Surface EMG Validation and Reliability Studies
Questions & Answers

1. For what uses or conditions has SEMG been shown to be reliable and valid?

   Electrical potentials are produced when muscle tissue contracts. These potentials may be measured and recorded by inserting wire or needle electrodes in the muscle tissue, or by placing surface electrodes on the skin overlying the muscle(s) being evaluated.

   Surface electrodes measure the activity of groups of muscles working together. Paraspinal sEMG is a physiological measurement, not a “stand alone” diagnostic procedure for a specific disease or condition. It may be used when a quantitative assessment of paraspinal muscle activity is desired. By analogy, consider other physiological measurements used in clinical practice. An oral thermometer will tell the clinician if a fever is present, and whether the clinical status of the patient is improving. It is useful screening tool, and helps the clinician evaluate response to treatment. However, by itself, it cannot be used to diagnose the condition causing the fever. Similarly, sEMG is useful in evaluating alterations in paraspinal muscle activity that are of interest to the chiropractor, such as those associated with vertebral subluxation.

   Paraspinal SEMG scans, taken in concert with other examination findings, may be helpful in determining the following:

   1. Asymmetrical contraction
   2. Areas of muscle splinting
   3. Severity of the condition
   4. Aberrant recruitment patterns
   5. Dysponesis
   6. Responses to dysafferentation
   7. Response to chiropractic adjustment

   The U.S. Food and Drug Administration has accepted the following indications for use:

   1. To measure bilateral differences in surface EMG along the spine
   2. To measure surface EMG along the spine during functional tasks.

   Reliability is a measure of the ability to reproduce a measurement, which is expressed as a coefficient ranging from 0.00 to 1.00. Perfect reliability results in a coefficient of 1.00, while chance agreement would be 0.0. As an example, Hass and Panzer (Haas M, Panzer DM. Palpatory diagnosis of subluxation. In: Gatterman M, ed. Foundations of Chiropractic Subluxation. St. Louis, MO: Mosby, 1995.) noted that the inter-examiner reliability of palpation for muscle tension is poor, with coefficients ranging from 0.07 to 0.20. Surface EMG, in contrast, demonstrates excellent reliability.

2. What are accepted protocols for the use of SEMG?

   Protocols and normative data for paraspinal EMG scanning have been published in the refereed literature. Hand held electrodes are applied to the skin of the patient overlying the spine at 15 paired
sites. EMG signals are measured in microvolts (10^-6 volts). A computer analyzes these signals, and compares them to a normative data base.


3. What is the evidence that SEMG can be used to reliably obtain data in a clinical setting?

Studies, by researchers from 3 colleges and universities confirm reliability of one sEMG widely used in chiropractic practice, the Insight SEMG:

1. The largest and most recent is collaborative study by researchers from the Florida Atlantic University College of Biomedical Science and Life University found that the Insight(tm) surface EMG technology demonstrated excellent reliability.

"This study revealed excellent inter-examiner and intra-examiner reliability of static paraspinal surface electromyography in a large number of subjects."


2. A second study was the basis of a dissertation by Hazel Faulkner, D.C., for an M.Sc. degree from the Institute of Medicine, Health and Social Care, University of Portsmouth.

“These results show that those subjects who have received recent and regular chiropractic adjustment have excellent reliability.”
4. What is the evidence that indicates which layers of muscle are read by SEMG?

A general rule is that the larger and more superficial a muscle is, the greater it’s contribution to the sEMG signal. In chiropractic applications, the objective is to measure the activity of groups of muscles working together, not to isolate individual muscles.

The muscles contributing to the sEMG recordings at the various regions may be summarized as follows:

- **CERVICAL**
  - Upper Trapezius
  - Splenius Capitis
  - Spinalis Cervicis
  - Semispinalis Cervicis

- **UPPER THORACIC**
  - Middle Trapezius
  - Longissimus
  - Semispinalis Cervicis
  - Splenius Cervicis
  - Multifidus

- **LOWER THORACIC**
  - Longissimus
  - Multifidus
  - Latissimus Dorsi
  - Serratus Posterior

- **LUMBAR**
  - Iliocostalis Lumbarum
  - Multifidus


5. What is the evidence that it is a valid measure of muscle activity associated with tissue the subluxation complex?


D.D. Palmer expressed the relationship between tone and the dynamics of health and disease as follows: “Life is an expression of tone. tone is the normal degree of nerve tension. Tone is expressed in function

Contemporary textbooks from major medical publishers address the association of sEMG assessment of paraspinal muscle activity and vertebral subluxation.


Eriksen reviews several studies where sEMG was used as an outcome assessment for subluxation complex. See: Eriksen K:Upper Cervical Subluxation Complex. Baltimore, MD. Lippincott Williams & Wilkins. 2004. Pages 215-220. Examples of sEMG changes are featured in Appendix G of this text. 473-G through 477-G.


6. What is the evidence that it is of use in monitoring a patient’s response to care?

A study was conducted at the New Zealand College of Chiropractic. It examined both reliability and pre/post sEMG changes.

“Under the conditions of this study, using the Insight… Subluxation Station, it is concluded that sEMG is an objective measure of change which can be used as an assessment of patient progress.”


Regarding clinical validity, paraspinal surface EMG has been shown, in controlled studies, to be responsive to chiropractic adjustments and spinal manipulation. Shambaugh (Shambaugh P. Changes in electrical activity in muscles resulting from chiropractic adjustment: a pilot study. JMPT 1987; 10(6):300) conducted a controlled study where surface electrodes were used to record paraspinal EMG activity pre- and post-chiropractic adjustment. Shambaugh concluded, “Results of this study show that significant changes in muscle electrical activity occur as a consequence of adjusting.”

In the osteopathic literature, Ellestad et al (Ellestad S, Nagle R, Boesler D, Kilmore M. Electromyographic and skin resistance responses to osteopathic manipulative treatment for low-back pain. JAOA 1988; 88(8):991.) conducted a controlled study which found that paraspinal EMG activity decreased in patients following osteopathic manipulation. Such changes were not observed in controls in either study.

These studies support the construct validity of paraspinal SEMG as an outcome assessment for chiropractic adjustment.