Myosymmetries Calgary - Surface Electromyography (sEMG)

What is Surface Electromyography?

Surface electromyography (sEMG) is a recent development emerging from the field of biofeedback. Biofeedback has been practiced in one form or another for most of this century, really emerging as a discipline in the late 1960's. One of the principle components of biofeedback was the use of electrodes to monitor muscle activity. This became known as surface electromyography in order to distinguish it from needle electromyography as practiced in neurology.

It was discovered that the electrical activity of a muscle and that of a single motor unit could be increased or decreased upon command through conscious mental control. One of the leading pioneers in this field is Dr. J. Basmajian.

The ability to decrease the electrical activity gradually became the domain of psychology through the use of relaxation techniques. Electrodes could provide the therapist immediate feedback as to the state of arousal, thus shortening therapy.

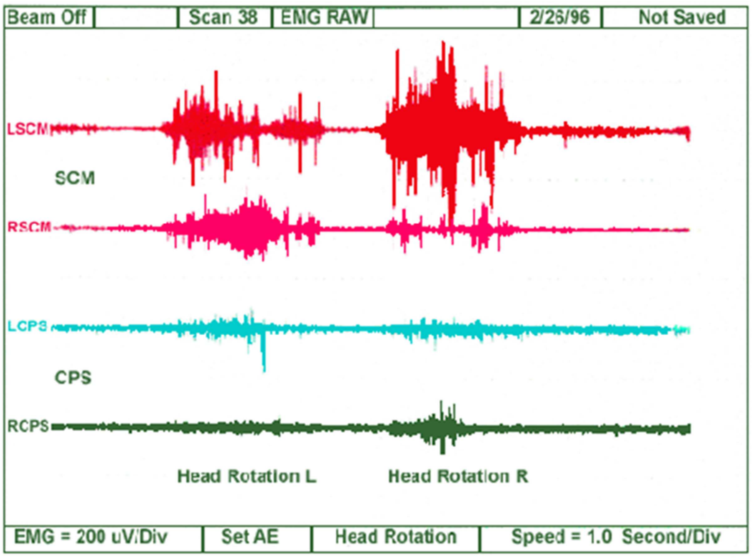
Meantime, physiotherapy, rehabilitation medicine and other allied disciplines started to use sEMG techniques to increase muscle activity or improve motor control. This was primarily developed in the stroke rehabilitation field.

This split between increasing and decreasing activity continued more or less into the late 1980's when the distinction between the fields began to blur.

The emergence of computers, gave the clinician the ability to access multiple channels of data and to process vast amounts of data. This changed the field. Research exploded with attention focused upon everything from examining the electrical characteristics of a muscle to simultaneously examining several muscles' activity during the movement.

How does sEMG work?

SEMG techniques involve the application of electrodes (currently two) placed on the surface of the skin, over the muscle under investigation. These electrodes read the electrical activity of the muscle and send the information to the computer, where this information is processed.



The computer displays the information usually in a graphic form, and performs various statistical manipulations preparing this data for interpretation.

sEMG is believed to impact upon treatment in two different manners:

- sEMG can be used to document treatment outcomes. If treatment is applied and change is reported then it will show on a follow-up sEMG assessment.
- sEMG can be used to define an end point of treatment. When the investigated muscle(s) show equal electrical activity on both sides of the body, treatment of the affected muscles is complete.

It is very hard, if not impossible, to fake muscle change (particularly over time). The sEMG does not lie.

How does Myosymmetries use sEMG?

Two features distinguish the SEMG techniques used at Myosymmetries**.**

First, dynamic procedures are the basis of operation. The individuals being assessed are asked to perform movements that are known to involve the muscle under study. This allows for examination of several features of muscle activity simultaneously.

Second, the activity of the left side of the body is compared to that of the right side for the same muscle. Called "within subject analysis", this procedure reduces or eliminates much of the criticism involved with other assessment procedures. (The premise of "within subject" analysis is that the electrical activity on either side of the body should be about equal, especially when performing a symmetrical movement)

Presently there appear to be 4 conditions that are found during dynamic "within subject" evaluations which may be associated with muscle dysfunction:

- differences from side to side in the amount of electrical activity
- cocontraction
- poor recovery of baseline
- differences in the timing of the muscle firing

Movement occurs when an unequal amount of force is applied to a joint. For example, the sternomastoids (SCMs) one on either side of the front of the neck, contract together producing enough force to move the head forward into flexion (touching the chin to the chest).

It is reasonable to expect that when doing a flexion of the head, the muscles on either side of the neck should work together, generating an equal amount of electrical activity, which summate to produce a movement. In individuals with trigger points in the SCMs (which cause headaches), the difference in levels of activity is about 45%, with the muscle showing the trigger point always higher.

Other dysfunctions (i.e. carpal tunnel syndrome and low back pain) show similar patterns. These patterns are evident in those who have been involved in a motor vehicle accident (MVA).

It is difficult to demonstrate the occurrence of these patterns during rotation (turning the head from a neutral position of facing forward to both the left and right sides), as it is very difficult to get an equal amount of rotation from side to side. However, when rotation is equal the results show similar patterns.

Cocontraction is a second condition that is seen using sEMG techniques.

Cocontraction is defined as occurring when a muscle that is normally quiet during a movement demonstrates a significant level of electrical activity. This can occur in any situation but the most commonly demonstrated is from side to side (i.e. the left side fires when a person reaches to the right), or between muscles or the muscles of the arms fire while the head is moving.

The most striking example of this latter situation occurs in Carpal Tunnel Syndrome in 2 ways:

- when movement of the head (particularly rotation) causes a discharge of electrical activity in the forearm flexor and extensor bundles.
- when flexion of the wrist produces electrical activity of the wrist extensors.

Correction of these cocontractions by different treatments has been shown to alter the nerve conduction results, returning the nerve conduction to "normal" and reducing or even eliminating the pain.

It is speculated that cocontraction occurs when a reflexive neurological process becomes dysfunctional. This causes muscles which should be electrically silent during movement to be active, leading to fatigue and overloading the muscle.

Kottke (1975) has suggested that a movement is learned through the development of what are called engrams. Engrams are dependent upon the afferent (electrical signal) generated by the muscle spindle fibers which then excite or inhibit other muscles which assist or oppose the movement.

Disruptions of this signal would then cause a disruption in the engram producing the patterns seen. Clinical observations suggest that cocontractions occur in about 40% of the cases seen and disappear with treatment.

In every movement there is a burst of electrical activity that rises with the force and speed of the movement but quickly disappears or quiets with completion or cessation of that movement. In the poor recovery of baseline situations (muscles at rest, or not active) the quiet period does not rapidly occur.

It is believed that the muscle does not completely shut off, never having a chance to recover before the next movement, eventually becoming fatigued. This phenomenon has been demonstrated and studied by several authors and appears to be associated with pain, fatigue and slowness of movement.

In a symmetrical movement, it is expected that each muscle on either side of the body should fire at the same time. In individuals with muscle pain, this does not occur. The significance of this is not yet understood.