Computerized gait analysis

Clinical Policy ID: CCP.1105

Recent review date: 2/2025

Next review date: 6/2026

Policy contains: Cerebral palsy; Progressive supranuclear Palsy; Parkinson's; gait dysfunction; instrumented gait analysis; quadriplegia; hemiplegia; orthopedic surgery; specialized laboratories; Spina Bifida; phenotypes.

Coverage policy

The use of computerized gait analysis is clinically proven and, therefore, may be medically necessary for the evaluation of musculoskeletal gait function to assess and aid in planning for orthopedic surgery or interventional neurology (e.g., nerve blocks to reduce spasticity orthotic application) in ambulatory members with certain gait dysfunctions associated with the following conditions (National Institute for Health and Care Excellence, 2016; States, 2024; Wren, 2020):

- Cerebral palsy.
- Spina bifida meningomyelocele.
- Traumatic brain injury.
- Incomplete quadriplegia.
- Spastic hemiplegia.
- Spastic diplegia.

For any determinations of medical necessity for medications, refer to the applicable state-approved pharmacy policy.

<u>Limitations</u>

All other uses of computerized gait analysis are not medically necessary.

Alternative covered services

Observational clinical gait analysis.

Background

Gait is the pattern of how a person walks or runs and the involvement of the muscles, joints, and neurological pathways. Deviations in gait are often distinctive of specific neurological, muscular, or skeletal conditions. Gait and balance disorders are common in the elderly, in whom they significantly contribute to falls; after orthopedic surgery; and in neurodevelopmental disorders such as spina bifida and cerebral palsy (Baker, 2018).

For the important aspects of treatment decision making, the provider must understand the ongoing relationship between orthopedic, neurological, and developmental considerations related to gait (States, 2021). The clinical heterogeneity of gait disorders reflects the large and complex neuromuscular systems involved and the vulnerability of walking to neurologic disease at every level of progression.

Providers have historically diagnosed and classified gait by visual observation, but this approach yielded more generalized results lacking information on more specific causes and treatment of failing gaits, balance and stability issues, and declining performance. In a review of 34 studies of gastrocsoleus lengthening surgery, outcomes improved, and authors found observational gait analysis and video recordings can be used to measure treatment outcomes as a comparison but are subjective in nature and have validity and reliability issues (Ma, 2021). More standardized gait analyses have been developed in specialized laboratories equipped with cameras, floor sensors, and other data collecting equipment inherent in more objective data classification.

Computerized gait analysis is the quantitative assessment of gait disturbances in order to support a functional diagnosis, assess for treatment planning, and monitor disease progress. The quantitative information correlates with the functional capacity of the patient and provides complementary information to clinical examination (Baker, 2018).

Types of gait analysis include but are not limited to: three dimensional gait analysis also known as 3DGA; optical tracking gait analysis; comprehensive computer-based motion analysis by videotaping; three-dimensional kinematics; dynamic plantar pressure measurements during walking; and dynamic surface electromyography of multiple muscles during walking or other functional activities. These analyses are used to assess, diagnose, develop a plan of care, and document treatment and surgical outcomes for multiple gait issues (Ma, 2021). Research into computerized gait analysis for early disease detection is emerging (Al-Hammadi, 2024; Čepukaitytė, 2024), as are wearable technologies using inertial sensors and markerless camera-based three-dimensional motion capture systems (Scataglini, 2024; Silva, 2024).

Findings

Guidelines

Guidelines for appropriate use of computerized gait analysis are very limited, due to the lack of homogeneity in published articles, and the large variety of conditions for which providers use the technology. Efforts to standardize acquisition and interpretation of gait analysis measurements have increased the accuracy and reliability of the results and, therefore, acceptance of computerized gait analysis (Baker, 2018).

The Academy of Pediatric Physical Therapy of the American Physical Therapy Association issued evidence-based recommendations for three-dimensional instrumented gait analysis in children with cerebral palsy. The Academy found three-dimensional instrumented gait analysis clinically useful to inform orthopedic surgical and non-surgical interventions, to identify or quantify gait deviations among segments/joints and planes (sagittal, coronal, and transverse), and to evaluate the effectiveness of an intervention. The Academy also provided guidance on the preferred characteristics of appropriate three-dimensional instrumented gait analysis laboratories with respect to instrumentation/equipment, staffing, and reporting practices (States, 2024).

The guideline from the National Institute for Health and Care Excellence (2016) addressed care of young persons with spasticity. The routine use of computerized gait analysis remains controversial. While it could alter decision making in some cases, it is less clear if the decisions based on computerized gait analysis lead to better patient outcomes. However, in ambulatory children with certain gait dysfunction (e.g., cerebral palsy) who are candidates for orthopedic surgery, it can aid in surgical planning by identifying common patterns of muscle overactivity and deformity and determining what type of muscle, tendon, or joint surgery would be most helpful. Specifically, it advises any decision to perform orthopedic surgery to improve gait must include a pre-operative functional assessment, preferably to include gait analysis. In addition, surgical outcomes of effects on gait should be performed one to two years post-operatively.

<u>Evidence review</u>

Evidence on the clinical use of computerized gait analysis has increased significantly over the last decade and is still evolving for different conditions. Most studies employed three-dimensional gait analysis, while the evidence for two-dimensional video gait analysis is insufficient for routine clinical application (Michelini, 2020). The highest quality and quantity of literature exists for cerebral palsy, showing high diagnostic accuracy and reliability of data and data interpretation (Baker, 2018; Rethlefsen, 2024), followed by acquired lesions of the central nervous system (e.g., stroke or traumatic brain injury), and lower limb amputation (Baker, 2018).

The evidence focuses on the ability of three-dimensional gait analysis to provide necessary and accurate information for individualized clinical decision making. However, there is a lack of consensus on the gait parameters that define certain disease conditions that, in turn, may serve as either pre-operative predictors or for treatment monitoring. While studies often show that gait analysis impacts decisions, limited evidence addresses impacts on patient outcomes.

Cerebral palsy

In children with cerebral palsy, various methods of calf lengthening surgeries are available to treat fixed equinus deformities, the most common procedure being surgical lengthening of the gastrocsoleus muscle-tendon unit. Pre-operative predictors for surgical outcomes are important for informed decisions to be made about interventions. A systematic review of 34 studies found three-dimensional gait analysis can provide objective outcome measurement, but the evidence is of poor study quality and heterogeneous with respect to patient characteristics and interventions. Further prospective studies and randomized control trials are needed to determine pre-operative predictors of surgical success (Ma, 2021).

A scoping review of 909 studies assessed the impact of Instrumented Gait Analysis on children with cerebral palsy. Results were divided into six categories, of which 49% used Instrumented Gait Analysis as an outcome measure for treatment. Authors state the large number of studies provide a basis for developing a guideline for managing children with cerebral palsy-related gait disorders (States, 2021).

Other populations

A systematic review of 2,712 articles examined the clinical efficacy of three-dimensional gait analysis across different study types and populations. The majority of studies addressed technical development, including reliability and validity studies, diagnostic accuracy, and assessment of treatment efficacy. Six studies, including one randomized controlled trial, examined the impact of three-dimensional gait analysis on treatment decisions, and three articles representing two studies assessed the impact of the information on treatment outcomes. The overall quality of included studies was graded as 3b, denoting a lesser quality prospective cohort study. Three-dimensional instrumented gait analysis can change treatment plans, increase clinicians' confidence in treatment decisions, and increase agreement among clinicians. A small number of these studies determined that patient outcomes (such as incidence of severe crouch gait) improved only when three-dimensional instrumented gait analysis was available and recommendations were followed (Wren, 2020).

For other populations, several systematic reviews demonstrated the feasibility of computerized three-dimensional gait analysis to analyze gait patterns in patients with ambulatory issues, for example, Parkinson's disease (Bouça-Machado, 2020; Bonacina, 2024), lumbar spinal stenosis (Chakravorty, 2019), post-surgical populations (Mandelli, 2024; Marino, 2024; Rivera 2024), fibromyalgia (Carrasco-Vega, 2022), and the elderly (Job, 2020; Liu, 2024).

Computerized three-dimensional gait analysis is recognized as a standard means of analyzing gait patterns in patients with ambulatory issues such as Parkinson's disease, cerebral palsy, spina bifida and other disorders such as flat foot (Ma, 2021). The procedure offers promise for identifying individuals in need of preventive measures regarding falls or ambulatory rehabilitation, but is a complex process producing vast amounts of data.

A systematic review of 25 studies assessed instrumental evaluation of function in patients with chronic obstructive pulmonary disease. Seven studies included three-dimensional gait analysis. Evaluation was hampered by lack of standardization, small sample sizes, and study design issues. Specifically, gait analysis was found to be costly, requiring dedicated space and infrastructure (Zucchelli, 2022).

A systematic review of 12 studies of instrumental gait assessments in persons with fractured ankles concluded that these assessments can objectively characterize gait alterations. Instrumental gait assessment may be useful in clinical practice (assess patient performance) and clinical research (evaluate existing or new rehabilitative interventions (Mirando, 2022).

In 2016, we identified no new evidence for this policy.

In 2017, we identified one evidence-based guideline from the National Collaborating Centre for Women's and Children's Health in the United Kingdom for this policy. (National Institute for Health and Care Excellence, 2012). This policy was amended to reflect this information.

In 2018, no new evidence was identified. The guideline published by National Collaborating Centre for Women's and Children's Health (National Institute for Health and Care Excellence, 2012) was updated in 2016 but the changes do not affect this coverage policy.

In 2019, we updated the policy references with no change to coverage. The policy ID changed from 15.01.01 to CCP.1105.

In 2020, we updated the policy references with no change to coverage.

In 2021, we updated the policy references and removed nine references. The new information confirms previous findings and warrants no change in coverage.

In 2022, we updated and added additional current references with no change to coverage.

In 2023, we updated and added additional current references with no change to coverage.

In 2024, we updated the references that warranted no policy changes.

In 2025, we updated the references and reorganized the findings section. No policy changes are warranted.

References

On December 11, 2024, we searched PubMed and the databases of the Cochrane Library, the U.K. National Health Services Centre for Reviews and Dissemination, the Agency for Healthcare Research and Quality, and the Centers for Medicare & Medicaid Services. Search terms were "gait analysis," "gait disorders, neurologic" [MeSH], "Cerebral Palsy/rehabilitation" [MeSH], "Cerebral Palsy/surgery" [MeSH], and "Spinal Dysraphism"

[MeSH]. We included the best available evidence according to established evidence hierarchies (typically systematic reviews, meta-analyses, and full economic analyses, where available) and professional guidelines based on such evidence and clinical expertise.

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Policy updates

5/2014: initial review date and clinical policy effective date: 6/2014

6/2016: Policy references updated.

5/2017: Policy references updated. Coverage changed.

3/2018: Policy references updated.

3/2019: Policy references updated. Policy ID changed.

2/2020: Policy references updated.

2/2021: Policy references updated.

2/2022: Policy references updated.

2/2023: Policy references updated.

2/2024: Policy references updated.

2/2025: Policy references updated.