

Validity of Surface EMG Testing

A Review of the relevant literature and legal precedence

Written by David Marcarian, MA

To Whom It May Concern:

This letter was written to establish the validity of Dynamic Surface EMG Technology which your organization has questioned. The main purpose of this paper is to respond to claims that the technology is experimental or investigational.

Based upon this statement, it is clear that the issue here is one of miscommunication or lack of thorough investigation, as there is no question that significant peer-reviewed literature does exist and there is even a superior court decision supporting that the technology is in fact valid based upon the scientific literature.

The following paragraphs cite the medical literature and legal precedence which prove that your statement is not justified, and is in fact false. Logically, based upon your own statement, if there are peer-reviewed medical literatures that do address the clinical application of these technologies, than it is a simple error on which occurred in investigation of these technologies (Dynamic Surface EMG), and the only logical conclusion is that payment is due.

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, making payment imperative:

1. Current Literature Review: Minimum of 33 relevant clinical studies between 2002 and 2005

The Literature Review below performed utilizing Medline searching for studies between only 2002 and 2005 (ignoring all the previous directly related studies reveals 33 relevant clinical studies on Surface EMG. Note that the first study in the review is specifically related to Surface EMG and chronic low back pain.



2. The AMA's position on Surface EMG

The American Medical Association (AMA) has provided a CPT code for billing SEMG, also contradicting the findings of the research paper you cite. The American Medical Association 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.

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

Authored by Geisser, Ranavaya, Haig, Roth, Zucker, Ambroz and Caruso published in the Journal of Pain, November 2005 p 711-726.

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.

A Meta-Analytic Review of Surface Electromyography Among Persons With Low Back Pain and Normal, Healthy Controls

Michael E. Geisser,^{*} Mohammed Ranavaya,[†] Andrew J. Haig,^{*} Randy S. Roth,^{*} Robert Zucker,^{*} Clara Ambroz,[‡] and Marianne Caruso[‡]

Abstract: Significant differences in surface electromyography (SEMG) have been reported between persons with low back pain (LBP) and normal, healthy controls. This manuscript presents a systematic meta-analytic review of studies examining SEMG differences between these groups. Forty-four articles were identified using MEDLINE and a review of reference lists in articles. For static SEMG, the largest effect size was observed for SEMG while standing, with subjects having LBP demonstrating higher SEMG. The effect size for flexion/relaxation measures was found to be very high ($d = 1.71$). Studies examining SEMG during isometric exercise or muscle recovery following exercise produced inconsistent findings. Sensitivity and specificity of SEMG for dynamic SEMG measures averaged 88.8% and 81.3%. Most classification schemes were statistically determined and utilized a combination of measures. Only one published study prospectively validated a classification scheme. SEMG measures of flexion/relaxation appear to distinguish LBP subjects from controls with good accuracy, and the sensitivity and specificity of SEMG can be increased by using multiple measures. Further research is needed to determine the combination of measures that are cost-effective, reliable, valid and discriminate with a high degree of accuracy between healthy persons and those with LBP. **Perspective:** SEMG is a simple and noninvasive measure of muscle activity. SEMG measures hold promise as an objective marker of LBP.
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The fact that this study alone references 44 relevant clinical studies on Surface EMG leads us to the conclusion that payment is required, as the technology is not experimental.

Research Paper: 2000, Nederhand et. al

Nederhand MJ, IJzerman MJ, Hermens HJ, Baten CT, Zilvold G. Cervical muscle dysfunction in the chronic whiplash associated disorder grade II (WAD-II). Spine 2000 Aug 1;25(15):1938-43.

1. 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.”
2. 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.
3. 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.

Research Paper: 1999 Ambroz, et. al

Ambroz C, Scott A, Ambroz A, Talbott EO. Chronic low back pain assessment using surface electromyography. J Occup Environ Med 2000;42:660-9.

1. Aim of this study has been to investigate the reliability of the SEMG technique in differentiating between CLBP 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 SEMG technique as an objective test to assess abnormal paraspinal muscle activity independently of different types of LBP. The effect of position on the SEMG 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 sEMG testing.

Research Paper: 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

<p style="text-align: right;">PAIN MEDICINE Volume 6, Number 2, 2005</p> <p>AAPM Annual Meeting Abstracts Clinical Abstract Page 26</p> <p>Research VAS Score Correlates with Static Surface EMG Signal Intensity in Chronic Spine Pain Alex Ambroz, MD, VA Medical Center, Martinsburg, WV Clara Ambroz, MD, MPH, Disability Evaluation Services, Martinsburg, WV Robert Zucker, MD, MPH, VA Medical Center, Martinsburg, WV Eugene Benjamin, MD, VA Medical Center, Martinsburg, WV Marianne Caruso, RN, VA Medical Center, Martinsburg, WV</p>	<p>There is currently no established objective measurement for pain intensity. Commonly used methods, including the visual analog scale (VAS), Numerical Rating Scale, Faces Scale, and Brief Pain Inventory, are subjective pain assessments. The search for an objective correlate for perceived pain intensity is imperative. A recent meta-analysis of surface-EMG (sEMG) research papers found that this procedure can demonstrate correlation of pain intensities in patients with low back pain compared with healthy persons, with sensitivities and specificities between 80% and 90%.</p> <p>We analyzed 60 noncompensation-seeking patients who were diagnosed with chronic lumbar or cervical sprain/strain. VAS scores and static sEMG signals were obtained before and after a 2-month pain treatment program in a multidisciplinary pain practice. sEMG measurements were carried out using a Myovision 8,000 unit. Thirty (30) patients reported improvement in their pain symptoms and were classified as Responders. The mean VAS score on presentation was reported as 6, and this corresponded to a mean static sEMG signal amplitude of 542 microvolts. Two months post treatment, the reported mean VAS score was 1 in this group, and corresponded to a mean static sEMG signal of 180 microvolts. The second group of 30 patients were Non-Responders who did not have pain relief post therapy, with the treatment protocol being identical in the two patient groups. The mean initial VAS score for the Non-Responders was 6.8 with a mean sEMG signal of 884 microvolts. Two months post treatment the mean VAS for Non-Responders was 6.8 with a mean sEMG signal amplitude of 709 microvolts. We conclude that static sEMG signal intensity can serve as an objective measurement of pain.</p> <p>References 1 Geisser M, Ranavava M, Ambroz A, et al. A metaanalytic review of surface electromyography among persons with low back pain and normal, healthy controls. In preparation. 2 Ambroz A, Ambroz C, Zucker R, et al. Surface EMG in chronic paraspinal pain: A review of 44 clinical trials. <i>Disabil Med</i> 2003;3(3):87-91.</p>
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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.
4. 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.

Research Paper: 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. *Arch Phys Med Rehabil* 1991 Dec;72(13):1080-7.

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. 26 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.

Research Paper: 2004, Cheung, J, et. al
Cheung J, Veldhuizen AG, Halbertsma JPK, Maurits NM, Sluiter WJ, Cool JC, Van Horn, JR: The relation between Electromyography and growth velocity of the spine in the evaluation of curve progression in idiopathic scoliosis. 2004 SPINE, vol. 29 number 9 PP 1011-1016

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.

Research Paper: 1997 Watson PJ, et. al
Watson PJ, Booker CK, Main CJ, Chen AC: 1997 Clin. Biomech. Vol 12 (3) Pg 165-171: Surface electromyography in the identification of chronic low back pain patient: the development of the flexion relaxation ratio:

Surface electromyography in the identification of chronic low back pain patients: the development of the flexion relaxation ratio.
 Watson PJ, Booker CK, Main CJ, Chen AC
 Clin Biomech (Bristol, Avon), 12(3): 165-171, 1997
 Service Fee: \$12.00 ; Copyright Royalties: \$30.00

OBJECTIVE: To develop a reliable and repeatable way to monitor changes in the flexion relaxation phenomenon of the lumbar paraspinal muscles during forward flexion by the development of a flexion relaxation ratio and observation of the sEMG activity in standing and during forward flexion in patients with chronic low back pain (CLBP) and healthy controls. **DESIGN:** Two experiments were conducted, the first to assess the test-retest reliability of the measure in a group of CLBP ($n = 11$) patients; the second compared the results between a group of normal healthy controls ($n = 20$) and a group of CLBP patients ($n = 70$). **RESULTS:** Repeated measurements over 4 weeks demonstrated between session reliability of between 0.81 and 0.98 for the dynamic activity. The levels of sEMG activity in the fully flexed position was significantly greater in the fully flexed position in the CLBP group than the controls. The flexion relaxation ratio (FRR), a comparison of the maximum sEMG activity during 1 s of forward flexion with activity in full flexion, demonstrated significantly lower values in the CLBP than the control group. The combined discriminant validity for the FRR for all four sites resulted in 93% sensitivity and 75% specificity. **CONCLUSION:** The FRR clearly discriminated the patients from the healthy controls. These results indicate that dynamic sEMG activity of the paraspinal muscles can be reliably measured and is useful in differentiating CLBP patients from normal controls. **RELEVANCE:** Analysis of the pattern of different levels of muscle activity during a forward flexion can be used in CLBP where normalization of the sEMG signal to the maximum voluntary contraction may be difficult. The FRR may be used in the assessment of change in the flexion relaxation phenomenon following treatment interventions.

EMG

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 (.081 - .098) for dynamic sEMG.
3. Sensitivity and specificity were high enough to recommend use in the clinical environment.

Research Paper: 1998, Nicholson, R.

Nicholson WR, The integration of surface EMG in the clinical decision making process: a case report; 1998 Journal of the Canadian Chiropractic Association, Vol 42 Number 1

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 courts 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:

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.

5. State of Washington WAC 246-808-505 List of "Procedures and Instrumentation Approved by the Chiropractic Quality Assurance Commission"

Note that not only is "Electrode Paraspinal Electromyography (EMG) –Surface approved (see page 1 of attached document), but specifically the MyoVision itself, utilized by the office filing the claim is also approved (page 2 of attached document).

In light of all the supporting evidence presented in this letter, the justification for your denial is clearly false, and therefore immediate payment is due.

Sincerely,



David Marcarian, MA
Surface Electromyography Expert Witness