ABSTRACT

Title: Neuro Biomechanical principles in robot-assisted gait training for pediatric patients

Background: There is a lack of data on how robot-assisted gait training (RAGT) contributes to gait changes in children with cerebral palsy (CP).

Methods: This research study investigated efficacy of a 4-week RAGT intervention in twelve ambulatory spastic diparesis children with CP (10.8±2.6 years old; 2 girls and 10 boys; Gross Motor Function Classification System I-III) by using computerized gait analysis (CGA); passive joint range of motion (PROM); selective control assessment of lower limbs evaluation (SCALE), and the six-minute walk test (6MWT). Pre-post RAGT intervention data of children with CP was compared with the normative data curves of typically developing children by cross-correlation, and further statistically evaluated by a Wilcoxon test.

Results: Significant pre-post RAGT intervention differences ($p<0.05$) that indicate more physiological gait comparing to the normative data curves were found. Biceps femoris, rectus femoris, and tibialis anterior decreased activity almost across all gait cycle phases. Medial gastrocnemius decreased activity mainly in terminal stance, mid-swing, and terminal swing phases. Internal hip rotations and foot progress angles decreased almost across all gait cycle phases. More economic energy expenditure was observed in spatiotemporal gait parameters. No significant changes were observed in kinetics. Decreased joint contractures were observed in all joints, except for the popliteal angles.

SCALE scores improved by at least one point and children increased walked distance by 75 meters in the 6MWT.

Conclusion: The key findings of the research study suggest that RAGT as monotherapy can induce more physiological muscle activity and joint kinematics trajectories, more economic energy expenditure in spatiotemporal gait parameters, increased SVMC ability, walking farther distances, and decreased joint contractures in CP children with spastic diparesis.

Keywords: Cerebral palsy, motor control, gait, computerized gait analysis, robot-assisted gait training, Lokomat, joint range of motion, six-minute walk test