



CIGNA HEALTHCARE COVERAGE POSITION

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Subject Gait Analysis

Table of Contents

Coverage Position.....	1
General Background	1
Coding/Billing Information	5
References.....	6

Hyperlink to Related Coverage Positions

[Botulinum Toxin Type A \(Botox® A\)](#)
[Electromyography Studies](#)
[Neurosurgical Treatment of Spasticity](#)
[Suit Therapy](#)

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Coverage Position

CIGNA HealthCare covers gait analysis as medically necessary when BOTH of the following criteria are met:

- A child or adolescent has a diagnosis of cerebral palsy.
- The procedure is performed as part of a preoperative assessment, and the results will be used in surgical planning.

CIGNA HealthCare does not cover gait analysis for any other indication, because it is considered experimental, investigational or unproven.

General Background

Gait analysis is the systematic evaluation of the dynamics of gait. It is a process of measuring and evaluating the walking patterns of patients with specific gait-related problems. Gait analysis is also referred to as motion analysis. Observational gait analysis, the standard method of evaluating gait, refers to the visual assessment of a patient's gait, with specific attention to hips, knees and ankles. Gait analysis by observer assessment does not use any specialized equipment, can adequately assess most conditions, and is used to note gross abnormalities in gait.

Gait analysis may also be performed in a gait analysis laboratory using specialized technology. This is also referred to as computerized gait analysis, quantitative gait analysis or clinical gait analysis. This procedure has been used to understand the etiology of gait abnormalities and as part of the treatment

decision-making in patients with complex walking problems. It has been most often used for patients with neuromuscular conditions, primarily as part of the surgical decision-making process when all conservative measures have been exhausted and surgical intervention is being considered. Computerized gait analysis is a process by which gait characteristics are measured, abnormalities are identified, causes are suggested and treatments are proposed. It is not intended to replace the clinical examination, but rather serves as an adjunct to understand the impairment better. The treatment decision should be made in the total context of the patient's condition, physical examination and medical history.

The technologies involved in clinical gait analysis include:

- Specialized computer-interfaced video cameras that measure patient motion. An initial videotape is recorded to provide documentation of how a patient walks and the patient's gait pattern.
- Passive reflective markers are placed on the surface of a patient's skin, aligning with specific bony landmarks and joints. As the patient walks along a straight pathway in the laboratory, the locations of the markers are monitored with a three-dimensional motion data-capture system comprising five or six special video cameras, all interfaced with a central controlling computer. An infrared light is reflected from the markers back to the cameras. Marker position data allow for the computation of the angular orientation of particular body segments as well as of the angles between segments (joint angles); these data are collectively referred to as kinematics.
- Multicomponent force platforms imbedded in the walkway provide measurement of reaction between foot and ground as the patient walks. The data are assessed directly or used to calculate the load in and across the joints. The joint load is referred to as kinetics.
- Electrodes placed on the surface of the skin or inserted as fine wires into specific muscles allow the muscle to be monitored as the patient walks. This is referred to as dynamic electromyography (EMG). This technique measures the electrical potential generated by a muscle when it is activated. This information, along with joint kinematic and kinetic results, is used to assess the gait abnormalities.

An extensive physical examination of the patient at rest should be performed. This information may then be correlated with the gait data. The gait analysis will usually take two to four hours to complete. In order to perform gait analysis, the patient must be ambulatory with or without assistive devices for a minimum of 10 consecutive steps. The patient must also be able to follow directions and be cooperative during the procedure. The gait analysis data are often interpreted by a team that includes the orthopedic surgeon; the physical therapist or kinesiologist who collected the data; and, at times, the engineer who collected data or the biomechanical engineer who developed the mathematical models used for processing the data. The information from the gait analysis is used along with results of the clinical examination to identify gait deviations, determine potential causes and determine treatment.

The most frequent application of gait analysis is in the treatment of children and adolescents with cerebral palsy, when surgical treatment is being considered. Cerebral palsy is a term used to describe a group of chronic disorders that impair the control of movement and that appear in the first few years of life. It is not progressive. Cerebral palsy is classified according to the type of movement disorder and which limb or limbs are affected. The four broad categories include (Rudolph, 2003; National Institute of Neurological Disorders and Stroke [NINDS], 2006):

- Spastic: In this form, the patient exhibits upper motor neuron signs, such as weakness, hypertonicity, hyperreflexia, clonus, pathologic reflexes and a tendency to contractures. This type affects 70–80% of patients with cerebral palsy. This type is further classified as to the limb impairment and includes:
 - quadriplegia, the symmetric impairment of all four extremities
 - diplegia, in which the bilateral spasticity of the legs is greater than that of the arms
 - monoplegia, a rare type in which only one limb is involved
 - paraplegia, involving only the lower extremities
 - triplegia, a rare type, with only one unaffected limb

- Athetoid, or dyskinetic: This form includes uncontrolled, slow, writhing movements. These movements may affect the hands, feet, arms or legs and, in some cases, the face and tongue, which may also affect speech, causing dysarthria.
- Ataxic: This is a rare form, affecting the sense of balance and depth perception.
- Mixed forms: It is common for patients to have symptoms of more than one of the three previous forms. The most common mixed form includes spasticity and athetoid movements.

There may also be other difficulties beyond the neuromuscular involvement, such as mental impairment, seizures, visual and auditory dysfunction, growth problems, and abnormal sensation and perception. The orthopedic difficulties encountered in children with cerebral palsy are frequently a result of high muscle tone, spasticity and rigidity that prevent normal growth of muscle and cause contractures. Treatment of this condition includes physical therapy, occupational therapy, casting, orthotics and medication. Surgery is often recommended when contractures are severe enough to cause movement problems. Gait analysis may be utilized to determine if surgery is necessary and to determine which surgical procedure is appropriate. There are several published studies regarding the use of gait analysis to provide objective information in the surgical planning process for this condition.

Literature Review

A study was conducted by DeLuca et al. (1997) to compare surgical recommendations based on information from clinical examination and videotaping with recommendations made after the inclusion of kinematic, kinetic and EMG data. Ninety-one ambulatory cerebral palsy patients with bilateral involvement were included in the study. It was noted that comparisons between the recommendations demonstrated that the addition of gait analysis data resulted in changes in surgical recommendations in 52% of the patients. When changes in surgery were recommended, there was an increase in recommendation for the gastrocnemius (59%) and rectus femoris (65%), and a decrease in recommendations for hamstrings (61%), psoas (78%), hip abductors (83%), femur (86%) and tibia (64%). The study concluded that computerized gait analysis information modifies the surgical treatment recommendation made by experienced physicians for the patient with cerebral palsy in about 52% of the patients evaluated and that gait analysis data generally lead to a reduction in the overall number of procedures.

Kay et al. (2000) conducted a study of 97 patients to determine the impact of preoperative gait analysis on orthopedic care. Of these 97 patients, 70 had a surgical plan identified before a preoperative gait study was performed. Of these 70 patients, 64 had static encephalopathy (60 with cerebral palsy, two with postmeningitis encephalopathy, one with traumatic brain injury, and one with hemiplegia secondary to Struge-Weber syndrome). Of the remaining six patients, two had isolated foot deformities and no central nervous system lesions; two had myelodysplasia; and one each had progressive spastic paraparesis and Lennox-Gastaut syndrome. The charts of all 70 patients were reviewed after the preoperative gait analysis to determine the frequency with which the treatment plan changed after gait analysis. The recommendation of the gait laboratory's physician coincided with those of the referring physician for only five of the 70 patients (7%). The ultimate treatment method matched that outlined on the preoperative evaluation for eight of the 70 patients (11%). No surgery was performed for three (4%) of the patients after the gait laboratory data were obtained. The study concluded that the additional information provided by gait analysis significantly alters orthopedic decision-making in pediatric patients with gait disorders.

Cook et al. (2003) conducted a study to assess the impact of gait analysis on the treatment of patients with cerebral palsy. The study included 102 ambulatory patients with cerebral palsy disorders affecting their lower limbs. Each patient was examined by the same orthopedic consultant. On the basis of this consultation, a treatment plan was formulated that included a recommendation for either surgical or nonsurgical treatment. If surgery was indicated, the level at which this surgery should be performed was noted. After this clinical assessment, each patient underwent three-dimensional gait analysis. Treatment recommendations were made after the gait analysis, including the need for surgical or nonsurgical treatment and the level and type of surgery recommended. The recommendations from the clinical assessment were compared with those following the gait analysis, along with a comparison of the recommended surgical procedures. After clinical assessment, 71 of the 102 patients were recommended for surgery, and 31 were recommended for nonoperative treatment. After gait analysis, the indications for treatment were confirmed in 91 cases: 61 of the 71 cases where surgery was recommended and 30 of the 31 cases did not require surgery. There was less agreement as to the actual surgical procedure required. More than one surgical procedure was proposed for many of the patients. After clinical

assessment, 215 procedures were proposed in 71 patients. After gait analysis, 213 procedures in 62 patients were recommended. There was agreement for 161 of these surgeries. Fifty-four more surgeries were proposed after the clinical assessment but not supported by gait analysis, and gait analysis recommended 52 more operations. The study concluded that results demonstrate that gait analysis would substantially alter surgical management and confirm the value of gait analysis for surgical decision-making in patients with cerebral palsy.

Chang et al. (2006) conducted a retrospective study to evaluate the impact of instrumented gait analysis on the walking performance of children with cerebral palsy. The study included two groups of 10 children. One group was composed of patients who followed the gait analysis recommendations and completed all surgical interventions. The control group included patients who chose not to follow surgical recommendations from the initial gait analysis but instead pursued alternative nonsurgical treatments. All participants had two instrumented gait analyses at least one year apart. Sagittal and coronal plane kinematic outcomes for each surgical procedure were obtained by comparing sequential instrumented gait analyses. These results were analyzed using logistic regression. The treatment group was found to experience a significantly higher percentage of positive outcomes (44%) than the control group (26%). The authors noted that the study demonstrates that patients who follow the surgical recommendations of instrumented gait analysis are 3.68 times more likely to have a positive result than patients who pursue alternative treatment. They concluded that, although the study was not a traditional outcome study, the results demonstrate that gait performance can significantly improve when instrumented gait analysis is used as a diagnostic tool to determine the appropriate surgical intervention.

Desloovere et al. (2006) conducted a study to document the correlation between gait analysis data and clinical measurements and evaluate the combined predictive value of static and dynamic clinical measurements on gait data of children with cerebral palsy. Two hundred patients were evaluated using a set of measurements that included range of motion (ROM), alignment, spasticity, strength, selectivity, and three-dimensional gait analysis. It was noted that there were fair to moderate correlations found between clinical measurements and gait data, with the overall highest correlation being 0.60. The clinical measurements of strength and selectivity had the highest degree of significant correlations with gait data, as compared to the ROM and spasticity. The authors noted that gait analysis data cannot be sufficiently predicted by a combination of clinical measurements. They concluded that the independence of the measurements supports the theory that both clinical examination and gait analysis data provide important information for delineating the problems of children with cerebral palsy.

Kawamura et al. (2006) conducted a retrospective study that included 50 patients to evaluate observational as compared to computerized gait analysis in patients with spastic diplegic cerebral palsy. Four observers evaluated ten specific points of interest of the gait cycle by viewing videotaped gait cycles: hip flexion at terminal stance; knee flexion at initial contact; knee extension at terminal stance; knee flexion at initial swing; ankle dorsiflexion at initial contact; pelvic obliquity at mid stance; hip adduction at loading response; pelvic rotation; hip rotation at mid stance and foot progression angle, in relation to the lower limb, at mid stance. The evaluation was then compared to the 3-D kinematics data, with a statistical analysis of the results performed in order to determine interobserver and visual/3-D analysis agreement. The results indicated that interobserver agreement was high; however, only two points of the gait cycle (knee flexion at initial contact and pelvic obliquity) were shown to have been similarly evaluated visually and with the 3-D analysis. The authors concluded that only knee flexion at initial contact and pelvic obliquity appear to be reliably evaluated on a visual basis alone and that visual observation is therefore inadequate for the evaluation of the other eight selected points of the gait cycle which require some form of quantitative assessment.

Molenaers et al. (2006) conducted a retrospective study to evaluate the impact of computerized gait analysis and botulinum toxin A injections on the timing, prevalence, and frequency of orthopedic surgery in children with cerebral palsy. Four hundred twenty-four patients with cerebral palsy were divided into three groups: Group 1 was composed of 122 patients who were managed throughout the entire study period consistent with best-practice guidelines in orthopedics; Group 2 was composed of 170 patients who were similarly managed but also received input from gait analysis; and Group 3 was composed of 132 patients who had gait analysis and also received botulinum toxin type A injections. The prevalence of orthopedic surgical procedures at different ages (three to nine years) and the time to the first surgical procedure were evaluated. The results indicated that the progression to orthopedic surgery was

significantly different among the three groups. The proportion of patients who had undergone at least one surgical procedure by the age of seven years was 52% for Group 1 (64 patients), 27% for Group 2 (46 patients), and 10% for Group 3 (13 patients). There was a delay in surgery in Group 2 as compared with Group 1 and a significant decrease in the prevalence of orthopedic surgical procedures for Group 3 as compared to Groups 1 and 2. The authors concluded that in the treatment of children who have cerebral palsy, the introduction of gait analysis increases the age of the first orthopedic surgical procedure and botulinum toxin type A treatment delays and reduces the frequency of surgical procedures.

Lofterod et al. (2007) reported on prospective study that evaluated to what extent introduction of 3-D gait analysis changes preoperative surgical planning. Sixty ambulatory children with spastic cerebral palsy had a specific surgical plan outlined based on clinical examination by orthopedic surgeons. The patients then underwent gait analysis. The proposed surgical plans were then reviewed. To determine the frequency with which the treatment plans changed. It was noted that treatment plans changed for 42 of the 60 patients. For 49 patients surgery was recommended and for 11 patients non-surgical treatment was recommended. Two hundred fifty-three procedures had been proposed prior to gait analysis. After the analysis, 97 procedures were not recommended and 65 additional procedures were recommended. There appeared to be overall agreement between the referring orthopedic surgeon and gait analysis in 156 of 318 procedures (49%). With the use of gait analysis, there was an increase in surgery proposed for psoas tenotomy and rectus femoris transfer, while less surgery was proposed for other soft tissue and bony procedures. The accordance between gait analysis recommendations and the actual surgery performed was noted to be 92%.

Summary

The literature indicates that clinical gait analysis may be utilized in the surgical decision-making process for children and adolescents with cerebral palsy. It may be performed to assist in determining if surgery is necessary and to determine which surgical procedure is appropriate. There is insufficient evidence in the published, peer-reviewed scientific literature to conclude that gait analysis has a role in the diagnosis or management of other medical conditions. Well-designed clinical trials are needed to demonstrate the clinical benefit of this procedure for other medical conditions.

Coding/Billing Information

Note: This list of codes may not be all-inclusive.

Covered when medically necessary:

CPT®*	Description
96000	Comprehensive computer-based motion analysis by video-taping and 3-D kinematics
96001	Comprehensive computer-based motion analysis by video-taping and 3-D kinematics; with dynamic plantar pressure measurements during walking
96002	Dynamic surface electromyography, during walking or other functional activities, 1-12 muscles
96003	Dynamic fine wire electromyography, during walking or other functional activities, 1 muscle
96004	Physician review and interpretation of comprehensive computer based motion analysis, dynamic plantar pressure measurements, dynamic surface electromyography during walking or other functional activities, and dynamic fine wire electromyography, with a written report

HCPCS Codes	Description
	No specific codes

ICD-9-CM	Description

Diagnosis Codes	
343.0-343.9	Infantile cerebral palsy

***Current Procedural Terminology (CPT®) © 2007 American Medical Association: Chicago, IL.**

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