The services described in Oxford policies are subject to the terms, conditions and limitations of the Member's contract or certificate. Unless otherwise stated, Oxford policies do not apply to Medicare Advantage enrollees. Oxford reserves the right, in its sole discretion, to modify policies as necessary without prior written notice unless otherwise required by Oxford's administrative procedures or applicable state law. The term Oxford includes Oxford Health Plans, LLC and all of its subsidiaries as appropriate for these policies.

Certain policies may not be applicable to Self-Funded Members and certain insured products. Refer to the Member's plan of benefits or Certificate of Coverage to determine whether coverage is provided or if there are any exclusions or benefit limitations applicable to any of these policies. If there is a difference between any policy and the Member's plan of benefits or Certificate of Coverage, the plan of benefits or Certificate of Coverage will govern.

**APPLICABLE LINES OF BUSINESS/PRODUCTS**

This policy applies to Oxford Commercial plan membership.

**BENEFIT CONSIDERATIONS**

Essential Health Benefits for Individual and Small Group:
For plan years beginning on or after January 1, 2014, the Affordable Care Act of 2010 (ACA) requires fully insured non-grandfathered individual and small group plans (inside and outside of Exchanges) to provide coverage for ten categories of Essential Health Benefits (“EHBs”). Large group plans (both self-funded and fully insured), and small group ASO plans, are not subject to the requirement to offer coverage for EHBs. However, if such plans choose to provide coverage for benefits which are deemed EHBs (such as maternity benefits), the ACA requires all dollar limits on those benefits to be removed on all Grandfathered and Non-Grandfathered plans. The determination of which benefits constitute EHBs is made on a state by state basis. As such, when using this guideline, it is important to refer to the member specific benefit document to determine benefit coverage.

**NON-COVERAGE RATIONALE**

Gait analysis for surgical or clinical decision-making is considered unproven and not medically necessary.
The available clinical evidence does not establish that gait analysis benefits health outcomes. While the available data suggest that gait analysis can distinguish between normal and abnormal gait, the evidence is too limited to draw definitive conclusions regarding the role of gait analysis in the continuum of care. Evidence that includes clinical outcome results from randomized controlled trials is needed.

**APPLICABLE CODES**

The codes listed in this policy are for reference purposes only. Listing of a service or device code in this policy does not imply that the service described by this code is a covered or non-covered health service. Coverage is determined by the benefit document. This list of codes may not be all inclusive.

<table>
<thead>
<tr>
<th>CPT® Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>96000</td>
<td>Comprehensive computer-based motion analysis by video-taping and 3D kinematics</td>
</tr>
<tr>
<td>96001</td>
<td>Comprehensive computer-based motion analysis by video-taping and 3D kinematics; with dynamic plantar pressure measurements during walking</td>
</tr>
<tr>
<td>96002</td>
<td>Dynamic surface electromyography, during walking or other functional activities, 1-12 muscles</td>
</tr>
<tr>
<td>96003</td>
<td>Dynamic fine wire electromyography, during walking or other functional activities, 1 muscle</td>
</tr>
<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>
</tr>
</tbody>
</table>

**DESCRIPTION OF SERVICES**

Gait analysis 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, 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.

Surface or fine wire electromyography (EMG) data and force platform data may complement computerized gait analysis (Sutherland, 2001; Sutherland, 2005).

**CLINICAL EVIDENCE**

Dobson et al. (2007) conducted a systematic review of the literature to evaluate the validity of existing classifications of gait deviations in children with cerebral palsy (CP). Numerous efforts have been made to develop classification systems for gait in CP to assist in diagnosis, clinical decision-making and communication. The internal and external validity of gait classifications in 18 studies were examined, including their sampling methods, content validity, construct validity, reliability and clinical utility. Half of the studies used qualitative pattern recognition to construct the gait classification and the remainder used statistical techniques such as cluster analysis. Few adequately defined their samples or sampling methods. Most classifications were constructed using only sagittal plane gait data. Many did not provide adequate guidelines or evidence of reliability and validity of the classification system. No single classification addressed the full magnitude or range of gait deviations in children with CP. The authors concluded that although
gait classification in CP may be useful in clinical and research settings, the methodological limitations of many classifications restrict their clinical and research applicability.

Domagalska et al. (2013) assessed the relationship between the spasticity of lower extremity muscles and deviations from the normal gait pattern in children with cerebral palsy (CP) by using gait analysis and clinical measurements. Thirty-six children with spastic CP (18 with spastic hemiplegia [HS] and 18 with spastic diplegia [DS]), ranging in age from 7 to 12 years, participated in the study. The children were classified as level I (n=24) or level II (n=12) according to the Gross Motor Function Classification System. Spasticity levels were evaluated with the Dynamic Evaluation of Range of Motion (DAROM) using the accelerometer-based system, and gait patterns were evaluated with a three dimensional gait analysis using the Zebris system. The Gillette Gait Index (GGI) was calculated from the gait data. The results show that gait pathology in children with CP does not depend on the static and dynamic contractures of hip and knee flexors. Although significant correlations were observed for a few clinical measures with the gait data (GGI), the correlation coefficients were low. Only the spasticity of rectus femoris showed a fair to moderate correlation with GGI. The authors concluded that the results indicate the independence of the clinical evaluation and gait pattern and support the view that both factors provide important information about the functional problems of children with CP. This study is limited by small sample size. In addition, further research is needed to determine the clinical relevance of these findings.

Overall, computerized gait analysis can distinguish between normal and spastic or dyskinetic gait. It is also a promising tool for gait classification. Gait analysis does not necessarily correlate with clinical assessment. At this time, exact technical parameters and gait analysis models have not been established.

Cerebral Palsy Treatment Planning
Wren et al. (2013a) conducted a randomized controlled trial to determine if gait analysis improves correction of excessive hip internal rotation in ambulatory children with spastic cerebral palsy (CP). Children undergoing orthopedic surgery were randomized to receive or not receive a preoperative gait analysis report. This secondary analysis included all participants whose gait report recommended external femoral derotation osteotomy (FDRO). One-year postoperative, and pre- to postoperative change in femoral anteversion, mean hip rotation in stance, and mean foot progression in stance were compared between groups and in subgroups based on whether the recommendation for FDRO was followed. Outcomes did not differ between the group which received a gait report (n=39; 19 males, 20 females; mean age 10y 4mo) and the control group (n=26; 14 males, 12 females; mean age 9y 5mo), but improved more in the gait report subgroup in which the FDRO recommendation was followed (seven limbs; change in anteversion -32.9°, hip rotation -25.5°, foot progression -36.2°) than in the control group (anteversion -12.2°, hip rotation -7.6°, foot progression -12.4°) and the gait report subgroup in which FDRO was not performed (32 limbs; anteversion -1.0°, hip rotation 0.5°, foot progression -8.0°). Postoperative measures became normal only in the gait report subgroup in which the recommended FDRO was performed. The authors concluded that gait analysis can improve outcomes when its recommendations are incorporated in the treatment plan. According to the authors, the major limitation of this study is that only seven of the 39 of the recommended FDROs were performed in the gait report group, indicating poor compliance with the gait analysis recommendations. This practice pattern may limit generalizability of the study findings since other surgeons may be more likely to implement the gait analysis recommendations.

In a randomized controlled trial, Wren et al. (2013b) examined the impact of gait analysis on surgical outcomes in ambulatory children with cerebral palsy (CP). A total of 156 children with CP (94 male; age 10.2±3.7 years) underwent gait analysis and were randomized to two groups: Gait Report group (N=83), where the referring surgeon received the patient's gait analysis report, and Control group (N=73), where the surgeon did not receive the gait report. Outcomes were assessed pre- and 1.3±0.5 years post-operatively. An intent-to-treat analysis compared outcomes between the two groups. Outcome measures included the Gillette Functional Activity Questionnaire (FAQ), Gait Deviation Index (GDI), oxygen cost, gross motor function measure, Child Health Questionnaire (CHQ), Pediatric Outcomes Data Collection Instrument (PODCI), and
Pediatric Evaluation and Disability Inventory. The outcomes that differed significantly between groups were change in health from the CHQ, which was rated as much better for 56% (46/82) of children in the Gait Report group compared with 38% (28/73) in the Control group, and upper extremity physical function from the PODCI. Gait outcomes (FAQ and GDI) improved more when over half of the recommendations for a patient were followed or the recommended extent of surgery (none, single, or multi-level) was done. However, less than half (42%) of the gait analysis recommendations were followed in the Gait Report group. Since 35% were implemented in the Control group where the gait analysis recommendations were not known, the relative difference was only 7%. According to the authors, this is much less than the >85% reported in previous studies and may account for the lack of differences between groups for some of the outcome measures. Several study limitations were noted by the authors including relatively short length of follow-up, the small number of surgeons involved, and relatively small sample size and heterogenous patient population which may limit the generalizability of the study results. According to the authors, future research should investigate why gait analysis recommendations are not always followed.

Wren et al. (2013c) examined the extent to which gait analysis recommendations are followed by orthopedic surgeons with varying degrees of affiliation with the gait laboratory. Surgical data were retrospectively examined for 95 patients with cerebral palsy who underwent lower extremity orthopedic surgery following gait analysis. Thirty-three patients were referred by two surgeons directly affiliated with the gait laboratory (direct affiliation), 44 were referred by five surgeons from the same institution but not directly affiliated with the gait laboratory (institutional affiliation), and 18 were referred by 10 surgeons from other institutions (no affiliation). Data on specific surgeries were collected from the gait analysis referral, gait analysis report, and operative notes. Adherence with the gait analysis recommendations was 97%, 94%, and 77% for the direct, institutional, and no affiliation groups, respectively. Procedures recommended for additions to the surgical plan were added 98%, 87%, and 77% of the time. Procedures recommended for elimination were dropped 100%, 89%, and 88% of the time. Of 81 patients who had specific surgical plans prior to gait analysis, changes were implemented in 84% (68/81) following gait analysis recommendations. According to the authors, gait analysis influences the treatment decisions of surgeons regardless of affiliation with the gait laboratory, although the influence is stronger for surgeons who practice within the same institution as the gait laboratory.

Wren et al. (2011a) used data from a randomized controlled trial to determine the effects of gait analysis on surgical decision-making in children with cerebral palsy (CP). A total of 178 ambulatory children with CP (110 male; age 10.3±3.8 years) being considered for lower extremity orthopaedic surgery underwent gait analysis and were randomized into one of two groups: gait report group (N=90), where the orthopaedic surgeon received the gait analysis report, and control group (N=88), where the surgeon did not receive the gait report. Data regarding specific surgeries were recorded by the treating surgeon before gait analysis, by the gait laboratory surgeon after gait analysis, and after surgery. Agreement between the treatment done and the gait analysis recommendations was compared between groups using the 2-sided Fisher's Exact test. When a procedure was planned initially and also recommended by gait analysis, it was performed more often in the gait report group (91% vs. 70%). When the gait laboratory recommended against a planned procedure, the plan was changed more frequently in the gait report group (48% vs. 27%). When the gait laboratory recommended adding a procedure, it was added more frequently in the gait report group (12% vs. 7%). According to the authors, these results provide a stronger level of evidence demonstrating that gait analysis changes treatment decision-making and also reinforces decision-making when it agrees with the surgeon’s original plan. The study examined only the baseline data and the decision-making effects of gait analysis. The authors stated that future research will address the effects of gait analysis on patient outcomes. The primary limitations of this study are the small number of surgeons involved and the absence of outcome data. This study involved a single gait laboratory and gait laboratory surgeon and four referring surgeons from another institution. Larger multicenter studies are needed to obtain more generalizable results.

Wren et al. (2011b) conducted a systematic review to evaluate and summarize the current evidence base related to the clinical efficacy of gait analysis including the use of gait analysis in
Gait Analysis: Clinical Policy (Effective 07/01/2015)
surgical recommendations in diplegic CP patients, when decided by two different blinded clinicians based on clinical assessment alone and GA in addition to clinical assessment. The study included 25 diplegic children who were evaluated by GA before surgery and at a follow up of at least 6 months. Two separate lists of problems and consequent surgical interventions were outlined for all the patients by two blinded experts from clinical and GA assessment. The two sets of nominal-scale ratings for all patients of the two groups were statistically evaluated for agreement. A fair and slight agreement was found respectively between the two sets of problems and the two sets of surgical plans. The main differences in problems identified were relative to the presence of generalized spasticity and bony deformities as detected by means of GA instead of local problems and soft tissues spasticity/retraction clinically identified. As a consequence, by means of GA, surgery was indicated only in 65% of patients. The authors concluded that the availability of a GA laboratory helps in diagnostic reasoning in CP children indicated for surgery. According to the authors, the low agreement found appears to be a result of a different clinical approach of the surgeons. According to the authors, it is difficult to interpret the results of this study with respect to surgical changes introduced by gait analysis planning because although gait analysis has been shown to alter decision making, evidence that the decisions based on gait analysis could lead to better outcomes is still unclear.

In a prospective study, Lofterod et al. (2007) evaluated to what extent 3-D gait analysis changes preoperative surgical planning. Before gait analysis, 60 ambulatory children (age range 4 to 18 years) with spastic cerebral palsy had a specific surgical plan outlined, based on clinical examination by orthopedic surgeons. After gait analysis, the proposed surgical procedures were reviewed to determine the frequency with which the treatment plans changed. Treatment plans for 42 of the 60 patients were altered after gait analysis. Surgical treatment was recommended for 49 patients whereas 11 were recommended non-surgical treatment. Of the 253 specific surgical procedures proposed, 97 procedures were not recommended after gait analysis and 65 additional procedures were recommended after the analysis. Thus, the number of procedures proposed was reduced by 13%. There was good accord between gait analysis recommendations and the surgery performed subsequently (92%). According to the investigators, gait analysis provided important additional information that modified preoperative surgical planning to a high degree. The high accordance between recommendations and surgery performed suggests that surgeons seriously consider the gait data and treatment recommendations. Study limitations include small sample size and the study did not evaluate how computerized gait analysis affects patient outcomes.

In a follow-up report, Lofterod and Terjesen (2008) assessed the outcome of orthopaedic surgery in ambulatory children with cerebral palsy, when the orthopaedic surgeons followed the recommendations from preoperative three-dimensional gait analysis. Fifty-five children were clinically evaluated by orthopaedic surgeons who proposed a surgical treatment plan. After gait analysis and subsequent surgery, three groups were defined. In group A, there was agreement between clinical proposals, gait-analysis recommendations, and subsequent surgery in 128 specific surgical procedures. In group B, 54 procedures were performed based on gait analysis, although these procedures had not been proposed at the clinical examination. In group C, 55 surgical procedures that had been proposed after clinical evaluation were not performed because of the gait-analysis recommendations. The children underwent follow-up gait analysis 1 to 2 years after the initial analysis. Overall, at follow-up, there was improvement in kinematic parameters for children in groups A and B. The investigators concluded that gait analysis was useful in confirming clinical indications for surgery, in defining indications for surgery that had not been clinically proposed, and for excluding or delaying surgery that was clinically proposed. This study suggests that change in treatment planning due to gait analysis may be beneficial, but it is not known whether the outcome would be different if the original treatment plan had been followed.

Filho et al. (2008) performed a study to determine if recommendations based on three-dimensional gait analysis (3DGA) are associated with better postoperative outcomes in patients with cerebral palsy (CP). Thirty-eight patients who underwent orthopedic surgery and assessment at the Gait Analysis Laboratory were evaluated retrospectively. The patients were divided into four groups according to the agreement between the recommendations from gait analysis and the procedures actually carried out. Fifteen patients with diplegic spastic cerebral palsy and indication
for orthopedic surgery to improve walking and whose surgical intervention was postponed were also included in the study as a control group. Fourteen gait parameters recorded before and after treatment, were included in the statistical analysis. No gait improvement was noted in the control group or in patients on whom no procedures recommended by the gait exam were performed (agreement of 0%). In the other groups, agreements averaged 46.71%, 72.2%, and 100%, respectively. Improvement of gait parameters after treatment was observed in these groups, with more significant values directly related to increased agreement percentage. According to the investigators, the patients whose treatment matched the recommendations from three-dimensional gait analysis showed a more significant improvement in walking. These findings require confirmation in a larger study.

Lee et al. (1992) assessed 23 ambulatory children with cerebral palsy preoperatively by a detailed clinical examination and by gait analysis using a video-based gait analysis system (VICON). Surgery was then performed based on either the clinical assessment alone or a combination of clinical evaluation and gait analysis. About one year after surgery, a postoperative clinical and gait analysis assessment was performed. Sixteen children had improved and seven children had not improved after surgery. Most of the children who had not improved were found to have had operations that differed from those recommended by gait analysis. Dynamic EMG studies were found to be useful in preoperative planning but did not show any consistent improvement even in the children with good results. According to the investigators, the combination of a careful clinical assessment and gait analysis can produce better results in surgery for children with cerebral palsy. This study is limited by small sample size and non-randomization of study participants.

Deluca et al. (1997) conducted a prospective comparative study to evaluate the impact of 3D gait analysis on surgical decisions in 91 patients with CP. Gait analysis affected surgical decision making in 52% of patients. Based on the gait analysis results, the physicians recommended additional surgery in 23% of patients and less surgery in 26% of patients. In a prospective, intrapatient comparative study to evaluate the impact of 3D gait analysis on the clinical management of 102 CP patients, Cook et al. (2003) found that the overall agreement between clinical assessment and gait analysis was 60%; better agreement was achieved for osteotomy (77%) than for soft-tissue surgery (55%). This study did not evaluate if gait analysis had an impact on clinical outcomes.

Rathinam et al. (2014) systematically reviewed the available pediatric observational gait analysis tools and examined their reliability and validity compared to instrumented gait analysis (IGA). The review also examined the structure of these tools, their clinical use and limitations. Studies that examined children's gait using a structured assessment tool were included and analyzed for their quality, reliability and validity. Nine studies related to children with cerebral palsy (CP) were enrolled for the review. Pre-established criteria were used to judge the quality of methodology and reliability and validity. Five observational gait tools for children with CP and one for children with Downs Syndrome were identified. According to the authors, observational gait analysis tools are valuable to determine the effect of clinical intervention on gait but they cannot be used for pre-surgical planning or for diagnostic purpose due to their limited reliability and validity. The authors concluded that Edinburgh Visual Gait Score (EVGS) was found to have better concurrent validity and reliability and it should be considered to assess CP gait in regular practice. According to the authors, more research is needed to investigate the use of low cost technology to improve observers’ accuracy of EVGS.

Narayanan (2012) reviewed the scientific literature to describe the role of gait analysis in the orthopaedic management of ambulatory children with cerebral palsy (CP) and examined the current best evidence to support these roles. The author stated that although gait analysis has been shown to alter decision making, there remain concerns about the reliability (reproducibility) of these decisions or whether implementing these recommendations would result in better outcomes.

In a retrospective review, Wren et al. (2009) evaluated the effects of clinical gait analysis (GA) and the amount of surgery that ambulatory children with cerebral palsy (CP) undergo. The
patients were grouped into those who had undergone GA before their index surgery (GA group, N=313) and those who had not (NGA group, N=149). Patients in the GA group were significantly older and less functionally involved, had their first surgery in later years, and had a shorter follow-up than patients in the NGA group. Adjusting for these differences, patients in the GA group had more procedures and higher cost during index surgery, but less subsequent surgery. A higher proportion of patients went on to additional surgery in the NGA group with more additional surgeries per person-year. The total number of procedures (GA: 2.6/person-year, NGA: 2.3/person-year; P=0.22) and cost (GA: $20,448/person-year, NGA: $19,535/person-year; P=0.58) did not differ significantly between the 2 groups. The investigators concluded that clinical GA is associated with a lower incidence of additional surgery, resulting in lesser disruption to patients' lives. This study was retrospective, did not specifically evaluate health outcomes, and patients were not randomized to a treatment group.

One small retrospective study evaluated the impact of computerized gait analysis on clinical outcomes (Chang et al., 2006). The study included 10 patients with CP and 10 age- and sex-matched controls. Children in the control group chose not to follow the gait analysis recommendation and chose a nonsurgical treatment approach, whereas children in the gait analysis group followed a physician's recommendation for gait analysis. The results documented that 74% of patients in the control group had no change or a negative outcome, 26% in the control group had a positive outcome. Of the gait analysis group 61% had no change or a negative outcome, while 44% of this group had a positive outcome. While the results of this study suggest that gait analysis recommendations may improve clinical outcomes, the control group did not undergo surgery, whereas those in the gait analysis group did. Therefore, it is not possible to determine the relative contributions of gait analysis and surgery.

Based on these studies, the addition of gait analysis data to clinical assessment may delay or avoid surgery or result in additional surgery. However, it is not clear whether decisions that were based on gait analysis data improved patient outcomes. Further studies, including results of randomized controlled clinical trials documenting clinical outcomes, are needed to determine the future role of gait analysis.

In guidance on the spasticity in children and young people with non-progressive brain disorders, the National Institute for Health and Care Excellence (NICE) states that the decision to perform orthopaedic surgery to improve gait should be informed by a thorough pre-operative functional assessment, preferably including gait analysis (NICE 2012).

The National Institute of Neurological Disorders and Stroke (NINDS) Web information for Cerebral Palsy Hope through Research states that surgery for cerebral palsy may not be indicated for all gait abnormalities and the surgeon may request a quantitative gait analysis before surgery (NINDS, updated 2015).

A registered trial relevant to gait analysis was identified on ClinicalTrials.gov. This ongoing multi-center randomized trial will provide evidence to support or refute the need for gait laboratory analysis for surgical decision-making for children with cerebral palsy. The estimated study completion date is March 2015. See the following Web site for more information: http://clinicaltrials.gov/ct2/show/NCT00419432. Accessed February 2015.

Computerized Gait Analysis for Patient Management and Treatment Planning of Other Conditions
Alradwan et al. (2015) conducted a systematic review to evaluate the current status of gait and lower extremity kinematics as an outcome measure in patients treated surgically for femoroacetabular impingement (FAI). Five studies met the eligibility criteria for inclusion in the systematic review. These studies included a total of 58 patients with symptomatic FAI (age range, 18 to 50 years). All included studies were of moderate methodologic quality. Kinematic assessments were completed preoperatively and postoperatively with variable methodology and follow-up (range, 3 to 32 months). Most studies used high-speed motion-capture camera systems with reflective tracking markers to evaluate in vivo kinematic function. Of the 5 included studies, 3 documented kinematic improvements postoperatively particularly regarding sagittal hip range of
motion primarily with flexion. The authors concluded that gait and lower extremity kinematics can be used as an outcome measure after FAI surgery. However, the lack of uniformity in the methodology used and underpowered case series limit the ability to identify clear and predictable differences after corrective surgery for FAI. Though statistically significant, functional outcome improvements were often conflicting and not necessarily of clinical significance. According to the authors, a uniform outcome measure and technique to reliably assess in vivo hip motion are required for future comparative studies.

A systematic literature search was performed in PUBMED and the Cochrane database by selecting manuscripts assessing any psychometric property of gait analysis in knee or hip osteoarthritis (OA). Among the 252 articles identified, the final analysis included 30 reports (781 knee OA patients and 343 hip OA patients). Gait analysis presents various feasibility issues and there was limited evidence regarding reliability (three studies, 67 patients). Discriminant capacity showed significant reduction of gait speed, stride length and knee flexion in OA patients compared to healthy subjects. Few data were available concerning construct validity (three studies, 79 patients). Responsiveness of gait speed was moderate to large with effect size ranging respectively from 0.33 to 0.89 for total knee replacement, and from 0.50 to 1.41 for total hip replacement. The reviewers concluded that available data concerning validity and reliability of kinematic gait analysis are insufficient to date to consider kinematic parameters as valuable outcome measures in OA. Further studies evaluating a large number of patients are needed (Ornetti et al. 2010).

Holly et al. (2009) conducted a systematic review of published evidence to identify valid, reliable, and responsive measures of functional outcome after treatment for cervical degenerative disease. The authors identified 11 studies of cervical degenerative disease and functional outcome that were included in an evidentiary table summarizing the quality of evidence (Classes I-III). Disagreements regarding the level of evidence were resolved through an expert consensus conference. The group formulated recommendations that contained the degree of strength based on the Scottish Intercollegiate Guidelines network. Validation was done through peer review by the Joint Guidelines Committee of the American Association of Neurological Surgeons/Congress of Neurological Surgeons. Gait analysis was found to be valid and reliable measures (Class II) for assessing cervical spondylotic myelopathy. The studies analyzed for gait analysis included non-randomized trials by Singh and Crockard (1999) (41 patients), Moorthy et al. (2005) (6 patients) and Kuhtz-Buschbeck et al. (1999) (12 patients).

Benedetti et al. (2013) evaluated gait analysis as a clinical assessment tool to determine if the results are consistent, irrespective of the laboratory. A baseline assessment between site consistency of one healthy subject was examined at 7 different laboratories. Anthropometric and spatio-temporal parameters, pelvis and lower limb joint rotations, joint sagittal moments and powers, and ground reaction forces were compared. The consistency between laboratories for single parameters was assessed by the median absolute deviation and maximum difference, for curves by linear regression. Twenty-one lab-to-lab comparisons were performed and averaged. Large differences were found between the characteristics of the laboratories (i.e. motion capture systems and protocols). Different values for the anthropometric parameters were found, with the largest variability for a pelvis measurement. The spatio-temporal parameters were in general consistent. Segment and joint kinematics consistency was in general high, except for hip and knee joint rotations. The main difference among curves was a vertical shift associated to the corresponding value in the static position. The consistency between joint sagittal moments ranged from $R^2=0.90$ at the ankle to $R^2=0.66$ at the hip, the latter was increasing when comparing separately laboratories using the same protocol. Pattern similarity was good for ankle power but not satisfactory for knee and hip power. The force was found the most consistent, as expected. According to the authors, the differences found were in general lower than the established minimum detectable changes for gait kinematics and kinetics for healthy adults.

Li et al. (2012) assessed the accuracy of surface-measured tibiofemoral kinematics in functional activities in 10 subjects with unilateral, isolated grade II posterior cruciate ligament (PCL) deficiency. A dynamic stereo radiography (DSX) system and a Vicon motion capture system simultaneously measured knee or lower extremity movement during level running and stair
ascent. Surface marker motion data from the Vicon system were used to create subject-specific models in OpenSim and derive the tibiofemoral kinematics. The surface-measured model-derived tibiofemoral kinematics in all six degrees of freedom (DOFs) were compared with those measured by the DSX as the benchmarks. The authors found that surface-based measures significantly underestimated the mean as well as inter-subject variability of the differences between PCL-injured and intact knees in abduction-adduction, internal-external rotations, and anterior-posterior translation.

Fuller et al. (2002) assessed the influence of gait analysis with dynamic electromyography upon surgical planning in patients with upper motor neuron syndrome and gait dysfunction. Two surgeons prospectively evaluated 36 consecutive adult patients with a spastic equinovarus deformity of the foot and ankle. After the initial clinical evaluation and surgical planning, all patients underwent instrumented gait analysis collecting kinetic, kinematic and poly-EMG data using a standard protocol by a single experienced physiatrist. Each surgeon reviewed the gait studies and patients independently and again formulated a surgical plan. Overall a change was made in 64% of the surgical plans after the gait study. The investigators concluded that instrumented gait analysis alters surgical planning for patients with equinovarus deformity of the foot and ankle and can produce higher agreement between surgeons in surgical planning. These findings require confirmation in a larger study.

Sankar et al. (2009) evaluated 35 patients (56 feet) with recurrent clubfoot in an uncontrolled study. According to the investigators, quantitative gait analysis resulted in 28 changed procedures in 19 of 30 patients (63%) compared to pre-study surgical plans. Study limitations include small sample size and the study did not evaluate how computerized gait analysis affects patient outcomes.

Del Din et al. (2011) evaluated gait alterations in patients with ankylosing spondylitis (AS). Twenty-four patients were evaluated: 12 normal and 12 pathologic in stabilized anti-TNF-alpha treatment. Physical examination and gait analysis were performed. Gait analysis results showed statistically significant alterations in the sagittal plane at each joint. According to the investigators, gait analysis, through gait alterations identification, allowed planning-specific rehabilitation intervention aimed to prevent patients' stiffness together with improve balance and avoid muscles' fatigue. Further research is needed to determine the clinical relevance of these findings.

The evidence from these studies was too limited to draw definitive conclusions regarding the role of gait analysis for these conditions.

**U.S. FOOD AND DRUG ADMINISTRATION (FDA)**

The FDA has approved a large number of gait analysis systems for medical use under the 510(k) approval process, product code LXJ. Additional information regarding FDA approvals can be accessed at: [http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPMN/pmn.cfm](http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPMN/pmn.cfm). Accessed on February 2015.

**REFERENCES**

The foregoing Oxford policy has been adapted from an existing UnitedHealthcare national policy that was researched, developed and approved by the UnitedHealthcare Medical Technology Assessment Committee. [2015T0506J]


<table>
<thead>
<tr>
<th>Date</th>
<th>Action/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>07/01/2015</td>
<td>Added benefit considerations language for Essential Health Benefits for Individual and Small Group plans to indicate:</td>
</tr>
<tr>
<td></td>
<td>For plan years beginning on or after January 1, 2014, the Affordable Care Act of 2010 (ACA) requires fully insured non-grandfathered individual and small group plans (inside and outside of Exchanges) to provide coverage for ten categories of Essential Health Benefits (“EHBs”)</td>
</tr>
</tbody>
</table>
|            | Large group plans (both self-funded and fully insured), and small group ASO plans, are not subject to the requirement to offer coverage for EHBs; however, if such plans choose to provide coverage for benefits which are deemed EHBs (such as maternity benefits), the ACA requires all dollar limits on those benefits to be removed on all Grandfathered and Non-
<table>
<thead>
<tr>
<th>Grandfathered plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The determination of which benefits constitute EHBs is made on a state by state basis; as such, when using this guideline, it is important to refer to the member specific benefit document to determine benefit coverage</td>
</tr>
<tr>
<td>- Updated supporting information to reflect the most current clinical evidence and references</td>
</tr>
<tr>
<td>- Archived previous policy version OUTPATIENT 039.8 T2</td>
</tr>
</tbody>
</table>