Paraspinal Surface Electromyography to Evaluate and Monitor Back Pain

Description

Surface electromyography (SEMG), a noninvasive procedure that records the summation of muscle electrical activity, has been investigated as a technique to evaluate the physiologic functioning of the back. In addition, 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 (ROM), or postural disorders.

Background

Back pain is an extremely common condition, affecting 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. For example, 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 will resolve with conservative therapy, such as physical therapy, and continuing normal activities within limits permitted by the pain. Thus, initial imaging or other diagnostic testing is generally not recommended unless “red flag” warning signs are present or the pain persists for longer 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.

Aside from physical examination, diagnostic tests include imaging technologies, such as magnetic resonance imaging (MRI), designed to identify pathology (eg, bulging discs) or tests such as discography to localize the abnormality by reproducing the pain syndrome. However, due to their lack of specificity, all diagnostic tests must be carefully interpreted in the context of the clinical picture. For example, 5% of asymptomatic patients will have bulging discs as identified by MRI. Therefore, the presence of a bulging disc may only be clinically significant if well correlated with symptoms. Assessment of the musculature may focus on ROM or strength exercises.
In contrast to anatomic imaging, 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 is contrasted with needle electromyography, an invasive procedure in which the electrical activity of individual muscles is recorded. Paraspinal SEMG, also referred to as paraspinal EMG scanning, has been explored 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 ROM, or postural disorders. The technique is performed using 1 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 can be assessed by computer analysis of the frequency spectrum (ie, spectral analysis), amplitude, or root mean square of the electrical action potentials. In particular, 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 also 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

**Regulatory Status**

SEMG devices approved by the U.S. Food and Drug Administration (FDA) include those that use a single electrode or a fixed array of multiple surface electrodes.

Several FDA-approved devices combine surface EMG 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, 1 of which is surface EMG. The indications include measuring bilateral differences in surface EMG along the spine and measuring surface EMG along the spine during functional tasks. (Earlier Insight models had fewer sensor types).

**Related Policies**

None
Policy

This policy statement applies to clinical review performed for pre-service (Prior Approval, Precertification, Advanced Benefit Determination, etc.) and/or post-service claims.

Paraspinal surface electromyography (SEMG) is considered **not medically necessary** as a technique to diagnose or monitor back pain.

Rationale

**Literature Review**

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 on which SEMG parameters best differentiate between individuals with and without back pain. (5,6) However, validation of its use as a clinical diagnostic technique involves a sequential 3-step procedure as follows:

1. Technical performance of a device is typically assessed by studies that compare test measurements with a criterion standard and those that compare results taken with the same device on different occasions (test-retest).

2. Diagnostic performance is evaluated by the ability of a test to accurately diagnose a clinical condition in comparison with the criterion standard. The sensitivity of a test is the ability to detect a disease when the condition is present (true-positive), while specificity indicates the ability to detect patients who are suspected of disease but who do not have the condition (true-negative). Evaluation of diagnostic performance, therefore, requires independent assessment by the 2 methods in a population of patients who are suspected of disease but who do not all have the disease.

3. Evidence related to improvement of clinical outcomes with use of this testing assesses the data linking use of a test to changes in health outcomes (clinical utility). While in some cases, tests can be evaluated adequately using technical and diagnostic performance, when a test identifies a new or different group of patients with a disease; randomized trials are needed to demonstrate impact of the test on the net health outcome.

The following discussion focuses on these 3 steps as they apply to SEMG.

**Technical performance**

Several studies using different SEMG devices have suggested that paraspinal SEMG, in general, is a reliable technique, based on coefficients of variation or test-retest studies. (1, 7) No studies were identified that compared the performance of SEMG to a criterion standard reference test.
Diagnostic performance

No articles that 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. For example, no articles were identified in the published peer-reviewed literature that established definitions of normal or abnormal SEMG. In some instances, asymmetrical electrical activity may have been used to define abnormality; results may be compared with a “normative data base.” However, there was no published literature defining what degree of asymmetry would constitute abnormality or how a normative database was established. (8)

In the absence of a criterion standard diagnostic test, correlation with the clinical symptoms and physical exam is critical. De Luca has published a series of studies investigating a type of SEMG called the Back Analysis System (BAS), consisting of surface electrodes and other components to measure the electrical activity of muscles during isometric exercises designed to produce muscle fatigue. (2) Using physical exam and clinical history as a criterion standard, the author found that BAS was able to accurately identify control and back pain patients 84% and 91% of the time, respectively, with the values increasing to 100% in some populations of patients. (Accuracy is 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 in Hong Kong published 2 articles on dynamic topography, an approach to analyzing SEMG findings. (9,10) The studies had similar protocols. Both included low back pain patients 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 healthy people and people with back pain, e.g., a more symmetric pattern in healthy controls.9 After physical therapy, the dynamic topography images of back pain patients were more similar to the healthy controls on some of the parameters that were assessed. In the second study, following rehabilitation, back pain patients were classified as responders or nonresponders based on changes in back pain severity.10 Some associations were found between baseline SEMG parameters and response to rehabilitation. SEMG was not repeated following the rehabilitation program, and thus it is not clear whether there are any significant associations between continued symptoms and SEMG abnormalities. Moreover, it is not clear how SEMG analysis would affect treatment decisions for low back pain patients.

Improvement of Clinical Outcomes

Several articles describe the use of SEMG as an aid in classifying low back pain. (11-13) Much of this research in this application has focused on the use of spectral analysis to assess muscle fatigability rather than how information from SEMG could enhance patient management. While SEMG may be used to objectively document muscle spasm or other muscular abnormalities, 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. In addition, as noted in the Background section, no specific workup is recommended for acute low back pain without warning signs.

There are no data regarding the impact of SEMG on the final health outcome. For example, SEMG has been proposed as a technique to differentiate muscle spasm from muscle contracture, with muscle spasm treated with relaxation therapy and contracture treated with stretching exercises. However, there are no data to validate that such treatment suggested by SEMG resulted in improved outcomes.14,15

A literature review of spinal muscle evaluation in low back pain patients, published in 2007, indicated that the validity of SEMG remains controversial.16 The authors note that although many studies show increased fatigability of the paraspinal muscles in patients with low back pain, it is not known whether these changes are causes or consequences of the low back pain. Also, the utility of SEMG is limited because of the inability to clearly define normal versus abnormal profiles due to factors such as a lack of normative data.

Practice Guidelines and Position Statements

In a 2011 guideline from the American College of Occupational and Environmental Medicine, surface electromyography is not recommended as a technique for diagnosing low back disorders due to insufficient evidence of efficacy. (17)

U.S. Preventive Services Task Force Recommendations

Paraspinal surface electromyography is not a preventive service.

Summary

There are inadequate data on the technical and diagnostic performance of paraspinal SEMG compared to a criterion standard reference test. Moreover, there is insufficient evidence regarding how findings from paraspinal SEMG impact patient management and/or how use of the test improves health outcomes. Thus, paraspinal surface electromyography for diagnosing and monitoring back pain is considered not medically necessary.

Medicare National Coverage

There is no national coverage determination.

References


Policy History

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<td>December 2013</td>
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Keywords

Dynamic Surface Electromyography (sEMG)
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This policy was approved by the FEP® Pharmacy and Medical Policy Committee on December 5, 2014 and is effective January 15, 2015.

Signature on File
Deborah M. Smith, MD, MPH