Dynamic Chiropractic

Static Paraspinal EMG Scanning -- Clinical Utility and Validity Issues

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In the second issue of Potentials (Cram 1992), an important question was explored with respect to the science of surface EMG (SEMG) procedures. The science of surface electrode applications has clearly been settled. Using correct techniques, the underlying myoelectric activity of muscles within the range of the electrodes can be quantitatively displayed. The important question arising from the clinical applications of this science is, "What does it mean?" It is this issue that serves as the underpinning for the continuing controversies on the experimental applications of SEMG procedures. While the use of surface electrodes to record the electrical events occurring at varying depths beneath the skin is not experimental, the interpretation of their meaning often is. This crucial difference is widely misunderstood for many forms of high technology methods of data collection for biological information that are available today. Instruments, including SEMG electrodes, cannot be validated. Rather, it is the interpretation of information derived from these instruments that is valid or invalid.

Perhaps a recent example occurring in the clinical scientific literature where one use of surface myoelectric technology was discussed will best serve to illustrate this point. Triano, Humphreys & Brandl (1987) published an initial observation of results in a select population of low back pain (LBP) patients. The objective of that study was to look for a parameter that might be clinically meaningful in helping to identify and predict response to therapy in mechanical LBP patients. The objective of that study was to look for a parameter that might be clinically meaningful in helping to identify and predict response to therapy in mechanical LBP patients. The initial report was highly favorable towards use of the ratio of H-reflex maximum amplitude with the maximum M-wave (H/M max ratio) and gained some enthusiastic supporters. A subsequent exploration of this question in greater depth (Cramer, Humphreys, Hondras, McGregor, and Triano, in press) demonstrated convincing evidence that while the H/M max ratio does vary, there is no clinical utility for this application. The initial report, as positive as it seemed, was misleading for at least two reasons. First, the sample population was selected to help define the measurement parameter rather than being broadly representative of the patients we see with LBP. Second, normative data on a larger population of healthy subjects determined that there is a wider variation in the H/M max ratio than the original small sample had revealed.

Was SEMG experimental in this study? No. Was its application experimental? Yes. Results from testing H/M max ratios using SEMG technology is not a valid representation of identifying or predicting outcomes in cases of acute, mechanical low back pain, despite the fact that an underlying trend in H/M max behavior may be apparent. As has been pointed out by many others, it is often the question asked that is the most crucial factor in whether an application of technology is valid and useful clinically.

Practical parallels exist to the H/M max experience regularly. Health care providers are victimized daily by enthusiastic sales people who offer equipment for applications that have not been adequately examined. Equipment and procedures are commonly offered with poor quality, and sometimes misrepresented evidence in support of their use. (Bunch and Patwardhan 1989), for a

non-SEMG example, relate the sad history for operative correction of scoliosis by Luque rods. Initially reported in 1977, the method rapidly became a "marketing tool" for a "modern" procedure. By 1982, it became evident that what the Luque procedure offered, that pre-existing methods did not, was a reduction in postoperative immobilization in trade for an alarming increase in neurological complications.

The rapid development of applications of static scanning SEMG has similarly been accompanied by a high degree of marketing with a plethora of unsubstantiated claims for clinical utility. This is particularly true of, but not isolated to, static scanning methods. In many cases, the claims arise from a sincere misunderstanding of the questions of validity and clinical utility. In fact, often misguided supporters of specific clinical applications will parade studies on SEMG reliability in defense of a specific application whose validity is in doubt. It can be argued, for example, that the data shown in Figure 1 is reliable. It even may be considered delightful to a passbook holder where the decision on account balance is based upon this information. To the banker, however, who will make the decision to pay, these results would clearly and defensibly be declared invalid.

Figure 1.

2 + 2 = 5

2 + 2 = 5

2 + 2 = 5

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To underscore the differences, it may be worth a brief review of the fundamental issues confronting a provider who is faced with the decision to perform specialized testing on a patient. The principle concern is which clinical data are worth harvesting. For each case, there should be demonstrable benefit to the patient, that is, the results of testing should weigh heavily in settling diagnostic uncertainty or therapeutic alternatives; and, the same or similar information is not otherwise obtainable at reasonable cost or convenience. In order to appraise the usefulness of a procedure for conditions that are not frequently seen, it may be adequate to rely upon the opinions of colleagues. For tests proposed to be of benefit on cases that are more routine, it is the provider's personal responsibility to obtain, examine, and keep abreast of the actual evidence pertaining to claims of clinical utility. Sackett, et al., (1991) have written a concise summary of the eight guides for deciding the clinical usefulness of a diagnostic test (Table 1). Clearly, clinical or scientific articles selected for their agreement with the reviewer's favorite hypothesis is an inappropriate basis for decisions. It is the preponderance of high quality evidence that determines the balance of valid opinion. The quality of evidence can be judged best for evaluating and selecting diagnostic tests by determining how well the literature meets the criteria set down by the guides in Table 1.

Table 1. Eight guides for deciding the clinical usefulness of a diagnostic test (adapted from Sackett, et al., 1991).

1. Is there an acceptable/reasonable "gold standard" of diagnosis?

2. Has a "blind" comparison been made to that "gold standard?"

3. Has the test response been studied in an appropriate sample of disorders? a. mild to severe?

b. treated and untreated? c. commonly confused conditions?

4. Is there sufficient on study site and sample selection information to assess predictive value in a more general clinical setting?

5. Has the reproducibility for the test result and its interpretation been studied?

6. Has an appropriate control group response been included with reasonable definition for the terms "normal" or "healthy?"

7. What is the individual and overall validity of the test alone or as a part of an ensemble?

8. Are test methods sufficiently detailed to permit their exact replication in another clinical setting?

9. Has the usefulness of the test in terms of patient and provider cost/benefit ratio been examined?

On first encounter, many providers who have no prior acquaintance with these issues of validity and utility are unconvinced of their necessity or rationale. The social and medicolegal obligation to strive toward them is reinforced by such actions as the Americans with Disabilities Act of 1990 (Perritt 1990) in its sections on Testing Requirements (Section 4.8), Medical Tests (Section 7.8), and Skill Tests (Section 7.10), as well as other work-related regulations. The Agency for Health Care Policy Research (AHCPR) of the federal government uses exactly these types of criteria in its various MEDTEP (Medical Effectiveness Programs) expert panels currently engaged in recommending guidelines on standards of practice for specific disorders including low back pain.

The primary purpose of static paraspinal scanning EMG is the measurement of the absolute and relative myoelectric activity in standardized postures. The parameters of interest commonly referenced include bilateral activity levels at different sites, scanned vertically along the axial skeleton and left/right differences at single levels. There is little doubt that variations in both types of parameters are seen. When considering the preponderance of quality evidence, there is considerable uncertainty on what these variations mean.

Table 2 summarizes common claims for the purpose or basis of therapeutic necessity for spinal EMG scanning procedures. Reviewing them with the criteria posed in Table 1 and the three questions below will hopefully lead to some interesting observations.

1. What additional information is gained by a paraspinal static scan with respect to these circumstances, that is not already available by nature of the claim?

2. How would the SEMG findings change the therapeutic plan? a. in the early acute stage of the complaint? b. in the later chronic stages?

3. Does the test actually reflect the conclusions implied? a. in the early acute stage of the complaints? b. in the later chronic stages?

Table 2: Common Claims on Purpose and Utility

1. Palpable paraspinal muscle spasm or asymmetry.
2. Asymmetric range of motion.
3. Muscle tenderness
4. Paraspinal pain.
5. History of trauma.
6. Nerve root irritation.
7. Antalgic gait.
8. Reduced muscle strength.
9. Spinal subluxation.
10. Scoliosis.

For these circumstances, asymmetrical findings from static scanning SEMG alone simply have not been shown discriminable with respect to differentiating healthy from unhealthy patients or, at best, are redundant and unnecessary in the clinical decision-making process. Used as the sole method determining muscle activity, the balance of evidence does not as yet support the procedure for addressing the clinical conditions listed in Table 2. When reviewing the three questions posed above, it can be seen that the isolated procedure of static scanning usually will not benefit the patient in either the form of reducing uncertainty around the diagnosis or helping to direct the therapy plan. Used for screening as a first step in a sequence of a more focused SEMG assessment, it serves to narrow the scope of areas to be examined by the "second tier" (Cram, et al., 1990) of tests available. Coupled in this way, the SEMG procedures can provide helpful information to alter the treatment plan, and ultimately the course of recovery in patients whose responses have been disappointing. Other SEMG assessments making up the more advanced procedures include dynamic test protocols, fatigue studies or muscular re-education procedures where the questions of clinical utility and patient benefit is on more solid ground.

For those providers who have relied heavily on static SEMG methods and found themselves frustrated by the continuing scientific, clinical and practical reimbursement controversies, it may be useful to become more familiar with training programs available in the more advanced methods. Rounding out familiarity with the full spectrum of procedures and the evidence that supports them provides a stronger basis for clinical decisions in patients who are appropriate candidates.

(Additional information on this developing clinical field including available continuing education programs can be obtained through the Surface EMG Society of North America, P.O. Box 487, North San Juan, CA 95960, (916) 292-9236

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