

# Effect of Error Augmentation-based Treadmill Training with Functional Electrical Stimulation on Balance and Gait among Post-stroke Individuals

SAKSHI SONI<sup>1</sup>, KAVITA SHARMA<sup>2</sup>, ROHIT GUPTA<sup>3</sup>

## ABSTRACT

**Introduction:** Stroke is one of the foremost causes of acquired neurological disability globally. Persistent deficits in gait and balance following stroke profoundly impair functional independence, mobility, and quality of life. While treadmill-based gait training and Functional Electrical Stimulation (FES) have individually demonstrated efficacy in post-stroke rehabilitation, the combined influence of these approaches alongside Error Augmentation (EA)- a motor learning strategy that harnesses deliberate perturbation to facilitate adaptive corrections has not been rigorously evaluated, particularly within the Indian clinical context.

**Aim:** To find out the effect of EA-based treadmill training with FES on balance and gait among individuals with stroke.

**Materials and Methods:** A multicentre randomised controlled trial enrolled 28 subacute post-stroke participants (age 40-70 years; 4 weeks to 6 months post-stroke). Participants were randomised into Group A (Treadmill Training, n=10), Group B (Treadmill Training+FES, n=9), or Group C (Treadmill Training+FES+EA, n=9). All interventions were delivered over 4 weeks (5 sessions/week, approximately 45-60 minutes/session). The primary outcome measures were gait speed assessed via the 10-Metre Walk Test (10MWT) and step length and symmetry via instrumented gait analysis. Secondary outcomes included balance measured by the Berg Balance Scale (BBS) and

the Timed Up and Go (TUG) test, functional mobility assessed via the Functional Ambulation Category, and endurance measured by the 6-Minute Walk Test.

**Results:** All groups demonstrated statistically significant within-group improvements ( $p < 0.05$ ). Group A (n=10): BBS A +10.20+3.55, TUG A -6.96+1.84 s, speed A +0.381+0.09 m/s. Group B (n=9): BBS A +10.78+2.77, TUG A -5.12+1.55 s, speed A +0.328+0.07 m/s. Group C (n=9): BBS A +10.67+2.40, TUG A -6.69+2.55 s, speed A +0.352+0.06 m/s, cadence A +14.44+4.19 steps/min (highest across groups). Post-intervention walking speed for Groups A and C both attained 0.90 m/s, approaching the community ambulation threshold.

**Conclusion:** All three multimodal protocols produced clinically meaningful and statistically significant gains in balance and gait following 4 weeks of structured rehabilitation. The EA-based combined protocol (Group C) offered the most comprehensive locomotor improvement profile, particularly in rhythmic gait parameters, suggesting its potential as a preferred intervention for enhancing cadence and overall gait quality in the subacute stroke population.

**Keywords:** Berg Balance Scale, Motor learning, Neuroplasticity, Stroke rehabilitation.

## PARTICULARS OF CONTRIBUTORS:

1. MPT Student, Department of Physiotherapy, Amity Institute of Health Allied Sciences, Amity University, Noida, Uttar Pradesh, India.
2. Assistant Professor, Department of Physiotherapy, Amity Institute of Health Allied Sciences, Amity University, Noida, Uttar Pradesh, India.
3. Physiotherapist, Osteorehab Clinic, Movement Science Institute, Gurgaon, Haryana, India.

## NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Kavita Sharma,  
Assistant Professor, Department of Physiotherapy, Amity Institute of Health Allied Sciences, Amity University, Sector-125, Noida-201313, Uttar Pradesh, India.  
Email: ksharma8@amity.edu