World Academy of Science, Engineering and Technology
International Journal of Medical and Health Sciences
Vol:18, No:10, 2024

Microchip-Integrated Computational Models for Studying Gait and Motor Control Deficits in Autism

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Abstract : Introduction: Motor control and gait abnormalities are commonly observed in individuals with autism spectrum disorder (ASD), affecting their mobility and coordination. Understanding the underlying neurological and biomechanical factors is essential for designing effective interventions. This study focuses on developing microchip-integrated wearable devices to capture real-time movement data from individuals with autism. By applying computational models to the collected data, we aim to analyze motor control patterns and gait abnormalities, bridging a crucial knowledge gap in autism-related motor dysfunction. Methods: We designed microchip-enabled wearable devices capable of capturing precise kinematic data, including joint angles, acceleration, and velocity during movement. A cross-sectional study was conducted on individuals with ASD and a control group to collect comparative data. Computational modelling was applied using machine learning algorithms to analyse motor control patterns, focusing on gait variability, balance, and coordination. Finite element models were also used to simulate muscle and joint dynamics. The study employed descriptive and analytical methods to interpret the motor data. Results: The wearable devices effectively captured detailed movement data, revealing significant gait variability in the ASD group. For example, gait cycle time was 25% longer, and stride length was reduced by 15% compared to the control group. Motor control analysis showed a 30% reduction in balance stability in individuals with autism. Computational models successfully predicted movement irregularities and helped identify motor control deficits, particularly in the lower limbs. Conclusions: The integration of microchip-based wearable devices with computational models offers a powerful tool for diagnosing and treating motor control deficits in autism. These results have significant implications for patient care, providing objective data to guide personalized therapeutic interventions. The findings also contribute to the broader field of neuroscience by improving our understanding of the motor dysfunctions associated with ASD and other neurodevelopmental disorders.

Keywords : motor control, gait abnormalities, autism, wearable devices, microchips, computational modeling, kinematic analysis, neurodevelopmental disorders
Conference Title : ICA 2024 : International Conference on Autism
Conference Location : Barcelona, Spain
Conference Dates : October 24-25, 2024