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Instrumented Gait Assessment for Spinal Cord Injury: A Review of Technology Driven Objective Measures

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ABSTRACT

Individuals with Spinal Cord Injuries (SCI) tend to develop slow, inefficient, unbalanced, or uncoordinated gait patterns. Traditional clinical tools, although found to be reliable measure for assessing gait deviations, are subjective and often have inter-rater variability. The technology-driven instrumented gait assessment tools may offer an objective and quantifiable method of assessing gait deviations among individuals with SCI. This review aims to synthesise the current application of objective gait analysis tools to detect gait abnormalities in individuals with SCI.

A literature search was conducted on PubMed and Scopus databases to identify studies that have assessed the gait of individuals with spinal cord injury using technology-driven tools. Studies were included if they utilised any technology-driven tool, including Inertial Measurement Units (IMU) sensors, wearable sensors, 3D motion kinetic systems, pressure-sensitive platforms, etc., for gait assessment in SCI, either to evaluate reliability/validity or as an outcome measure in randomised controlled trials. Data extracted included characteristics of participants, features of the tools, gait parameters evaluated, and main study findings.

Our search yielded 1728 articles. The title and abstract screening reduced the number of articles to 22 and finally 10 studies were included for this review based on the eligibility criteria. Most of the studies utilised IMU sensors for the gait evaluation of individuals with SCI, followed by a 3D kinetic motion sensor system. The IMU sensors are a reliable technology-driven objective measures for determining spatiotemporal parameters such as stride length, step length, cadence, and double support time. However, 3D kinetic motion systems allow detailed information on kinematic parameters, including joint range of motion at the hip and knee.

Instrumented gait assessment offers objective and quantifiable insights into locomotor function in individuals with spinal cord injury. Among the available technologies, IMU-based wearable sensors have emerged as the most practical and widely adopted tool due to their portability, ease of use, and ability to capture spatiotemporal parameters in real-world conditions. Meanwhile, 3D motion analysis provides more in-depth biomechanical insights.

Keywords: Clinical gait analysis, Motion capture, Mobility evaluation, Objective measures, Technology

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