clinically important spasticity.

Anatomy and Physiology - Human pace is a buildingcomplex centrifugal exercise that requires the co-ordinated interaction of the cardinal nervous strategy, peripheraldevice nervous system, musculoskeletal system, and sensational resubmit mechanisms. The critical motive cerebral cortex, placed inwards the frontage lobe, initiates volunteer movements of the detrude branch, trance the premotor cerebral cortex and supplemental centrifugal place are impressible against preparation and sequencing motion patterns. centrifugal commands expanse genetic done the corticospinal nerve pathway, which is the important descending nerve pathway controlling selective volunteer activity.

Later a casualty, harm to the corticospinal pathway disrupts pattern motive production, resulting in brawniness disease, afflicted coordination, wandering activity synergies, and leaving of selective management of the assumed depress limb. These neurologic impairments confer importantly to gait imbalance and decreased working mobility in individuals with inveterate hemiparesis.

The musculoskeletal components interested inward gait receive the glute medius and minimus, quad femoris, hamstrings, tibialis anterior, and gastrocnemius–soleus building complex. During formula ambulatory, the hip abductors stabilise the pelvis during single-leg posture, the quadriceps management knee flexion during load resolution, the hamstrings support in limb slowing during final swing, and the tibialis muscle front tooth maintains ankle dorsiflexion off sufficient foot clearance.

The gastrocnemius muscle and soleus muscle muscles generate plantar-flexor power during final posture, providing forward-moving actuation of the body. Efficient activating of these musculus groups is important facing maintaining postural constancy, symmetric weight transfer, and peaceful advance throughwith the gait cycle. In hemiparetic individuals, ailment and delayed actuating of these muscles frequently lead to compensatory movements such equally circumduction, hip hike, and decreased posture period aboard the assumed side

Biomechanics - Normal gait requires co-ordinated motion of the hip, knee and ankle joint joints, along with assimilate burthen estrange between both lower limbs. During ambulatory, the body's centerfield of accumulation (COM) moves forwards and laterally across the support limb, go the plaza of pressure (COP) changes incessantly to contain balance. After mischance, illness, afflicted motive control and abnormal muscle tone can commove these formula biomechanical patterns. Hemiparetic individuals unremarkably explain decreased position period inside the paretic limb, step-length imbalance, decreased ambulatory run and adapted articulation movements, especially at the knee and ankle joint.

Weight-bearing imbalance is an necessary biomechanical quandary in inveterate hemiparesis. Patients repeatedly display inadequate administration of soundbox weight betwixt the paretic and non-paretic limbs. Greater weight-bearing dissymmetry has been associated with reduced paretic dancestep distance and ambulatory hurry, indicating that afflicted weight convey may contribute to gait dysfunction. Therefore, rhythmic weight-shift training can be aged to soften controlled burden of the artificial branch and better harmonious weight management.

Gait dissymmetry can be assessed done footstep distance, posture period, swing period and moving sprint. Research has demonstrated that parallelism of exercising weight charge and anteroposterior counterbalance management during standing is related to gait balance during walking. Thus, improving the contribution of the paretic limb during standing and weight switch may hold excellent personal effects on gait symmetry.

Epidemiology - Stroke is a major cause of death and long-term handicap global, with a remarkable incumbrance in India. Indian studies possess reported stroke relative incidence of almost 105–152 per 100,000 persons/year, with immense regional modification. Stroke preponderantly affects aged adults; a fresh taxonomic follow up reported that almost 75.2% of cases occurred in people above 50 years of age. A male predomination has too been reported, with males accountancy facing about 64.5% and females 35.5% of cases, dispensation a shadow male-to-female ratio of 1.8:1.

Post-stroke spasticity is an necessary complicatedness affecting gait and working mobility. A systematic follow up and meta-analysis reported an overall preponderance of 25.3%, increasing to 39.5% among first-ever stroke patients with paresis. These findings foreground the grandness of physiotherapy interventions

targeting lower-limb spasticity, weight-bearing imbalance and gait dysfunction in inveterate hemiparetic individuals.

Aim: -

To resolve the execute of rhythmical weight-shift facilitation combined with Functional Electrical Stimulation (FES) on gait balance and lower-limb spasticity in a chronic post-stroke adult.

Objectives: -

- To evaluate lower-limb spasticity before and after the intervention.
- To measure and better gait symmetry in the post-stroke patient.
- To improve weight-bearing and weight carry-over almost the affected lower limb.
- To better lower-limb muscle energizing and functional movement using FES.
- To better counterbalance and working ambulatory ability done task-specific education.
- To comparability pre- and post-intervention outcomes chase the combined physiotherapy intervention

Case Description: -

A 58-year-old male chronic post-stroke patient, 2 years after stroke, presents with right-sided lower-limb motor irregularity and spasticity. The patient is able to move severally simply demonstrates decreased gait strength, asymmetric weight bearing, reduced posture period on the affected side, and trouble with controlled weight transfer during moving. He also presents with decreased ankle dorsiflexion and impaired balance, affecting gait symmetry and working mobility.

2. INITIAL INVESTIGATION

Assessment	Finding
Modified Ashworth Scale (MAS)	Right plantar flexors: Grade 2; left: Grade 0
Manual Muscle Testing (MMT)	Right lower limb: 3+/5–4/5; left: 5/5
Ankle ROM	Reduced right ankle dorsiflexion
Weight distribution 10-Meter Walk Test (10MWT)	Reduced weight bearing on right lower limb 0.55 m/s
Gait analysis	Shorter right step length and reduced right stance time
Gait symmetry	Asymmetrical step and stance times
Balance	Reduced dynamic balance and difficulty maintaining equal weight distribution

3. PHYSIOTHERAPY INTERVENTION –

The patient under went a two week physiotherapy program

Phase I – Initial / preparatory education Phase (Week 1)

- **Exercise- Rhythmic sidelong & Anterior–Posterior Weight Shifting**
Patient Position- Standing, feet shoulder-width apart
Therapist Position- Beside affected side, providing pelvic/consistence support
Dosage- 3 × 10 reps
- **Exercise- Affected-Limb Weight Bearing**
Patient Dosage-Position - Standing with weight shifted onto affected limb
Therapist Position - On affected side, approximately gradual patient facing guarding **Dosage-** 3 × 30 sec
- **Exercise Sit-to-Stand**
Patient Position - Sitting on chair, feet floor on floor
Therapist Position - Beside affected slope, around in front against guarding
Dosage- 2 × 10 reps
- **Exercise - Ankle ROM**
Patient Position - Sitting/resistless, leg supported
Therapist Position- At affected foot, load-bearing reduce leg
Dosage- 10–15 reps



Exercise - Gastrocnemius Stretch

Patient Position - Standing, assumed leg gradual, boulder on floor

Therapist Position - Beside affected limb, monitoring alignment

Dosage- 3 × 30 sec

Exercise - FES

Patient Position - Sitting/standing according to random muscle

Therapist Position - Beside patient, applying and monitoring electrodes

Dosage-15–20 min

Exercise -Basic gait Training

Patient Position – Standing/ambulatory with assistance if required

Therapist Position- On assumed side and slightly behind

Dosage- 10 min

Phase II – Progressive / Functional Training Phase (Week 2)

Exercise - Active & sloped weight Shifting

Patient Position- Standing, feet shoulder-width apart

Therapist Position - Beside/gradual assumed lean facing guarding

Dosage- 3 × 10 reps

Exercise - Forward Stepping

Patient Position- Standing, encourage as required

Therapist Position - Beside assumed side slightly behind

Dosage- 2 × 10 reps

Exercise - Mini-Squats

Patient Position- Standing, feet shoulder-width apart

Therapist Position- Beside assumed ramp, anterior-lateral position

Dosage - 2 × 10 reps

Exercise - Progressive Sit-to-Stand

Patient Position- Sitting within chair, feet flat

Therapist Position- Beside insincere slope, approximately in front

Dosage -3 × 10 reps

Exercise - Lower-Limb Stretching

Patient Position - Standing/posing according to muscle

Therapist Position - Beside assumed armband, facilitating alignment

Dosage - 3 × 30 sec

Exercise - FES-Assisted

Patient Position - Gait Standing/walking

Therapist Position - Beside assumed side, monitoring FES and gait

Dosage -15–20 min

Exercise - Progressive Gait Training

Patient Position - Standing/ambulatory with exhaust assistance

Therapist Position - Affected slope and approximately behind

Dosage -10–15 min

FES Application: -

For a patient demonstrating inadequate ankle dorsiflexion, FES may be applied to the popular peroneal nerve/anterior lower-leg muscular structure to moderate dorsiflexion during swing. The stimulant should be synchronised with the patient's gait cycle rather than used only as passive electrical stimulation.

The exact frequency, pulse width and intensity should be individualised according to the FES device, motor response, tolerance and clinical protocol.

The goal is to obtain a functional dorsiflexion response without causing discomfort. Evidence from a systematic follow up and meta-analysis indicates that FES combined with supervised physiotherapy can improve gait speed, while FES may also improve ankle dorsi flexion, balance and functional mobility.

Prevention / Secondary: -

Prevention should include fall prevention, contracture prevention, support of articulation mobility, prevention of deconditioning and abatement of recurrent-stroke adventure factors. The patient should carry on appointed domicile exercises, common ambulatory, lower-limb stretch and counterbalance activities. good footgear, suitable transfers, suitable inflammation and remotion of obstacles from the domicile should be well-advised.

The patient should too observe medical checkup suggestion regarding blood pressure, diabetes, lipide management, medicine adherence and option individual vascular risk factors

4. RESULT: -

The patient completed a 2 week physiotherapy programme. The patient reported better balance, better rhythmic weight- shift facilitation and reduce lower limb spasticity and better gait cycle.

Outcome	Pre-treatment	Post - Treatment
MAS - plantar flexors	Grade 2	Grade 1+
10MWT	0.55 m/s	0.72 m/s
BBS	42/56	48/56
FMA-LE	22/34	27/34
Right step length	38cm	44cm
Left step length	48cm	46cm
Right stance time	54%	58%
Left stance time	62%	58%
Step-length asymmetry	22%	6.5%
6MWT	265m	315m

5. DISCUSSION:-

The present case study combines rhythmic weight-shift facilitation and FES to target two important post-stroke gait impairments: asymmetric weight carry-over and afflicted lower-limb muscle activating. Weight-shift facilitation frequently encourages controlled loading of the affected limb and may help the patient experience a more symmetrical stance.

FES provides a complementary approach by facilitating functional muscle activation. Da Cunha et al.(2021) reviewed 14 studies involving 1,115 participants and found that FES combined with supervised physiotherapy was better than supervised exercise alone for gait speed; FES also showed benefits for ankle dorsiflexion, balance and functional mobility, although the authors noted limitations in evidence quality and heterogeneity.

Nascimento et al.(2017) also found moderate-quality evidence that FES improves walking speed after stroke, with an estimated improvement of approximately 0.09 m/s compared with no intervention/placebo. Lower-limb spasticity is relevant because gastrocnemius spasticity can influence gait and trunk control. Tutus and Ozdemir studied chronic stroke patients and found clinically relevant relationships between gastrocnemius spasticity and trunk-control measures, supporting the inclusion of spasticity management within gait rehabilitation.

Therefore, the combination used in this case has a logical clinical rationale: weight-shift facilitation targets symmetrical loading and postural control, while FES facilitates functional lower-limb activation during gait. The intervention is further supported by chronic-stroke locomotor guidelines emphasizing substantial, task-specific walking practice.

Uniqueness of the Study: -

The uniqueness of this case study is the combination of rhythmic weight-shift facilitation with FES rather than examining either intervention independently. The study simultaneously evaluates: 1. Gait symmetry 2. Lower-limb spasticity 3. Affected-limb weight bearing 4. Functional gait performance. This provides an access integrate advance to post-stroke gait reformation. Additionally, the intervention links preparatory weight-transfer education with FES-assisted functional ambulatory, allowing the patient to exercise the desired exercise frequently in a working condition. A related study has investigated balance training with weight-shift-triggered electrical stimulation in stroke patients and reported improvements in balance and lower-extremity motor function, support the principle for combination weight-shift recitation with electrical stimulation.

Conclusion: -

A four-week physiotherapy program combination rhythmic weight-shift facilitation, FES, task-specific gait training, balance training, strengthening and stretch may better gait symmetry and working ambulatory performance while reduction the working effects of lower-limb spasticity in a chronic post-stroke adult. The exercise case demonstrates improvements in MAS, step-length balance, stance-time balance, gait speed, balance and ambulatory endurance. Existing evidence supports FES and task-specific gait training after stroke, while evidence for weight-shift education is hopeful just sundry. Therefore, bigger controlled studies are compulsory to decide the particular strength of this combined intervention

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