

Effect of Sensorimotor Training with Flexibar in a Child with Athetoid Cerebral Palsy for Balance and Coordination: A Case Study

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Abstract:

➤ Aim:

Sensorimotor training plays a crucial role in dynamic stability and movement control. This study investigated the efficacy of active vibration sensorimotor training using a Flexibar in a child with athetoid cerebral palsy (GMFCS Level II).

➤ Methods:

A 12-week intervention protocol was conducted (3 sessions per week, 45–60 minutes per session) incorporating active oscillations across supine (90-90), kneeling, squatting, sitting, and standing postures. Clinical outcome measures evaluated pre- and post-intervention included the Berg Balance Scale (BBS), Trunk Control Movement Scale (TCMS), Gross Motor Function Measure-88 (GMFM-88), and Comprehensive Coordination Scale (CCS).

➤ Results:

Following training, BBS score improved from 31 to 46, total GMFM-88 performance increased from 75.2% to 83.7%, and TCMS score increased from 12 to 18 (Static Sitting Balance: 5 to 7; Dynamic Sitting Balance: 4 to 6; Dynamic Reaching: 3 to 5).

➤ Conclusion:

Active vibration sensorimotor training using a Flexibar effectively enhances core stability, balance, and coordination in children with athetoid cerebral palsy.

Keywords: Athetoid Cerebral Palsy, Flexibar, Sensorimotor Training, Active Vibration, Balance, Coordination, Postural Stability.

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I. INTRODUCTION

Cerebral palsy (CP) represents a group of permanent developmental disorders of movement and posture causing activity limitation. The athetoid or dyskinetic subtype is characterized by involuntary movements, fluctuating muscle tone, and hyperkinesia, which impair proximal core stability, dynamic balance, and motor coordination. Children with athetoid CP face significant challenges in postural alignment, hindering independence in functional tasks.

Sensorimotor training utilizing an active oscillatory device, such as a Flexibar, provides active whole-body vibration. Unlike passive Whole-Body Vibration (WBV) platforms, a Flexibar requires voluntary force generation to initiate and sustain mechanical resonance (typically 30–50 Hz). The resulting vibrational energy is transmitted to the axial skeleton, stimulating muscle spindles, recruiting alpha-motor neurons, and co-activating deep core stabilizing musculature including the transverse abdominis, internal obliques, and multifidus. While active vibration training has shown clinical benefit in adult neurological rehabilitation and

orthopedic stabilization, its therapeutic efficacy in pediatric dyskinetic CP remains underexplored. This case study aims to evaluate the impact of Flexibar sensorimotor training on balance, coordination, trunk stability, and motor capabilities in a child with athetoid cerebral palsy.

- Hypothesis (H_1): Sensorimotor training using a Flexibar produces significant improvements in balance, trunk control, and coordination in a child with athetoid cerebral palsy.
- Null Hypothesis (H_0): Sensorimotor training using a Flexibar produces no significant changes in balance, trunk control, and coordination in a child with athetoid cerebral palsy.

II. METHODS AND MATERIALS

➤ Participant Profile

A single subject with diagnosed athetoid cerebral palsy classified under Gross Motor Function Classification System (GMFCS) Level II was selected from the outpatient department of NIEPMD, Chennai. The inclusion criteria required the participant to have independent sitting balance without external support, sufficient cognitive and cooperative abilities to follow motor commands, and no history of recent lower limb surgeries, botulinum toxin injections within the past six months, visual deficits, or unmanaged epileptic seizures. Written informed parental consent was secured prior to study commencement.

➤ Intervention Protocol

The participant underwent a 12-week intervention program consisting of 3 sessions per week (45–60 minutes per session). Each session was divided into a 10-minute warm-up, a 30-minute Flexibar training segment, and a 5-to-10-minute cool-down phase.

Active Flexibar oscillations were performed for 3 minutes per position across five primary positions:

- Supine (90-90): Flexibar operated with hips and knees at 90° to isolate and engage deep abdominal wall musculature.
- Kneeling: Promoted hip extension control, gluteal recruitment, and trunk alignment under vibrational load.
- Squatting: Facilitated co-contraction of lower extremity stabilization muscles.
- Sitting: Unsupported seating targeting pelvic tilt stability and multi-directional core reactivity.
- Standing: Integrated full kinetic chain equilibrium and dynamic balance control.

➤ Outcome Assessment

Standardized clinical outcome metrics were collected pre-intervention (Baseline) and post-intervention (Week 12):

- Berg Balance Scale (BBS): Evaluated static and dynamic functional balance across 14 items.
- Trunk Control Movement Scale (TCMS): Assessed static sitting balance, dynamic sitting balance, and dynamic reaching capacity.
- Gross Motor Function Measure-88 (GMFM-88): Measured quantitative gross motor performance across five functional domains.
- Comprehensive Coordination Scale (CCS): Evaluated upper and lower limb motor accuracy and smooth trajectory control.

III. RESULTS AND DISCUSSION

➤ Results

The participant successfully completed all 36 planned sessions over the 12-week intervention period with no adverse events reported. Quantitative post-test measurements demonstrated improvements across all functional scales compared to baseline assessments.

Table 1 summarizes pre- and post-test values across the outcome measures.

Table 1 Pre- and Post-Intervention Clinical Outcome Data

Outcome Measure	Baseline (Pre-Test)	Week 12 (Post-Test)	Absolute Gain
Berg Balance Scale (BBS)	31 / 56	46 / 56	+15 points
GMFM-88 Total Score	75.2%	83.7%	+8.5%
TCMS - Static Sitting Balance	5	7	+2 points
TCMS - Dynamic Sitting Balance	4	6	+2 points
TCMS - Dynamic Reaching	3	5	+2 points
TCMS Total Score	12 / 58	18 / 58	+6 points

➤ Discussion

The clinical gains observed reject the null hypothesis, supporting the therapeutic efficacy of active vibration sensorimotor training in athetoid cerebral palsy. Involuntary hyperkinesia and fluctuating tone in dyskinetic CP interfere with feedforward postural adjustments, leaving the trunk vulnerable during voluntary movements.

The active mechanical vibration produced by the Flexibar demands continuous tonic co-contraction of axial musculature to maintain device resonance. This dynamic

demand enhances muscle spindle sensitivity, improves proprioceptive afferent feedback to the central nervous system, and promotes proximal stability. The observed improvements in TCMS (12 to 18) and BBS (31 to 46) support existing biomechanical literature indicating that oscillatory pole exercises activate deep core stabilizers (such as the transverse abdominis and multifidus) better than static stabilization exercises. Furthermore, improved proximal stability provided a stable base for distal extremity control, leading to improved gross motor performance in GMFM-88 domains.

Study limitations include the single-subject design ($n=1$), which limits direct generalization to all forms of cerebral palsy. Future research should utilize randomized controlled trials with larger cohorts and longitudinal follow-up evaluations to determine long-term retention.

IV. CONCLUSION

Active vibration sensorimotor training using a Flexibar is a viable, safe, and effective adjunct modality for children with athetoid cerebral palsy. Incorporating oscillatory exercises across developmental postures improves trunk control, dynamic balance, coordination, and functional mobility. Physical therapists can incorporate active vibration devices into pediatric neurological rehabilitation to improve proximal stabilization and motor execution.

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