Paraspinal surface electromyography (SEMG) is considered investigational as a technique to diagnose or monitor back pain.

Policy Guidelines

Coding

There is no specific CPT code for surface electromyography (SEMG) other than the following code which is part of the CPT coding for motion analysis:

- **96002**: Dynamic surface electromyography, during walking or other functional activities, 1-12 muscles

Existing codes for electromyography (95860-95872) explicitly describe needle electromyography, in which a needle is inserted into an individual muscle. Therefore, these codes do not describe SEMG.

One of the following nonspecific CPT codes might be used:

- **95999**: Unlisted neurological or neuromuscular diagnostic procedure
- **97799**: Unlisted physical medicine/rehabilitation service or procedure
- **99199**: Unlisted special service, procedure or report

The following HCPCS code is specific to SEMG:

- **S3900**: Surface electromyography (EMG)

Description

A noninvasive procedure that records the summation of muscle electrical activity, paraspinal surface electromyography (SEMG) has been investigated as a technique to evaluate the physiologic functioning of the back. Additionally, this procedure has been studied as a technique to evaluate abnormal patterns of electrical activity in the paraspinal muscles in patients with back pain symptoms, such as spasm, tenderness, limited range of motion, or postural disorders.

Related Policies

- N/A

Benefit Application

Benefit determinations should be based in all cases on the applicable contract language. To the extent there are any conflicts between these guidelines and the contract language, the contract language will control. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage of these services as it applies to an individual member.

Some state or federal mandates [e.g., Federal Employee Program (FEP)] prohibits plans from denying Food and Drug Administration (FDA)-approved technologies as investigational. In these instances, plans may have to consider the coverage eligibility of FDA-approved technologies on the basis of medical necessity alone.
Regulatory Status

Surface electromyography (SEMG) devices approved by the U.S. Food and Drug Administration include those that use a single electrode or a fixed array of multiple surface electrodes. Examples include the CMAP Pro (Medical Technologies) and Model 9200 EMG System (Myotronics-Noromed).

Several U.S. Food and Drug Administration–approved devices combine SEMG along the spine with other types of monitors. For example, in 2007, the Insight Discovery (Fasstech, Burlington, MA) was cleared for marketing through the 510(k) process. The device contains 6 sensor types, one of which is for SEMG. The indications include measuring bilateral differences in SEMG along the spine and measuring SEMG along the spine during functional tasks. (Earlier Insight models had fewer sensors.) U.S. Food and Drug Administration product code: IKN.

Rationale

Background

Back Pain

Back pain is a common condition that affects most individuals at some point in their lives. Identifying the pathogenesis of back pain is a challenging task, in part due to the complex anatomy of the back, which includes vertebrae, intervertebral discs, facet joints, spinal nerve roots, and numerous muscles. Back pain may be related to osteoarthritis, disc disease, subluxation, or muscular pathology, such as muscle strain or spasm. Moreover, due to referred pain patterns, the location of the pain may not be anatomically related to the pathogenesis of the pain. For example, buttock or leg pain may be related to pathology in the spine. In addition to the diagnostic challenges of back pain is the natural history of acute back pain. Most cases of acute low back pain resolve with conservative therapy (e.g., physical therapy) while continuing normal activities within limits permitted by the pain. Therefore, initial imaging or other diagnostic testing is generally not recommended unless “red flag” warning signs are present or the pain persists for more than 4 to 6 weeks. Red flag findings include significant trauma, history of cancer, unrelenting night pain, fevers or chills, and progressive motor or sensory deficits.

Diagnosis

Aside from physical examination, diagnostic testing includes imaging technologies, such as magnetic resonance imaging, designed to identify pathology (e.g., bulging discs), or tests such as discography to localize the abnormality by reproducing the pain syndrome. However, these tests lack specificity and must be carefully interpreted in the context of the clinical picture. For example, magnetic resonance imaging identifies 5% of asymptomatic patients as having bulging discs. However, the presence of a bulging disc may only be clinically significant if correlated with other symptoms. Assessment of the musculature may focus on range of motion or strength exercises.

In contrast to anatomic imaging, surface electromyography (SEMG), which records the summation of muscle activity from groups of muscles, has been investigated as a technique to evaluate the physiologic functioning of the back. A noninvasive procedure, SEMG differs from needle electromyography, an invasive procedure in which the electrical activity of individual muscles is recorded. Paraspinal SEMG has been explored to evaluate abnormal patterns of electrical activity in the paraspinal muscles in patients with back pain symptoms such as spasm, tenderness, limited range of motion, or postural disorders. The technique is performed using a single or an array of electrodes placed on the skin surface, with recordings made at rest, in various positions, or after a series of exercises. Recordings can also be made by using a handheld device, which is applied to the skin at different sites. Electrical activity is assessed by computer analysis of the frequency spectrum (i.e., spectral analysis), amplitude, or root mean square of the electrical action potentials. In particular, a spectral analysis that focuses on the median frequency has been used to assess paraspinal muscle fatigue during isometric
endurance exercises. Paraspinal SEMG has been researched as a technique to establish the etiology of back pain and has been used to monitor the response to therapy and establish physical activity limits, such as assessing capacity to lift heavy objects or ability to return to work.

Paraspinal SEMG is an office-based procedure that may be most commonly used by physiatrists or chiropractors. The following clinical applications of the paraspinal SEMG have been proposed:
- clarification of a diagnosis (i.e., muscle, joint, or disc disease)
- selection of a course of medical therapy
- selection of a type of physical therapy
- preoperative evaluation
- postoperative rehabilitation
- follow-up of acute low back pain
- evaluation of exacerbation of chronic low back pain
- evaluation of pain management treatment techniques.

**Literature Review**
Assessment of a diagnostic technology typically focuses on 3 categories of evidence: (1) its technical performance (test-retest reliability or interrater reliability); (2) diagnostic accuracy (sensitivity, specificity, and positive and negative predictive value) in relevant populations of patients; and (3) clinical utility demonstrating that the diagnostic information can be used to improve patient outcomes. The following is a summary of the key literature to date.

**Surface Electromyography**
Surface electromyography (SEMG) has been used as a research tool to evaluate the performance of paraspinal muscles in patients with back pain and to further understand the etiology of low back pain.1-4 Preliminary research has also been performed to determine which SEMG parameters best differentiate patients with and without back pain.5,6

**Clinical Context and Test Purpose**
The purpose of paraspinal SEMG in patients who have back pain is to identify the pathogenesis of the pain (i.e., muscle, joint, or disc disease) to inform a decision on a treatment plan.

The question addressed in this evidence review is: Does paraspinal SEMG improve the net health outcome in individuals with back pain?

The following PICOTS were used to select literature to inform this review.

**Patients**
The relevant population of interest is individuals with back pain.

**Interventions**
Paraspinal SEMG is a noninvasive technique that aggregates data on muscle activity from groups of muscles. One or more electrodes are placed on the skin surface, and recordings are taken at rest, in various positions, or during a series of exercises.

**Comparators**
Other noninvasive techniques to assess back pain include clinical examination and imaging technologies.

**Outcomes**
The general outcomes of interest are reduction in back pain and improvement in activities of daily living.

Both false-positive test results and false-negative results can lead to an incorrect recommendation for the type of treatment or no treatment at all. Some treatments are long-
term programs, and if individuals are incorrectly referred to the program, resources will be used inefficiently and more appropriate therapy will be delayed.

**Timing**
Testing would occur before determining the treatment plan.

**Setting**
Paraspinal SEMG can be performed in an office setting by physiatrists, chiropractors, or physical therapists.

**Technical Performance**
Villafane et al (2016) conducted a systematic review of studies testing the validity and clinical applicability of SEMG among patients with chronic nonspecific low back pain (LBP). The literature review, conducted through September 2014, identified 24 studies for inclusion. The quality of the studies was assessed using a modification of the checklist for cohort, case-control, and cross-sectional studies from Strengthening the Reporting of Observational Studies in Epidemiology. The checklist has 22 items, and reviewers used the 15 items that related to methods and results. Of a possible total 15 points, study scores ranged from 6 to 12. Reviewers focused on the 10 studies with scores from 10 to 12. One was large (N=349), the second largest had 67 patients, and the remaining studies had 40 or fewer patients. While SEMG recordings were taken, patient position (upright, seated) and type of test (e.g., isometric trunk extension, semi-crouched lifting, Roman chair endurance) varied among the studies. Reviewers reported inconsistent findings on the validity and reliability for SEMG in discriminating between patients with chronic nonspecific LBP and healthy controls. Conclusions were limited due to the heterogeneity of methods across the studies.

A systematic review by Mohseni Bandpei et al (2014) identified 12 studies on the test-retest reliability of paraspinal SEMG. Seven included only healthy individuals. The remaining 5 studies evaluated SEMG in patients with low back pain; 3 of these included a healthy control group. Overall, the studies reported that interrater reliability, as measured by an intraclass coefficient, varied widely (range, 0.26-0.91), with most of the values in the moderate to high range. Studies were heterogeneous regarding methodology and SEMG parameters used. This evidence demonstrated that the reliability of SEMG would at least be moderate in the assessment of back muscle fatigue, but it did not address the accuracy or validity of the test.

A literature review of spinal muscle evaluation in low back pain patients, published in 2007, indicated that the validity of SEMG remains controversial. Reviewers noted that, although many studies showed increased fatigability of the paraspinal muscles in patients with LBP, they could not determine whether these changes were causes or consequences of the LBP. Also, the utility of SEMG was found to be limited because of the inability to distinguish between normal and abnormal profiles due to factors such as a lack of normative data.

**Diagnostic Performance**
No articles that directly compare the results of SEMG (which tests groups of muscles) with needle electromyography (which tests individual muscles) for diagnosing any specific muscle pathology were identified in literature searches. However, the pathology of individual muscles (i.e., radiculopathy, neuropathy) may represent a different process than the pathology of muscle groups (i.e., muscle strain, spasm), and thus SEMG may be considered by its advocates as a unique test for which there is currently no criterion standard. Nevertheless, even if one accepts this premise, there are inadequate data to evaluate the diagnostic performance of SEMG. In some instances, the asymmetrical electrical activity may have been used to define abnormality; results may be compared with normative data. However, we found no published literature defining what degree of asymmetry would constitute abnormality.

A study by du Rose and Breen (2016) looked into the relation between lumbar intervertebral range of motion and paraspinal muscle activity in healthy adults, as measured by SEMG and
quantitative fluoroscopy, to establish “normal” measurements. Fluoroscopic images and SEMG measurements were taken for 20 men with no history of LBP. What would be considered normal intervertebral ranges of motion were related to a diverse set of muscle activation patterns as measured by SEMG. The authors concluded that larger sample sizes and measurements from patients with LBP are needed to establish standard criterion.

Absent a criterion standard diagnostic test, correlation with the clinical symptoms and physical exam is critical. De Luca (1993) published a series of studies investigating a type of SEMG called the Back Analysis System, consisting of surface electrodes and other components to measure the electrical activity of muscles during isometric exercises designed to produce muscle fatigue. Using physical exam and clinical history as a criterion standard, De Luca found that the Back Analysis System accurately identified control and back pain patients 84% and 91% of the time, respectively, with the values increasing to 100% in some populations. (Accuracy was defined as the sum of true-positive and true-negative results.) However, these studies were not designed as a clinical diagnostic tool per se but were intended to investigate the etiology of back pain and to investigate muscular fatigue patterns in patients with and without back pain.

Hu et al (2010, 2014) in Hong Kong published 2 articles on dynamic topography, an approach to analyzing SEMG findings. Both studies included patients with LBP and healthy controls; all participants underwent SEMG at study enrollment and then back pain patients participated in a rehabilitation program. The first study found different dynamic topography at baseline between the healthy people and back pain samples (a more symmetric pattern in healthy controls). After physical therapy, the dynamic topography images of back pain patients were more similar to the healthy controls on some of the parameters assessed. In the second study, following rehabilitation, back pain patients were classified as responders or nonresponders based on changes in back pain severity. Some associations were found between baseline SEMG parameters and response to rehabilitation. SEMG was not repeated after the rehabilitation program, and thus it is unclear whether there are any significant associations between continued symptoms and SEMG abnormalities. Moreover, it is unclear how SEMG analysis would affect treatment decisions for patients with LBP.

Clinical Utility
A number of studies have described SEMG as an aid in classifying low back pain. Most of this research has focused on the use of SEMG to assess muscle fatigability rather than on how information from test findings could enhance patient management. While SEMG may be used to document muscle spasm or other muscular abnormalities objectively, it is unclear how such objective documentation would supplant or enhance clinical evaluation, or how this information would be used to alter the treatment plan. In part, the difficulty in clinical interpretation is understanding the extent to which the SEMG abnormalities are primary or secondary. Additionally, as noted in the Background section, no specific workup is recommended for acute LBP without warning signs.

The following studies have proposed using SEMG results to inform treatment decisions; however, none provided data to validate whether treatment based on SEMG results improved outcomes.

In a 2016 study of patients with chronic LBP (N=216), SEMG showed potential to discriminate between impaired and unimpaired neuromuscular regulation of back extensors, which would provide useful information for designing individualized exercise programs.

In a 2015 study of patients with LBP (n=27) and pain-free controls (n=23), SEMG detected a loss of discrete motor cortical organization of the paraspinal muscles among those with LBP. The invasive technique of needle electromyography is usually performed to detect this pathology. Patients with cortical reorganization may benefit from motor skill training.
In 2 studies (1988, 1992), SEMG was shown to differentiate muscle spasm from muscle contracture. Muscle spasm would be treated with relaxation therapy, and contracture would be treated with stretching exercises.20,21

Summary of Evidence
For individuals who have back pain who receive paraspinal surface electromyography (SEMG) for evaluation and monitoring, the evidence includes a systematic review of interrater reliability, a systematic review of validity and reliability, and several nonrandomized studies on using findings to classify back pain. Relevant outcomes are test accuracy and validity, symptoms, functional outcomes, quality of life, and resource utilization. Addressing the technical performance of SEMG, systematic reviews of small nonrandomized studies have concluded that the validity and reliability of SEMG have not been established. Heterogeneity on how SEMG recordings of muscle activity are taken limit generalizability. Across studies, patients may be sitting or standing, and exercises are isometric or dynamic. Addressing diagnostic performance of SEMG, there have been no studies directly comparing SEMG with other noninvasive techniques for evaluating back pain, and standard criteria for normal and abnormal SEMG measurements have not been determined. Addressing clinical utility, SEMG has been proposed as a noninvasive technique providing objective measurements that would inform treatment decisions in patients with back pain. While the studies have shown that SEMG results have detected different pathologies in patients with back pain, none of the studies reported health outcomes. There are no data on the impact of SEMG for patient management or health outcomes. The evidence is insufficient to determine the effects of the technology on health outcomes.

Supplemental Information
Practice Guidelines and Position Statements

American College of Occupational and Environmental Medicine
In a 2011 guideline, the American College of Occupational and Environmental Medicine did not recommend SEMG as a technique for diagnosing low back disorders, based on insufficient evidence of efficacy.

American Pain Society
In 2009, the American Pain Society issued guidelines on the evaluation and management of low back pain.22 When discussing the diagnostic accuracy of nonimaging tests, the guidelines stated that “There is no evidence supporting the use of thermography or surface electromyography for diagnosis of low back pain (level of evidence: fair).”

U.S. Preventive Services Task Force Recommendations
Not applicable.

Medicare National Coverage
There is no national coverage determination. In the absence of a national coverage determination, coverage decisions are left to the discretion of local Medicare carriers.

Ongoing and Unpublished Clinical Trials
A search of ClinicalTrials.gov in May 2017 did not identify any ongoing or unpublished trials that would likely influence this review.

References


**Documentation for Clinical Review**

- No records required

**Coding**

This Policy relates only to the services or supplies described herein. Benefits may vary according to benefit design; therefore, contract language should be reviewed before applying the terms of the Policy. Inclusion or exclusion of a procedure, diagnosis or device code(s) does not constitute or imply member coverage or provider reimbursement.

IE

The following services may be considered investigational.

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<thead>
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<th>Type</th>
<th>Code</th>
<th>Description</th>
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<td>Unlisted neurological or neuromuscular diagnostic procedure</td>
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<tr>
<td></td>
<td>96002</td>
<td>Dynamic surface electromyography, during walking or other functional activities, 1-12 muscles</td>
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<td>Unlisted special service, procedure or report</td>
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<tr>
<td>HCPCS</td>
<td>S3900</td>
<td>Surface electromyography (EMG)</td>
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<td>Measurement of Musculoskeletal Contractility, External Approach</td>
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**Policy History**

This section provides a chronological history of the activities, updates and changes that have occurred with this Medical Policy.

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<thead>
<tr>
<th>Effective Date</th>
<th>Action</th>
<th>Reason</th>
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<tbody>
<tr>
<td>09/12/2008</td>
<td>Adopted BCBSA policy MPP 2.01.35 on Paraspinal Surface EMG. Title and Scope broadened to include all Surface EMG’s. Policy Statement, literature search, coding update, and rationale added.</td>
<td>Medical Policy Committee</td>
</tr>
<tr>
<td>10/07/2011</td>
<td>Policy revision without position change</td>
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<tr>
<td>10/31/2014</td>
<td>Policy title change from Surface Electromyography Policy revision with position change</td>
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<td>Policy revision without position change</td>
<td>Medical Policy Committee</td>
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</table>
Definitions of Decision Determinations

Medically Necessary: A treatment, procedure, or drug is medically necessary only when it has been established as safe and effective for the particular symptoms or diagnosis, is not investigational or experimental, is not being provided primarily for the convenience of the patient or the provider, and is provided at the most appropriate level to treat the condition.

Investigational/Experimental: A treatment, procedure, or drug is investigational when it has not been recognized as safe and effective for use in treating the particular condition in accordance with generally accepted professional medical standards. This includes services where approval by the federal or state government is required prior to use, but has not yet been granted.

Split Evaluation: Blue Shield of California/Blue Shield of California Life & Health Insurance Company (Blue Shield) policy review can result in a split evaluation, where a treatment, procedure, or drug will be considered to be investigational for certain indications or conditions, but will be deemed safe and effective for other indications or conditions, and therefore potentially medically necessary in those instances.

Prior Authorization Requirements (as applicable to your plan)

Within five days before the actual date of service, the provider must confirm with Blue Shield that the member's health plan coverage is still in effect. Blue Shield reserves the right to revoke an authorization prior to services being rendered based on cancellation of the member's eligibility. Final determination of benefits will be made after review of the claim for limitations or exclusions.

Questions regarding the applicability of this policy should be directed to the Prior Authorization Department. Please call (800) 541-6652 or visit the provider portal at www.blueshieldca.com/provider.

Disclaimer: This medical policy is a guide in evaluating the medical necessity of a particular service or treatment. Blue Shield of California may consider published peer-reviewed scientific literature, national guidelines, and local standards of practice in developing its medical policy. Federal and state law, as well as contract language, including definitions and specific contract provisions/exclusions, take precedence over medical policy and must be considered first in determining covered services. Member contracts may differ in their benefits. Blue Shield reserves the right to review and update policies as appropriate.