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Development and Feasibility of a MediaPipe-based Pipeline for Markerless Gait Analysis in Clinical Settings

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Background: Quantitative gait analysis is crucial for clinical assessment, yet gold-standard 3D motion capture is limited by high costs and specialized constraints. To overcome these barriers, we developed an accessible pipeline capable of extracting objective biomechanical markers from standard monocular video.

Objective: In this study, we aimed to: 1) develop and validate our markerless gait analysis pipeline against a gold-standard 3D system, and 2) evaluate its clinical feasibility in differentiating pathological gait patterns.

Methods: We conducted a two-phase study. First, we developed the computational pipeline to extract key spatiotemporal and kinematic parameters from sagittal-view videos. We then validated its accuracy using data from 21 healthy adults, assessing agreement with a 3D motion capture system via ICC, DTW, and SPM. Second, we evaluated the pipeline's clinical utility on the GAVD dataset, containing 49 recordings of healthy controls and six distinct pathological gait patterns.

Results: We found that our pipeline's outputs demonstrated high concordance with the gold-standard 3D system for principal gait parameters. In the clinical feasibility assessment, we successfully processed 92% (45/49) of the recordings and robustly extracted biomechanical features that distinguished between control and diverse pathological gait patterns. Our findings confirm the system's reliability and performance on clinically relevant data.

Conclusions: In this study, we established and validated a MediaPipe-based pipeline as a viable tool for objective gait analysis. We demonstrated its capacity to quantify pathological gait deviations from monocular video, highlighting its significant potential for accessible, point-of-care assessments and decentralized remote monitoring.

Keywords: Markerless motion capture, Gait analysis, Clinical application, Computer vision