Gait Analysis

**Policy Number:** 2.01.03  
**Last Review:** 8/2020  
**Origination:** 1/1986  
**Next Review:** 8/2021

**Policy**

Blue Cross and Blue Shield of Kansas City (Blue KC) will provide coverage for gait analysis when it is determined to be medically necessary because the criteria shown below are met.

**When Policy Topic is covered**

Comprehensive gait analysis may be considered *medically necessary* as an aid in surgical planning in patients with gait disorders associated with cerebral palsy (see Considerations).

**When Policy Topic is not covered**

Comprehensive gait analysis is considered *investigational* for all other applications, including but not limited to:

- Surgical planning for conditions other than gait disorders associated with cerebral palsy.
- Postoperative evaluation of surgical outcomes and rehabilitation planning and/or evaluation for all conditions.

Gait analysis that is not comprehensive is considered *investigational*.

**Considerations**

Gait analysis should not be confused with gait training.

Comprehensive gait analysis includes a quantitative assessment of coordinated muscle function in a dedicated laboratory, and uses the codes listed below.

Prior to 2002, no CPT codes explicitly described gait analysis, although CPT codes 95860-95870 describe various aspects of needle electromyography, some of which may have been used to describe components of gait analysis. In 2002, 5 new CPT codes were introduced that identify specific components of gait analysis as follows:

- **96000:** Comprehensive computer-based motion analysis by videotaping and 3-D kinematics
- **96001:** Above 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 measurement, dynamic surface electromyography during walking or other functional activities, and dynamic fine wire electromyography, with written report.

**Description of Procedure or Service**
Gait analysis (GA) is the quantitative laboratory assessment of coordinated muscle function, typically requiring a dedicated facility and staff and analysis of a video recorded observation of a patient walking. Gait analysis has been proposed as an aid in surgical planning, primarily for children with cerebral palsy (CP). It is also a potential tool to help plan rehabilitative strategies for ambulatory problems related to cerebral palsy, aging, stroke, spinal cord injury and other conditions.

**Background**
Gait analysis is the quantitative assessment of coordinated muscle function; evaluation is conducted in a laboratory and typically involves a dedicated facility and staff. A visual assessment of walking is supplemented by video recording. Videos can be observed from several visual planes at slow speed, allowing detection of movements not observable at normal speed. Joint angles and various time-distance variables, including step length, stride length, cadence, and cycle time, can be measured. Electromyography (EMG), assessed during walking, measures timing and intensity of muscle contractions. This calculation allows determination of whether a certain muscle’s activity is normal, out of phase, continuous, or clonic.

Kinematics is the term used to describe movements of joints and limbs such as angular displacement of joints and angular velocities and accelerations of limb segments. The central element of kinematic assessment is some type of marker system that is used to represent anatomic landmarks, which are then visualized and quantitatively assessed during analysis of videotaped observations. Movement data are compiled by computer from cameras oriented in several planes, and the movement data are processed so that the motion of joints and limbs can be assessed in 3 dimensions. The range and direction of motion of a particular joint can be isolated from all the other simultaneous motions that are occurring during walking. Graphic plots of individual joint and limb motion as a function of gait phase can be generated.

Kinetics is the term used to describe those factors that cause or control movement. Evaluating kinetics involves the use of principles of physics and biomechanics to explain the kinematic patterns observed and generate analyses that describe the forces generated during normal and abnormal gait analysis.
Gait analysis has been proposed as an aid in surgical planning, primarily for cerebral palsy but also for other conditions such as clubfoot. In addition, it is being investigated as a means to plan rehabilitative strategies (i.e. orthotic-prosthetic devices) for ambulatory problems related to cerebral palsy, aging, stroke, spinal cord injury, etc.

A non-profit organization established in 1997, the Commission for Motion Laboratory Accreditation, evaluates and accredits motion laboratories within clinical facilities. A multidisciplinary team uses a set of criteria to evaluate laboratories in the areas of administration (e.g., staffing, policies and procedures), equipment (e.g., accuracy and precision), and data management and reporting (e.g., control and clinical data sets).

**Regulatory Status**

In May 2003, the Peak Motus Motion Measurement System (Peak Performance Technologies) was cleared for marketing by the U.S. Food and Drug Administration (FDA) through the 510(k) process. This system uses off-the-shelf video cameras and sensors and proprietary software to document human movement in 2- or 3-dimensional space. The FDA determined that this device was substantially equivalent to existing devices and is indicated for assessment and training of limb or body motion in gait analysis, pre- or post-rehabilitation evaluation, physical therapy, and similar applications.

**Rationale**

This policy was developed in 1995 and modified based on a 2001 TEC Assessment on gait analysis in cerebral palsy. (1) At the time of the TEC assessment, there were no generally recognized standards of performance and interpretation of gait analysis and only limited reference standards to use for evaluating the accuracy of gait analysis. Gait analysis had been used extensively as an outcome tool in research on gait; however, there was only one small published case series addressing improved patient outcomes due to gait analysis in cerebral palsy. Gait analysis was considered investigational for all applications. Since the TEC assessment, the policy was updated regularly with a literature review using MEDLINE; most recently, the literature was searched from December 2011 through December 31, 2012. Following is a summary of key literature to date on gait analysis.

**Accuracy/reliability**

A systematic review of 18 studies on gait classification systems was published in 2007. (2) The review included studies that involved classification of gait impairment based on kinematic, temporal-spatial kinetic, or electromyographic (EMG) data. Fifteen studies used 3-dimensional gait analysis, 1 study used video observation analysis, and 6 studies used EMG data. The authors assessed the overall methodologic quality of the studies as low. Many studies appeared to classify patients arbitrarily rather than use clear clinical decision-making principles. Only 2 studies evaluated the reliability of classification, and the methods for determining the validity of classification systems was found inadequate. In an
earlier study funded by the United Cerebral Palsy Foundation, 4 different gait analysis centers gave different treatment recommendations after evaluating the same 11 patients. (3) Thus, there appears to be inconsistency in gait analysis recommendations between some centers.

Impact on health outcomes
The ideal study design to evaluate the utility of gait analysis for surgical planning or evaluation or rehabilitation planning would be a randomized controlled trial (RCT) and would compare health outcomes in patients managed with gait analysis to patients managed using another approach.

Pre- and/or postsurgical evaluation for children with cerebral palsy
There is one RCT, published in 2012 by Wren and colleagues, comparing post-surgery health outcomes in children with cerebral palsy who were managed with and without gait analysis. (4) This was a single-center, single-blind study. The trial included 186 ambulatory children with cerebral palsy who were candidates for lower extremity surgery to improve their gait. All participants underwent gait analysis at a gait laboratory. Patients were randomized to a treatment group in which the surgeon received the gait analysis report or a control group in which the surgeon did not receive the report. The reports included a summary of test results and treatment recommendations from the gait laboratory physician. The same surgeons treated the intervention and control patients i.e., they received gait reports for half of the patients. Patients were re-examined the day before surgery (i.e., following gait analysis) for pre-operative treatment planning. Outcomes were assessed pre-operatively and approximately 1 year post-surgery. There were 3 primary outcomes: pre- to post-surgical change between groups in the walking scale of the Gillette Functional Assessment Questionnaire (FAQ), the Gait Deviation Index (GDI) and the oxygen cost of walking, a measure of the energy expended while walking (oxygen, cost). A total of 156 of 186 (84%) participants returned for the follow-up examination; analysis was not intention to treat. There was not a statistically significant difference between groups in any of the 3 primary outcomes. For example, the proportion of patients improved according to the FAQ was 31% in the intervention group and 25% in the control group (p=0.38). There were significant differences between groups at the p=0.05 level for 2 of 19 secondary outcome variables; p values were not adjusted for multiple comparisons. The authors noted that physicians followed only 42% of recommendations in the gait analysis report for patients in the treatment group, which may partially explain the lack of significant differences between groups in the primary outcomes and most of the secondary outcomes. They further noted that there was a positive relationship between gait outcomes and following gait analysis recommendations.

Previously, in 2009, Wren and colleagues published a retrospective, non-randomized study comparing outcomes in patients managed with and without gait analysis. (5) The analysis included 462 children with cerebral palsy who had undergone lower extremity orthopedic surgery at a single hospital and had at least 6 months’ follow-up (n=313 had gait analysis prior to surgery and n=149 did not). Adjusting for baseline differences, the overall finding was that the number of
procedures and costs did not differ significantly between groups. The group that received gait analysis had a mean of 2.6 procedures per person-year compared to 2.3 per person-year in the non-gait analysis group. In sub-analyses, patients in the gait analysis group had significantly more initial surgical procedures (5.8 vs. 4.2, p<0.01) than the group that did not have gait analysis. Conversely, patients in the group not managed with gait analysis had more subsequent procedures (32% vs. 11%, p<0.001 – all respectively). Study findings suggest that gait analysis does not significantly affect overall utilization and cost. This study, however, did not specifically evaluate health outcomes. Also, since the study was not randomized, there may have been uncontrolled baseline differences that affected the number of procedures received.

In addition, several uncontrolled studies have been published in which children underwent both pre- and postoperative gait analysis. For example, in a study by Lofterod and colleagues, 60 children with cerebral palsy were referred for gait analysis after development of an initial surgical plan based on clinical observation. (6, 7) The original surgical plans were found to have been modified in 70% of patients following multidisciplinary team gait analysis. In a follow-up report, patients were divided into 3 groups: Group A: Agreement between clinical evaluation, gait analysis, and subsequent surgery; Group B: Procedures performed due to gait analysis recommendations that had not been part of the initial surgical plan; Group C: Procedures that were part of the initial surgical plan were not performed because they were not recommended after gait analysis. Based on gait analysis interpretation, surgery was not recommended in 11 children. Fifty-five children, including 47 who received surgery, underwent follow-up gait analysis 1–2 years after the initial analysis. Overall, at follow-up, there was improvement in kinematic parameters for children in Groups A and B. This suggests that the change in treatment planning associated with gait analysis may have been beneficial, or at least not harmful; we do not know what the outcome would have been if the original treatment plan had been followed. Group C had fewer surgical procedures or no surgery; among children in this group, there were no statistically significant changes in any kinematic parameters at the follow-up gait analysis. Of the 8 children in Group C, 4 children had clinical deterioration during more than 2 years of follow-up and were recommended to have multilevel surgery; most of their kinematic parameters were in the normal range at the time of initial evaluation. Based on this case series of patients referred for gait analysis, the authors concluded that gait analysis was useful for surgical planning.

Another study reviewed outcomes in 45 children with cerebral palsy who underwent gait analysis before and approximately 1 year after surgery that included collection of 3-dimensional motion and force-plate data. (8) The study aimed to determine whether gait analysis had a positive impact on treatment plans and whether gait analysis could predict which children would benefit from surgery. Most children had approximately 1 year between examinations. Like the Lofterod et al. study, patients were retrospectively classified into 3 groups, each with 15 children. A key outcome measure was change in the Gillette Gait Index (GGI); the article states that a change of 10% in the index is clinically significant. Based on change in the GGI, among the 15 children for whom surgery was not
recommended, 7 children improved, 4 were stable, and 4 deteriorated. In the
group that had surgery recommended but not performed (due to family preference
or other factors), 6 of 15 children improved, 1 was stable, and 8 deteriorated. In
the group for whom surgery was recommended and performed, 12 children
improved and 3 remained stable. A limitation of this study is that the authors did
not prospectively collect data on how treatment plans changed after the gait
analysis; instead, this was estimated by a multivariate analysis that found a
significant association between the GGI and choice of treatment, which the
authors state suggests that gait data influenced the treatment decision.

In 2011, prior to the publication of the RCT described above, (4) Wren and
colleagues published a systematic review of literature on the efficacy of gait
analysis. (9) The authors identified 7 studies evaluating the effect of gait analysis
on patients’ health outcomes; none were randomized controlled trials (RCTs). The
studies addressed a variety of clinical conditions, and the authors were not able to
pool findings. The systematic review also identified studies evaluating other
aspects of gait analysis including technical accuracy, diagnostic accuracy, and
societal efficacy (i.e., impact on number and cost of procedures). The authors
concluded that, although there is lower-level evidence (e.g., case series, case-
control studies) supporting gait analysis, there is a lack of evidence from RCTs on
the effect of gait analysis on health outcomes.

Conclusions: One randomized controlled trial has been published comparing
outcomes in patients with cerebral palsy managed with and without gait analysis.
The study did not find better health outcomes in patients managed with gait
analysis; however, surgeons followed only a minority of recommendations in the
gait analysis reports, and this trial is not definitive in ruling out a beneficial impact.
Overall, there is insufficient evidence from RCTs that gait analysis prior to surgery
improves health outcomes in patients with cerebral palsy.

Pre- and/or postsurgical evaluation for conditions other than cerebral palsy
In a study by Suda et al., gait analysis recommendations in 60 patients with
neurogenic intermittent claudication were evaluated and compared to 50 healthy
controls. (10) The authors concluded that gait analysis provided useful
quantitative and objective information to evaluate postsurgical treatment.
However, the study does not address how the gait analysis influenced treatment
decisions or affected health outcomes.

Sankar et al. received the records of 35 children (56 feet) who had recurrent
deformity after treatment of idiopathic clubfoot. (11) Gait lab recommendations
were compared to surgical plans prior to gait analysis and to actual surgery
received. Thirty of 35 (86%) children underwent surgery. Gait analysis resulted in
changed procedures in 19 of 30 (63%) patients. Gait analysis was found to
influence clinical decisions, but, like the study by Suda et al., this study does not
evaluate whether these changes resulted in improved health outcomes.
**Conclusions:** There is insufficient evidence that gait analysis as part of surgical planning improves health outcomes in patients with conditions other than cerebral palsy.

**Rehabilitation planning and/or evaluation**
No relevant clinical studies were identified.

**Ongoing clinical trials**
Outcomes of orthopedic surgery using gait laboratory versus observational gait analysis in children with cerebral palsy (NCT00419432). (12) This is a double-blind randomized controlled trial evaluating whether the addition of gait analysis to routine observation improves surgical outcomes in ambulatory children with cerebral palsy. Outcomes include measures of motor function and general functioning e.g., in the home and at school. The investigators intend to enroll 50 children in the study, which is being conducted at sites in the U.S. and Canada. The estimated date of study completion is October 2014.

**Clinical Input Received through Physician Specialty Societies and Academic Medical Centers**
In response to requests, input was received from 3 specialty societies (7 reviewers) and 2 academic medical centers (4 reviewers) while this policy was under review in 2010. While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process, through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted. The reviewers generally disagreed with the statement that gait analysis is investigational for all indications. There was agreement among the reviewers that comprehensive gait analysis (i.e., involving analysis of video recordings) may be medically necessary as an aid in surgical planning for children with gait disorders associated with cerebral palsy. Specifically, in children with cerebral palsy, reviewers consider comprehensive gait analysis to be important for planning prior to bony or muscle surgery in the lower extremities.

**Summary**
Gait analysis is the quantitative assessment of coordinated muscle function. For patients with cerebral palsy undergoing surgery for gait disorders, one randomized controlled trial did not find improvement in health outcomes for patients who received gait analysis as part of surgical planning, and one non-randomized controlled trial did not find improvement in utilization parameters. Several studies conducted among patients with cerebral palsy and other conditions suggest that gait analysis recommendations impact treatment decisions, but the impact of these decisions on health outcomes is as yet unknown. Based on input from clinical reviewers, gait analysis, when comprehensive, may be medically necessary for planning prior to surgery in children with gait disorders associated with cerebral palsy. Due to insufficient evidence, gait analysis is considered investigational for all other indications.
References

Billing Coding/Physician Documentation Information

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>96000</td>
<td>Comprehensive computer-based motion analysis by video-taping and 3-D kinematics</td>
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<tr>
<td>96001</td>
<td>Comprehensive computer-based motion analysis by video-taping and 3-D kinematics; with dynamic plantar pressure measurements during walking</td>
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<tr>
<td>96002</td>
<td>Dynamic surface electromyography, during walking or other functional activities, 1-12 muscles</td>
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<tr>
<td>96003</td>
<td>Dynamic fine wire electromyography, during walking or other functional activities, 1 muscle</td>
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<tr>
<td>96004</td>
<td>Review and interpretation by physician or other qualified health care professional 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 written report</td>
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ICD-10 Codes

<table>
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<tr>
<th>Code</th>
<th>Description</th>
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<tr>
<td>G80.0-G80.9</td>
<td>Cerebral palsy; code range</td>
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Additional Policy Key Words

N/A
Policy Implementation/Update Information

1/1/86  New policy.
8/1/00  No policy statement changes.
8/1/01  No policy statement changes.
8/1/02  Policy placed in Archives
8/1/05  Policy removed from Archives. No policy statement changes.
8/1/06  No policy statement changes.
2/1/07  No policy statement changes.
8/1/07  No policy statement changes.
2/1/08  No policy statement changes.
8/1/08  No policy statement changes.
2/1/09  No policy statement changes.
8/1/09  No policy statement changes.
2/1/10  No policy statement changes.
5/1/10  Policy statement added that comprehensive gait analysis may be considered medically necessary as an aid in surgical planning in patients with gait disorders associated with cerebral palsy; gait analysis considered investigational for all other applications.
8/1/10  No policy statement changes.
8/1/11  Second policy statement clarified that gait analysis for surgical planning for conditions other than gait disorders associated with cerebral palsy, and post-operative evaluation, rehabilitation planning and/or evaluation for all conditions is considered investigational.
8/1/12  No policy statement changes.
8/1/13  No policy statement changes.
8/1/14  No policy statement changes.
8/1/15  No policy statement changes.
8/1/16  No policy statement changes.
8/1/17  No policy statement changes.
8/1/18  No policy statement changes.
8/1/19  No policy statement changes.
8/1/20  No policy statement changes.

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