Gait parameters in children with bilateral spastic cerebral palsy: a systematic review of randomized controlled trials

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ABBREVIATIONS

IGA	Instrumented gait analysis
RCT	Randomized controlled trial
sEMG	Surface electromyography

AIM To identify the gait parameters used to assess gait disorders in children with bilateral spastic cerebral palsy (CP) and evaluate their responsiveness to treatments.
METHOD A systematic search within PubMed, Web of Science, and Scopus (in English, 2000–2016) for randomized controlled trials of children with bilateral spastic CP who were assessed by instrumented gait analysis (IGA) was performed. Data related to participants and study characteristics, risk of bias, and outcome measures were collected. A list of gait parameters responsive to clinical interventions was obtained.
RESULTS Twenty-one articles met the inclusion criteria. Eighty-nine gait parameters were identified, 56 of which showed responsiveness to treatments. Spatiotemporal and kinematic parameters were widely used compared to kinetic and surface electromyography data. The majority of responsive gait parameters were joint angles at the sagittal plane (flexion–extension).
INTERPRETATION The IGA yields responsive outcome measures for the gait assessment of children with bilateral spastic CP. Spatiotemporal and kinematic (at sagittal plane) parameters are the gait parameters used most frequently. Further research is needed to establish the relevant gait parameters for each clinical problem.

Cerebral palsy (CP) is the most common cause of chronic childhood motor disability[1] with a prevalence of above 2.0 per 1000 live births.[2] CP describes a group of permanent disorders affecting movement and posture and causing activity limitation that are attributed to non-progressive lesions in the developing fetal or infant brain.[3] The motor disorders of CP often occur together with disturbances of sensation, cognition, communication, and behaviour, with epilepsy and with secondary musculoskeletal problems.[3]

Spasticity is often the dominant motor disorder,[4] along with loss of selective motor control and impaired balance,[5] and it can be classified according to different topographical patterns such as quadriplegia, diplegia, and hemiplegia, with additional terms such as monoplegia and triplegia, or unilateral and bilateral.[6] Secondary musculoskeletal problems like muscle contractures, bony deformities, and joint instability appear as a consequence of growth and development of the musculoskeletal system.[5] Their interaction, occurring at multiple levels, affects the quality and efficiency of gait and other aspects of motor function, contributing to activity limitation and participation restriction.[5,7]

The Gross Motor Function Classification System (GMFCS) has been universally adopted to describe the movement ability of children with CP.[8] Its expanded and revised version uses five ordinal levels across five age bands, with emphasis on the typical performance in different settings.[9] The general headings for each level are: walks without limitations (level I); walks with limitations (level II); walks using a hand-held mobility device (level III); self-mobility with limitations, may walk with physical assistance or use powered mobility (level IV); and transported in a manual wheelchair (level V).[10] Children with unilateral CP almost always develop independent locomotion; in the case of bilateral CP, some children walk independently, some walk with aids, and others can never achieve this function.[11] Considerable research effort has been directed towards improving or maintaining walking ability of children with CP through different clinical interventions such as surgery, pharmacology, orthotics, or physical therapy.[5,12] Using reliable, valid, and responsive outcome measures to evaluate the success of these interventions is crucial.[12]