Validity of Surface Electromyography and Range of Motion Testing  
A Review of the Relevant Literature and Legal Precedence

Written by David Marcarian, MA

The following document establishes the validity of Dynamic Surface Electromyography Technology. The main purpose of this paper is to respond to various claims that the technology is experimental, investigational, lacks the scientific literature to support its use, or requires a “Motion Analysis Laboratory”.

This paper cites the medical literature and legal precedence which apply and prove that the denial of payment is not justified. There are many misconceptions about this technology, and oftentimes it is mistaken with another technology with a similar name.

Validity of Surface Electromyography Procedure:

The following paragraphs cite the medical literature and legal precedence which prove that the use of Surface EMG is a generally accepted procedure among the medical community. Logically, if there is peer-reviewed medical literature that addresses the clinical application of this technology, the only conclusion is that test is not experimental.

Please feel free to utilize Medline and Google to confirm the veracity of the cited claims below if this is a concern.

The following are the data proving that the statement made regarding the validity of the technology is false.


A literature review utilizing MEDLINE was performed on the search terms “Surface EMG” between only 2002 and 2005. This review revealed 33 relevant clinical studies on Surface EMG. Note that the first study to appear in the review is specifically related to Surface EMG and chronic low back pain.

2. AMA’s Position on Surface EMG

The American Medical Association (AMA) has provided a CPT code for billing Surface EMG. The AMA has determined that Dynamic Surface EMG is an insurance reimbursable procedure which is generally accepted in the medical community.
It states clearly in the document published by the American Medical Association (AMA) in “Applying for Codes: CPT Background and Categories of CPT Codes” (see CPT Code Book) that for a Category I code (any 5 digit code), which exists for Dynamic Surface EMG (96002 & 96004), that the procedure:

“generally based upon the procedure being consistent with contemporary medical practice and being performed by many physicians in clinical practice in multiple locations”

3. Literature Review (including one citing 44 clinical studies specifically on the use of Surface Electromyography)

2005, Geiser et. al
A Meta-Analytic Review of Surface Electromyography Among Persons with Low Back Pain and Normal, Healthy Controls:


Michael Geisser is a researcher with “The Spine Program, Department of Physical Medicine and Rehabilitation, University of Michigan Health System, Ann Arbor Michigan”.

This paper, which examined 44 relevant papers on the clinical value of Surface EMG concluded:

1. Surface EMG measures of flexion-relaxation appear to distinguish low back pain patients from healthy controls with good accuracy.

2. Sensitivity and specificity of Surface EMG for Dynamic measures averaged 88.8% and 81.3%” demonstrating that Surface EMG provides valuable data.

3. The effect size for flexion/relaxation measures was found to be very high (d—1.71) making the was able to accurately distinguish between low back pain patients and controls.

4. MyoVision was the only of the top two selling Surface EMG systems with unbiased research of high enough caliber to be included in this review, and which provided data supporting the use of Surface EMG, establishing it as the instrument of choice when evaluating patients.

The fact that this study alone references 44 relevant clinical studies on Surface EMG leads us to the conclusion that the technology is not experimental.
2000, Nederhand et. al:


**Results:** The most pronounced differences between patients with whiplash associated disorder Grade II and healthy control subjects were found particularly in situations in which the biomechanical load was low. Patients showed higher coactivation levels during physical exercise and a decreased ability to relax muscles after physical exercise.”

**Conclusions:** Patients with whiplash associated disorder Grade II can be distinguished from healthy control subjects according to the presence of cervical muscle dysfunction, as assessed by surface electromyography of the upper trapezius muscles. Particularly the decreased ability to relax the trapezius muscles seems to be a promising feature to identify patients with whiplash associated disorder Grade II. Assessment of the muscle (dys)function by surface electromyography offers a refinement of the whiplash associated disorder classification and provides an indication to a suitable therapeutic approach.

What makes this paper particularly practical and useful for court use is that all patients in the study were in a motor vehicle collision making this applicable directly to soft tissue injury associated with motor vehicle collisions.

1999 Ambroz, et. al:


1 Aim of this study has been to investigate the reliability of the Surface EMG technique in differentiating between Chronic Low Back Pain patients as a general group and healthy controls. Moreover, this investigation included a matching protocol, which was not used in the above –mentioned study. The findings of this report support the use of static and Dynamic Surface EMG technique as an objective test to assess abnormal paraspinal muscle activity independently of different types of Low Back Pain. The effect of position on the Surface EMG activity was indirectly addressed by the demonstration that different degrees of trunk flexion produced a significant variation in the readings.

2 This study demonstrated clear statistically significant differences between healthy controls and those with low back pain in for both Static and Dynamic Surface EMG testing.

2005 Ambroz, et. al:

Ambroz A, Ambroz C, Zucker R, Benjamin E, Caruso M: VAS scores correlate with Static Surface EMG Signal Intensity In Chronic Spine Pain. AAPM Annual Meeting
Abstracts, Pain Medicine, Volume 6, Number 2, 2005

This paper demonstrated the following:

1 VAS Scores correlated highly with the summation of all readings taken during a Static sEMG exam (24 readings summed total were presented).

2 Static sEMG values correlated highly with pain intensity changes over a 2 month treatment program with results indicating that a VAS score of 6 at presentation with a mean sum Static sEMG value of 542 microvolts. After 2 months of treatment, the VAS score mean was 1 for this group, with a mean value of 180 microvolts of summed Static sEMG values.

3 Those that did not respond to treatment showed very little change in both the VAS score and Static Surface EMG sum value, with a presentation mean VAS score of 6.8 with a mean summed Static sEMG value of 884 microvolts. Two months post treatment, with no response to treatment the VAS score remained a mean of 6.8 with mean summed Static sEMG values of 709 microvolts.

The conclusion of the authors were that the mean summed Static sEMG signal intensity can serve as an objective measurement which correlates highly with pain.

1991 Sihovnen, et. al:


1 Conclusion: Lumbar myoelectric rhythm measured during normal symmetric movements in the sagittal plane appears to be different in back pain patients compared to pain-free controls. We believe that it is an invaluable aid in detecting and objectifying disturbed function in paraspinal muscles in back pain patients and in general disability. This agrees with recent research which indicates that kinetic EMG patterns (in contrast to static levels) may best show the complex biomechanical events in the lumbar region.

2 Test re-test reliability was very high, with (r=0.91 to r=0.97) for flexion and re-extension respectively.

3 Surface EMG seemed to yield more information from activity level than needle EMG when evaluating low back pain.

4 The same phases seen in needle EMG were also seen in Surface EMG.
Twenty six out of 30 patients with low back pain demonstrated abnormally high readings in flexion, and a ratio of the peak in flexion compared with the peak in re-extension significantly lower than in normal, healthy controls.

2004, Cheung, J, et. al:


1 Conclusion: The combined measurement of spinal growth velocity and electromyographic ratio has significant predictive potential and may be valuable in the evaluation and treatment of idiopathic scoliosis.

2 The Surface EMG shows promise as a tool in evaluating and tracking progression of scoliosis.

1997 Watson PJ, et. al:


1 This paper demonstrated that the Surface EMG Flexion Relaxation Ratio could definitively discriminate between normal, healthy controls and Chronic Low Back Pain Patients.

2 Test-Retest Reliability was very high (.0.81 - .098) for dynamic sEMG.

3 Sensitivity and specificity were high enough to recommend use in the clinical environment.

1998, Nicholson, R.:


1 Utilizing a MyoVision Surface EMG system, patients were evaluated for injury to track progress with two patients.

2 Results of the Surface EMG correlated highly with successful treatment of both patients, and lead to their return to work earlier than anticipated.

3 Therapeutic intervention was significantly altered based upon the sEMG findings as it provided valuable information as to the patient’s physiologic state.
4. Legal Challenges To The Validity of Surface EMG

In addition, when the courts challenged the validity of the MyoVision exam in the State of Florida, the lower court’s 47 page decision (Case #04-1149RX) that Surface EMG was a medically valid diagnostic test was unanimously upheld by the Superior Court decision in appeal (Case #1D05-729). The tool has been established as valid in numerous court cases around the country.

According to Judge Cleavenger:

“The fact that SEMG has been found to meet the requirements of the AMA for assignment of five-digit CPT Codes provides evidence of the medical value of the test, and strong evidence of the high level of general acceptance of the test by the relevant provider community.

Common Misrepresentations & Misrepresented Research Papers:

Pullman et al:


The paper published in Neurology in 2000 was written for the purpose of providing “educational material” to help in making clinical decisions. At first glance, it purports to have provided an extensive review of the literature to provide the most objective data to help the doctor in making better clinical decisions, and to help insurers determine legitimate procedures.

One of the research criteria used to determine the validity of a paper is to review the list of references to determine potential bias in the research paper. Practically speaking, if there is no bias, the paper would include ALL research papers relevant to the topic, whether they support or do not support the basic thesis of the paper.

After this analysis, the only conclusion any trained researcher can arrive at is that this paper is extremely biased, and must be dismissed as virtually unusable when evaluating the value of Surface EMG.

What is the issue with this paper? Besides being too old to be considered relevant, this paper ignores the most commonly referenced literature cited in support of Surface EMG published PRIOR to its publication. Why did this study claim to evaluate research studies on Surface EMG yet not reference the most important research studies available.
at the time of publication? It is not clear, but what is clear is this fact invalidates the paper completely.

Listed below are a sample of some of the papers which the review did not address. All support the use of Surface EMG.


With the inclusion of the above studies in the paper, it is difficult as a scientist to consider the contents as unbiased, and therefore it must be dismissed.

“Needle or Fine Wire EMG Studies Are Better Than Surface EMG”

1991 Sihovenen, et. al:

Sihvonen T, Partanen J, Hanninen O, Soimakallio S. Electric behavior of low back muscles during lumbar pelvic rhythm in low back pain patients and healthy controls.

1 Conclusion: Lumbar myoelectric rhythm measured during normal symmetric movements in the sagittal plane appears to be different in back pain patients compared to pain-free controls. We believe that it is an invaluable aid in detecting and objectifying disturbed function in paraspinal muscles in back pain patients and in general disability. This agrees with recent research which indicates that kinetic EMG patterns (in contrast to static levels) may best show the complex biomechanical events in the lumbar region.

2 Test re-test reliability was very high, with (r=0.91 to r=0.97) for flexion and re-extension respectively.

3 Surface EMG seemed to yield more information from activity level than needle EMG when evaluating low back pain.

4 The same phases seen in needle EMG were also seen in Surface EMG.

5 Twenty six out of 30 patients with low back pain demonstrated abnormally high readings in flexion, and a ratio of the peak in flexion compared with the peak in re-extension significantly lower than in normal, healthy controls.

The key here is that Surface EMG and Needle or fine wire EMG are different technologies completely, and should never be compared directly. Surface EMG is used to document muscle guarding and bracing, while needle EMG is used to evaluate for nerve damage. They are not interchangeable in any way at all.

“Dedicated Motion Analysis Laboratory” is Required

*Please review the recent Superior Court Case in the State of Florida (Case # 1D05-729) titled:

Please note that I was the expert witness in this case, testifying on behalf of the validity of Surface EMG. The Superior Court Decision was unanimous, upholding the lower court decision (Case #04-1149RX) where Surface EMG was found to be valid, and that a motion analysis laboratory was found unnecessary for billing using the AMA CPT code for Dynamic SEMG.

The case files and all information related can be found at by emailing nicole@myovision.com and requesting the court transcript and/or court decision.

In the lower court decision, the court determined that the AMA CPT code did not in fact require that a motion analysis lab be present for the code to be utilized.

In the lower court decision, with regards to the AMA CPT Codes, Judge Cleavenger, in her 47 page decision stated:

42. Additionally, the American Medical Association Current Procedural Terminology (CPT) 2004 Manual is a proprietary system of the AMA for reporting medical services and procedures. CPT Codes are the uniform, established system for reporting medical services for reimbursement under government and private insurance programs. CPT coding is mandatory to describe the services a physician renders when submitting that service for payment to an automobile insurance carrier.

43. In order to be assigned a five-digit CPT Code, the procedure must be "consistent with contemporary medical practice and be . . . performed by many practitioners in clinical practice in multiple locations."
44. Code assignment is performed by a CPT Editorial Panel, consisting of 17 physician members, and a larger CPT Advisory Committee of medical and allied health professionals. Among the objectives of the CPT Advisory Committee is to “provide documentation to staff and the CPT Editorial Board regarding the medical appropriateness of various medical and surgical procedures. . . .” (emphasis supplied)

45. Among the considerations for Code assignment are the requirements “that the service/procedure is a distinct service performed by many physicians/practitioners across the United States” and “that the clinical efficacy of the service/procedure is well established and documented in peer review literature.”

46. Dynamic SEMG has been assigned a five-digit CPT Code 96002. Similarly, The review and interpretation of dynamic sEMG has been assigned a five-digit CPT Code 96004.

47. The fact that SEMG has been found to meet the requirements of the AMA for assignment of five-digit CPT Codes provides evidence of the medical value of the test, and strong evidence of the high level of general acceptance of the test by the relevant provider community.

See paragraph #76 of the decision where the judge concludes:

76. Additionally, based on a review of the entire record, the Petitioner has demonstrated, by a preponderance of the evidence, that SEMG has a level of general acceptance by the relevant provider community. SEMG is regularly used by chiropractic physicians who are a part of the relevant provider community.

The Florida Chiropractic Association and the Florida Chiropractic Society, the leading chiropractic professional groups in Florida, agree that SEMG is generally accepted by the practicing chiropractic community. The basis for the rating of “established” in the CPG, has been accepted and endorsed by the Florida Board of Chiropractic, the chiropractic physician regulatory and licensing arm of the Department of Health.

The American Medical Association had determined that SEMG is a distinct service performed by many
physicians and practitioners across the United States.

In addition, the clinical efficacy of SEMG has become established and documented as reflected in peer reviewed literature. Therefore, by including SEMG in Florida Administrative Code Rule 64B-3.004(2) the Department has exceeded its grant of rulemaking authority conferred by Section 627.736(5)(b)6., Florida Statutes, and has enlarged, modified, or contravened the specific provisions of Section 627.736(5)(b)6., Florida Statutes. As such, Florida Administrative Code Rule 64B-3.004(2) is an invalid exercise of delegated legislative authority.

The key word here is “distinct service”, meaning that it was interpreted by the court as to be functional independent of a motion analysis lab.

In the actual trial, if you review the court transcript you will note that it was determined by the court that the AMA CPT code did NOT in fact require a “Motion Analysis Laboratory” to perform Dynamic Surface EMG tests, and that the Dynamic Surface EMG code was in fact distinct and separate from the Motion Analysis section where it resides.

The court determined after significant argument that the CPT codebook was very clear about separating Dynamic Surface EMG from Motion Analysis, and that Dynamic Surface EMG COULD in fact be performed, and billed under the code based upon the CPT codebook without a motion Analysis laboratory.

If you read the CPT code under Motion analysis, you will note the following:

It states that “Codes 96000-96004 describe services performed as part of a major therapeutic or diagnostic decision making process”. The next sentence which states: “Motion analysis is performed in a dedicated motion analysis laboratory (i.e., a facility capable of performing videotaping from the front, back and both sides, computerized 3-D kinematics, 3-D kinetics and dynamic electromyography)” by using the term “Motion analysis” refers specifically to code 96000 and 96001.

The CPT code book makes quite clear, that dynamic electromyography is separate from the requirements of the motion analysis laboratory by stating: “Codes 96002-96003 describe dynamic electromyography”, separating dynamic EMG from “Motion analysis”, meaning the need for a facility which includes the ability to videotape is excluded from this code. If this were not the case, code 96002 would include the words “Motion Analysis” in the actual verbage.

Therefore, the office where the MyoVision testing occurred was and is equipped with the proper instrumentation for the utilization of the Surface Electromyography as described by the CPT code referenced.
In addition, the state of Washington WAC 246-808-505 list of “Procedures and Instrumentation Approved by the Chiropractic Quality Assurance Commission” has found that not only is “Electrode Paraspinal Electromyography (EMG) –Surface approved (see page 1 of the document), but the MyoVision unit itself, utilized by the office filing the claim is specifically approved (page 2 of the WAC document).

“Influence of External Factors on Surface EMG Test Reliability”

With regards to any questions you may have regarding the playing of music during exams (this has become a common question): This question specifically applies to the use of Surface EMG for Biofeedback muscle relaxation training (CPT CODE 90901) which was not performed, and thus does not apply. This in general applies to resting level measurements where the goal is to have the patient reduce muscle activity to an absolute minimum level. In addition, the presence or absences of fluorescent lights are irrelevant also, as we are not evaluating the psychological impact (affected by fluorescent lights). If the question regarding fluorescent lights relates to the equipment’s ability to measure itself, the device has passed all UL testing required for hospital use, and is technically designed for immunity to the electrical impact of fluorescent lights, although I believe the actual concern is the psychological impact associated with the CPT code 90901 which was not performed. via Surface EMG. We were measuring muscle activity in motion, thus making the resting level Surface EMG measurement questions irrelevant.

To reaffirm that your concerns are irrelevant in this claim, we are measuring muscle activity in motion and not performing resting level measurements. When measuring muscle activity in motion, the very high levels of muscle activity required to produce human motion overshadow so greatly any affect of room temperature, skin temperature, surface contact of the electrodes, piped music, fluorescent lights etc. that these factors become irrelevant. They may affect resting level measures, but not levels in motion as performed by the tests performed, and are therefore irrelevant and are not grounds for denial of this claim.

If you need further education on the difference between resting level measurements and muscle activity measurements in motion, I am available for a conversation with someone qualified to discuss this.

In light of all the supporting evidence presented in this document, the justification for your denial is clearly shown to be incorrect, and payment is therefore due for the services provided.

If you have any further questions, contact me at 206-448-3464.

David Marcarian, MA
Surface Electromyography Expert Witness

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REFERENCES


