

Advances in Chiropractic Analysis, Clinical Applications, and Ethical Issues Regarding Surface EMG in Private Practice

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Introduction

Recent advances in EMG equipment, coupled with promising findings from recent chiropractic scientific investigations, are enhancing the feasibility of using surface EMG equipment in private practice. Evidence that hand-held probes can determine abnormal muscle activity related to spinal pain, that they have excellent reliability, and that the new light-weight scanners can reproduce findings of earlier investigators with more cumbersome protocols, suggests improved chiropractic analysis and improved patient care will follow increased utilization of this new technology.

As with any new health care technology, the increased utilization of surface EMG in private practice poses risks of improper application, improper interpretation, and overutilization to the profession.

Chiropractic examining boards and other regulatory bodies can move to minimize these potential problems by immediately enacting rules requiring some basic education and proficiency in the use of surface electromyography. Clinicians already using this technology, and others interested in starting its use can voluntarily stay abreast of current research and attend appropriate continuing education. Office staff involved in EMG use should meet minimum proficiency requirements as well. Finally, ethical judgments must be made regarding appropriate reimbursement and appropriate utilization for this technology.

This article will briefly review these issues and offer an overview of the potential benefits of the use

of surface EMG in chiropractic practice.

Clinical Applications of Surface Electromyography

Recent advances in EMG equipment have opened new avenues for the use of this technology in private practice. Older, more expensive equipment was difficult to use, required lengthy set-up, cumbersome protocols, and data collected was difficult to interpret. Until recently, the use of surface EMG may not have been practical for the private practitioner. While medical and some chiropractic colleges and diagnostic centers have used surface EMG for decades, its use in private chiropractic practice was rare.

In the past decade hand-held, post-style electrodes have become widely available through various manufacturers. These hand-held scanners are backed by EMG equipment having extremely high impedance. The impedance, or resistance to an electrical current largely determines how sensitive the device is. Units now available have an impedance of 100 million ohms, to billions of ohms, whereas a typical unit 5 or 10 years ago may have offered less than 1 million ohms of resistance. The net effect of this and other enhancements is that practitioners wishing to quickly sample myoelectric activity in a busy practice can do so with a skin preparation consisting of only an alcohol abrade.¹ This avoids the time consumed by using attached cup electrodes and electrode creams.

Moreover, data collected by the hand-held scanners, when properly employed, has excellent reliability.² For example, extraneous head movements that can be a significant source of artifact for fine wire EMG assessment of the lumbar spine, in contrast have little effect on surface EMG reliability.³ These advances, coupled with lower costs for personal computers to integrate and image the data collected, have made the use of surface EMG more attractive for the busy private practitioner.

Recent chiropractic scientific investigations have used surface EMG as a follow up to prior studies carried out by scientists, osteopaths, and medical researchers. For example, Triano⁴ has utilized electromyography to determine the usefulness of heel lift recommendations. Triano and Schultz⁵ confirmed earlier observations by a host of scientists that flexion-relaxation (i.e., a period of lumbar erector spinal muscle silence during full trunk flexion) occurs in normal controls but not in low back pain patients. Indeed, since Allen⁶ first discovered the flexion-relaxation phenomenon in 1948, at least 14 separate investigations have confirmed his observations (references available upon request.)

Using a narrow band pass of 80-200 Hz and hand-held scanners with stainless steel, post-style electrodes, and testing erector spinae muscle at the end-ranges of trunk motion, Leach and co-workers⁷ offered initial evidence that the newer surface EMG can reproduce findings obtained by the previous researchers with more cumbersome protocols. These researchers demonstrated loss of flexion-relaxation in LBP patients, and offered a new indicator of back dysfunction in an initial abstract presented at the 1991 International Conference on Spinal Manipulation. Other chiropractic investigators have demonstrated that flexion-relaxation normally occurs in the cervical spine as well.⁸ And still others have observed improvement in postadjustment surface EMG,⁹ being generally in agreement with more recent osteopathic studies.^{10,11}

These studies and others, taken collectively, offer convincing evidence that surface EMG, using appropriate protocols, can improve chiropractic assessment of pain-related erector spinae muscle

dysfunction. Moreover, this dysfunction seems to be related to the subluxation complex (or segmental dysfunction, the manipulable lesion), as it appears to improve after chiropractic adjustment or osteopathic manipulation.^{9,11} The busy practitioner, properly trained, can now use surface EMG scanning to improve chiropractic assessment and patient care. The technique offers excellent promise as an indicator of therapeutic gains, and as an aid to screen for malingering, hysteria, and anxiety-related disorders.

Ethical Issues Regarding Use of Surface EMG in Private Practice

As with any new health care technology, increased utilization of surface EMG in chiropractic practice poses potential risks as well. There is the risk that the technology will be misapplied. Chiropractors purchasing the equipment may be unaware of basic principles of proper EMG use, may be unable to accurately reproduce their data collection on repeat tests of the same patient, may be unwilling to obtain continuing education for themselves or their staff that use the technology, and may be frustrated and disappointed when subsequent EMG exams, after chiropractic care, fail to demonstrate expected improvement in at least the majority of cases. Misapplication can occur when alcohol abrade only is used as the sole skin preparation for scans lasting longer than 30-40 seconds,¹ or when electrode bridging occurs by excessive use of alcohol or electrode creams; or by any of a host of potential pitfalls including unsteady hands that permit the post-style electrodes to make uneven contact. With improper application, the test data are unreliable and meaningless, revealing all patients to have multiple problems throughout their spine, both before and after chiropractic intervention. However, with proper education and use, these obstacles can be easily overcome, and appropriate application can result in highly reliable and useful data.^{2,7}

Provided surface EMG scans are performed appropriately yielding reproducible and valid data, the scans must still be appropriately interpreted. Scans can yield valuable, objective information that can contribute to the diagnosis. For example, an extreme loss of flexion-relaxation is rare in a pain free back, occurring in less than five percent of the pain free patients in most studies. Given any other positive clinical lumbar spine finding, loss of flexion-relaxation of the lumbar erector spinae muscles is strong confirmation of a patient's subjective complaints and should correlate well with higher Oswestry disability scores.^{5,7} (It would be interesting to determine if this loss of flexion-relaxation noted in a small percentage of pain free patients predicts that they will develop pain in the future. This will only be determined through research tracking such patients over a period of years.)

Interpretations based entirely on left/right spinal asymmetries seen in less stressful postures such as sitting or standing in the neutral or upright position may prove helpful to chiropractic analysis, but are still open to question. While Cram¹² and Matheson¹³ have some normative data regarding neutral standing surface EMG findings, Meeker⁸ and others have been unable to detect differences, using this protocol, between LBP patients and controls. However, in one of the largest as well as most recent investigations, Arena and co-workers¹⁵ demonstrated significant increases in paraspinal lumbar activity in five groups of back pain sufferers as opposed to control subjects. This confirmed earlier work by Hoyt and co-workers¹⁴ were able to distinguish LBP patients from controls in the neutral standing position, after 10 minutes of continuous monitoring. Moreover, Leach and co-workers⁷ have presented initial evidence of a new myoelectric indicator of pain-related muscle dysfunction in the neutral standing position, but this report is in the review process now and final results have yet to be fully published. However, neutral standing postures may be

altered by scoliosis, short-leg syndrome and other factors, which might alter myoelectric responses and be unrelated to back pain. These potential confounding factors may explain some inconsistencies in lumbar SEMG studies of neutral standing subjects, and should be considered by clinicians when interpreting these findings.

Finally, another risk to the profession and to the public, regarding the increased use of surface EMG in private practice: the potential for overutilization. The doctor who employs surface EMG only for his personal injury cases, where reimbursement is more assured, and then charges \$400 to \$600 for a 15-minute scan, risks killing the appropriate growth of the technology in chiropractic for personal gain. Since a complete surface EMG set-up with computer generally is much less expensive than a new x-ray set-up, and since patient preparation for x-ray or surface EMG (gowning, instructions, positioning) are somewhat comparable, it hardly seems justifiable to charge four to six times the amount charged for routine x-ray for surface EMG scanning of a comparable area. The doctor in private practice should be willing to charge fees for this service that would be asked from a cash-paying patient. Indeed, cash-paying patients should be able to receive this service also, in the opinion of these authors. Optimal patient care, not entrepreneurial gain, should be the primary motivation for expanded utilization.

What can be done then to assure appropriate growth of this technology in private practice, for the enhancement of chiropractic analysis, and for improved patient care? The following are some suggestions we believe must be followed in order that our patients will optimally benefit from these recent advances in surface EMG for chiropractic analysis:

1. Doctors of chiropractic currently using surface EMG scanning should be able to accurately reproduce their findings on back-to-back tests of the same subject. If they or their staff using the instrument cannot demonstrate test and retest reliability in-house, they should immediately discontinue scanning until they have received additional instruction and can correct their procedural errors.
2. Chiropractic examining boards must immediately adopt regulations to insure that doctors and staff performing EMG scans have received at least minimal training in the procedure. Minimal demonstrated proficiency could be part of the continuing education requirement as well.
3. Current users of surface EMG scanning should pause to reflect their fee schedule for the procedure. Should high fees and tests made on insurance patients only be the norm, or can we make brief scans of a problem area affordable even for the cash-only patient? Appropriate pricing of this technology will be observed, we believe, by fees being charged that are comparable with fees charged for x-rays.

Conclusions

Recent advances in surface EMG capabilities, in cost effectiveness of purchasing EMG equipment, and in chiropractic scientific evaluation of surface EMG performance, suggest that chiropractic assessment and patient care can be enhanced by the application of this technology in private practice.

However, significant risks to the public, as well as to the appropriate growth of surface EMG use in the profession, pose obstacles to its development. These risks include improper application, faulty interpretation, and overutilization.

Examining boards can adopt regulations requiring at least minimal proficiency for users of this technology. Current users can insure that appropriate fees are charged of their patients for whom EMG examination is indicated. Finally, current users can check to be sure they are getting reliable and clinically useful information from their EMG examinations. By so doing, the recent advances in surface EMG technology can be an enhancement to chiropractic patient care and management.

References

1. Cram JR, Rommen D: Effects of skin preparation on data collected using an EMG muscle-scanning procedure. *Biofeedback and Self-Regulation*, 14:75-82, 1989.
2. Thompson JM, Erickson RP, Offord KP: EMG scanning: Stability of hand-held surface electrodes. *Biofeedback and Self-Regulation*, 14:55-62, 1989.
3. Wolf SL, Wolf LB, Segal RL: The relationship of extraneous movements to lumbar paraspinal muscle activity: implications for EMG biofeedback training applications to low back pain patients. *Biofeedback and Self-Regulation*, 14:63-74, 1989.
4. Triano JJ: Objective electromyographic evidence for use and effects of lift therapy. *Journal of Manipulative and Physiological Therapeutics*, 6:13-16, 1983.
5. Triano JJ, Schultz AB: Correlation of objective measure of trunk motion and muscle function with low back disability ratings. *Spine*, 12:561-565, 1987.
6. Allen CEL: Muscle action potentials used in the study of dynamic anatomy. *The British Journal of Physical Medicine*, 11:66-73, 1948.
7. Leach RA, Owens EF, Giesen JM: Thoracolumbar asymmetry detected in low back pain patients with hand-held post-style surface electromyography. *International Conference on Spinal Manipulation*, 325-332, 1991.
8. Meeker W, Matheson D, Milus T, Wong A: Lack of correlation between scanning EMG asymmetries and history and presence of low back pain: Analysis of pilot data. *International Conference on Spinal Manipulation*, May 1990.
9. Shambaugh P: Changes in electrical activity in muscles resulting from chiropractic adjustment: A pilot study. *Journal of Manipulative and Physiological Therapeutics*, 10:300-303, 1987.
10. Beal MC, Vorro J, Johnston WL: Chronic cervical dysfunction: Correlation of myoelectric findings with clinical progress. *Journal of the American Osteopathic Association*, 89:891-900, 1989.

11. Ellestad SM, Nagle RV, Boesler DR, Kilmore MA: Electromyographic and skin resistance responses to osteopathic manipulative treatment for low back pain. Journal of the American Osteopathic Association, 88:991-997, 1988.
12. Cram JR, Engstrom D: Patterns of neuromuscular activity in pain and non-pain patients. Clinical Biofeedback and Health, 106-115, 1986.
13. Matheson DW, Toben TP, de la Cruz DE: EMG scanning: Normative data. Journal of Psychopathology and Behavioral Assessment, 10:9-20, 1988.
14. Hoyt WH, Hunt HH, DePauw MA, et. al: Electromyographic assessment of chronic low back pain syndrome. Journal of the American Osteopathic Association, 80:728-730, 1981.
15. Arena, JG, Sherman RA, Bruno GM, Younmg TR: Electromyographic recordings of five types of low back pain subjects and non-pain controls in different positions. Pain, 37:57-65, 1989.

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