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Surface electromyographic biofeedback to optimize performance in daily life: Improving physical fitness and health at the worksite^{1,2}

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ABSTRACT

Muscle pain is the primary cause of discomfort for more than 30% of patients who visit their primary physicians with severe pain. These pains are often caused by dysponesis which is unaware misdirected muscle efforts not necessary for task performances. It can consist of 1) excessively tightening muscles that are used for the task performance, 2) tightening muscles not necessary for the task performance (inappropriate co-contractions), 3) not relaxing muscles after the task has been completed, or 4) not relaxing muscles momentarily during task performance to allow for ongoing regeneration (surface electromyographic gaps/micro-breaks). These chronic covert muscle tensions are a significant co-factor in the etiology, maintenance and progression of many disorders such as headaches, backaches, joint pain, repetitive strain injuries, myalgias, etc. Dysponesis can be identified with surface electromyographic (SEMG) feedback. The benefits of using SEMG to reduce dysponesis through awareness and training are illustrated by two clinical case examples: 1) to improve health at work when packing apples and 2) to enhance performance while working out in the gym on an elliptical exercise machine. As documented by the SEMG recorded from the upper trapezius and/or forearm flexors, the reduction of misdirected muscle efforts decreased the neck and shoulder pains at work and at home and enhanced performance on an elliptical exercise machine. SEMG is a useful clinical tool to assess, monitor, provide feedback to the therapist and client, document muscle dysponesis, and teach clients awareness and voluntary control to reduce their dysponesis and improve health.

Keywords:

Surface electromyography (SEMG)

Dysponesis

Posture

Pain

Performance

Repetitive strain injury (RSI)

Using what I learned with muscle feedback while on the elliptical machine during the workout, I was able to work on keeping my muscles relaxed. Since that time, I have also become aware of gripping the steering wheel when driving in heavy traffic... ...I noticed that gripping the wheel makes me feel much more stressed and when I let my shoulders and arms relax I feel so much calmer.

--Marie Tallard

Stiffness, tightness, pain or other muscle discomforts and exhaustion are common experiences for most people. Muscle discomfort often limits what people would like to do and interferes with their daily activities. Muscle discomfort is often described as soft-tissue injury and most people assume that it is the result of aging--you just have to accept it and live with it and you just need to be more careful while doing your job or sport. Muscle pain, known as myofascial pain, is the primary cause of pain for more than 30% of patients who visit their primary physicians with severe pain (Skootsky, Jaeger, & Oye, 1989). More commonly, people experience neck, shoulder, back, leg, arm, and head pain while working at their job or enjoying their hobbies. For adults the life-time prevalence of neck pain is 66.7% (Côté, Cassidy, & Carroll, 1998); for adolescences the prevalence of back, neck and shoulder pain is increasing and in 2002 the prevalence rate for 18 years olds was 45% of girls and 19% of boys (Hakala, Rimpelä, Salminen, Virtanen, & Rimpelä, 2002); for employees working at the computer more than 30% experience neck and back pain, hand and arm pain, tingling and numbness, and exhaustion (Paoli & Merllié, 2001; Chauhan, 2003). The European Agency for Safety and Health at Work (2004) has reported that more than a third of European workers complained of back-ache. The largest increase in back pain is seen among computing professionals and technicians. More than 25% of Europeans experience work-related neck-shoulder pain and 15% experience work-related arm pain (De Kraker and Blatter, 2005) while more than 90% of college students report some muscular discomfort at the end of the semester especially if they work on the computer (Peper & Harvey, 2008).

The common treatment strategies for muscle discomfort include heat, massage and touch as well as many different educational or treatment strategies such as Swedish massage, acupuncture, medications (e.g., non-steroidal anti-inflammatory medication, muscle relaxants or painkillers), Shiatsu, aroma therapy massage, Alexander technique, Feldenkrais, chiropractic, Rolfing, Somatics and therapeutic physical therapy manipulations and exercises (Cram and Durie, 2003). Although these approaches are highly beneficial to reduce discomforts, symptoms often return. When the symptoms return, it may suggest that the ongoing dynamic muscle activation patterns that contribute to the development and maintenance of the disorder have not been changed nor has the excessive sympathetic arousal been reduced. Muscle pain is aggravated by sympathetic arousal which activates the trigger points and increases referred pain (Gevirtz, 2006; Travell & Simons, 1983).

People are usually unaware of their autonomic arousal or their muscle tension (Shumay & Peper, 1997). When working, many people 1) excessively tighten muscles necessary for the task, 2) tighten muscles that are not necessary for performing the task (inappropriate co-contractions), 3) do not relax the muscles after the task has been completed, or 4) do not relax muscles momentarily during task performance to allow for ongoing regeneration (surface electromyographic gaps/micro-breaks). These inappropriate efforts have been labeled dysponesis by Whatmore and Kohli (1974).

Experiential practice: *Threading the needle* (Peper et al, 2008)

Become aware of dysponesis when you imagine and “act out” the following experiential exercise, *threading the needle*. Perform the task so that an observer would not know that you are only simulating threading a needle.

Imagine that you are threading a needle — really imagine it by picturing it in your mind and acting it out. Hold the needle between your left thumb and index finger. Hold the thread between the thumb and index finger of your right hand. Bring the tip of the thread to your mouth and put it between your lips to moisten it and make it into a sharp point. Then attempt to thread the needle, which has a very small eye. The thread is almost as thick as the eye of the needle.

As you are concentrating on threading this imaginary needle, observed what happened? While acting out the imagery, did you raise or tighten your shoulders, stiffen your trunk, clench your teeth, hold your breath or stare at the thread and needle without blinking?

Most people are surprised that they have tightened their shoulders and braced their trunk while threading the needle. Awareness only occurred after their attention was directed to the covert bracing patterns.

Dysponesis consists of misplaced and misdirected efforts (from the Greek: *dys* = bad; *ponos* = effort, work, or energy). Although dysponesis usually refers to the striated muscular system, the concept includes any nonfunctional efforts, unnecessary work, or activation of physiological system (e.g., cardiovascular, respiratory, endocrine, etc.) that are part of sympathetic arousal and vigilance. Unfortunately, dysponetic activity is usually covert, and most people are unaware of unnecessary bracing or tightening. In the example of *threading the needle*, the covert bracing and attentional efforts were the excessive neck, shoulder and trunk muscle tension-tensions which were unnecessary for the performance of the task.

The unnecessary and covert muscle tension can usually be identified with surface electromyography (SEMG). For example, when a client who experienced chronic leg pain was asked to lift both shoulders up for five seconds and then relax them for five seconds and repeat this four times, she was totally unaware that she tightened her adductors and gluteus muscles of the legs as shown in Figure 1.

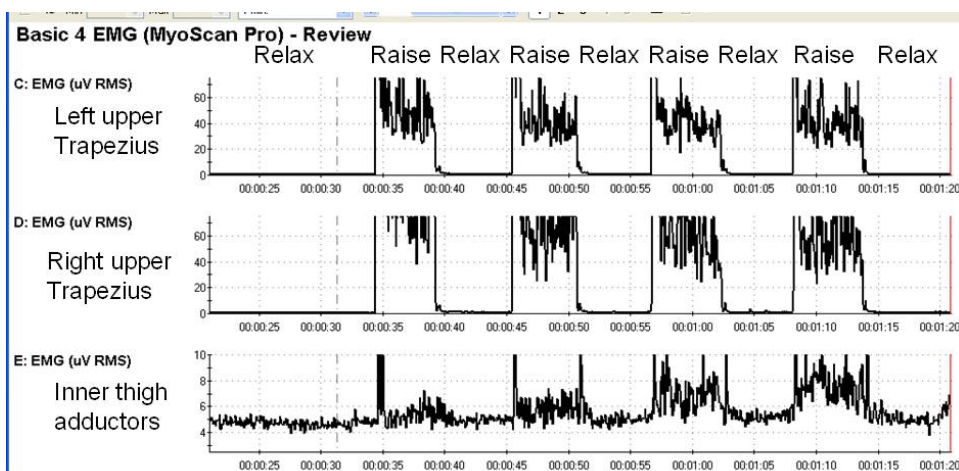


Figure 1. SEMG recording of the left and right upper trapezius and inner thigh adductor muscles. Each time she raised her shoulders, she unknowingly simultaneously co-contracted her inner thigh leg muscles.

The physiological recordings showed the dysponesis of the covert tension in her legs. Additionally, when she was asked to contract her calf muscles by lifting her heels while sitting, she unknowingly tensed her right and left trapezius muscles as shown in Figure 2. When she saw the physiological data, she finally understood why her legs muscles were hurting all the time and why she was so tired after work—with every movement she tightened her legs, shoulders and probable other muscles.

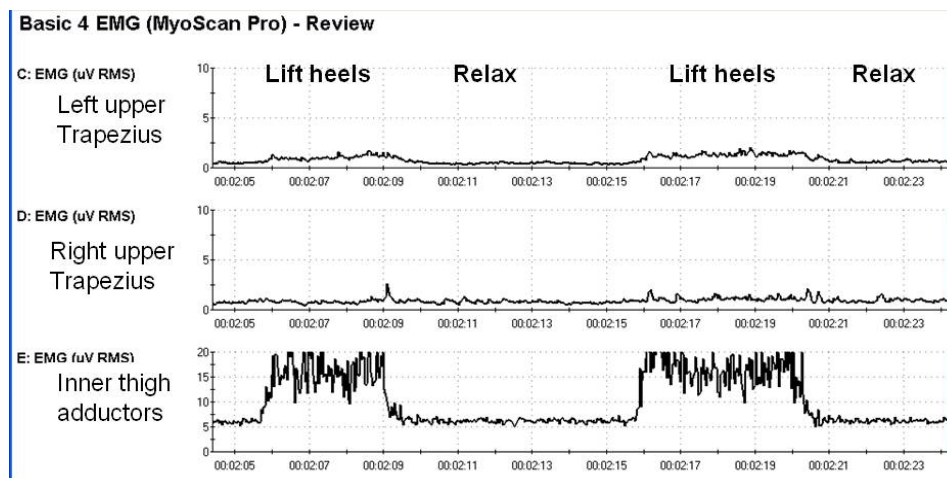


Figure 2. SEMG recording of the left and right upper trapezius and inner thigh adductor muscles. Each time she lifted her heels, she unknowingly also tightened her upper trapezius muscles.

The most common form of dysponesis is the tightening of muscles that are not necessary for the performance of a task; another form that occurs frequently is the excessive tightening of the

muscles that are used to perform the specific task (e.g., writer's cramp occurs when some people squeeze their pen too tightly and they need to learn to reduce the tension by which they squeeze their pen).

Dysponesis has been categorized into the following four types by Whatmore and Kohli (1974):

- Performing efforts: The necessary efforts used to perform such as walking, talking, lifting objects, etc.
- Bracing efforts: Efforts to hold the body, or a part of the body, rigid or "on guard". A steady effort is maintained that prepares us for quick initiation of performing efforts, for "fight or flight". Efforts often are pitted against each other (one muscle contracts against its antagonist).
- Representing efforts: Efforts we bring forth within our self during thinking, remembering, anticipating, daydreaming and worrying.
- Attention efforts: Efforts which allow impulses arriving from some sense organs to have a greater influence on the nervous system function than those arriving from others such as eye efforts as the act of directing attention

These chronic covert muscle tensions are a significant co-factor in the etiology, maintenance and progression of many disorders such as headaches, backaches, joint pain, repetitive strain injuries, myalgias, etc. (Whatmore & Kohli, 1974; Peper & Harvey, 2008). Often, the problem is less structural than functional. It is how the person uses their body. *From this perspective use develops structure and structure limits use and form follows function.* Acquiring awareness of and then reducing dysponetic efforts promotes homeostatic processes within the body that facilitate health. These beneficial changes occur when dysponesis has been reduced. For example, Peper and Harvey (2008) have shown that repetitive strain injuries (RSI) can be significantly prevented and reduced when employees learn to reduce their neck and shoulder muscle tension, breath more diaphragmatically and take micro-breaks and macro breaks while working at the computer.

As an evidence based teaching and clinical approach, SEMG biofeedback is applicable for treating a wide range of disorders (Yuka & Montgomery, 2008). These include specific muscle retraining training for physical rehabilitation, pelvic floor muscle control for the treatment of incontinence and severe pelvic floor pain, tension headaches, stress management etc. (Marinacce, 1968; Basmajian, 1981; Cram, Kasman, & Wolf, 1998; Bolek, 2007; Glazer & Laine, 2006; Lehrer, Woolfolk, & Sime, 2007; Budzynski, Stoyva, Adler, & Mullaney, 1973; Nestoriuc, Rief, & Martin, 2008).

Treatment of dysponesis

Dysponesis can be reduced by many approaches such as progressive relaxation, yoga, Feldenkrais, or muscle biofeedback. Muscle biofeedback is a useful evidence based teaching and treatment approach. The physiological monitoring can identify low level muscle activity which is not recognized by neither the client nor the therapist. Surface electromyographic feedback (SEMG) allows the invisible muscle tension to become visible. The SEMG can show 1) the unnecessary covert muscles co-contractions, 2) the muscles staying tense after performing a task and not relaxing, or 3) the emotions such as anger increasing muscle tension and inhibiting momentary rest periods while muscles are in use (Sella, 2003; Cram, 2003; Peper et al, 2008).

With the use of SEMG, the muscle tension levels can be monitored before, during and after a task (Cram, Kasman, & Holtz, 1998; Kasman, Cram, & Wolf, 1998; Peper & Gibney, 2006). During work, the muscle must be able to quickly relax after contraction and have momentary periods of rest during activation to allow regeneration. If a muscle contracts 20% or more without short relaxation periods, the lymph and blood flow through the muscle tissue is reduced by 80%. The absence of momentary muscle relaxation (EMG gaps) is a contributing risk factor for illness at the worksite (Schleifer et al, 2008). For example, the SEMG of female employees at a chocolate manufacturing plant were monitored at the beginning of their employment. Those with more EMG gaps (momentary SEMG relaxation breaks) while working were significantly less at risk for developing muscular pain and disability two years later (Veiersted, Westgaard, & Andersen, 1993).

Experiential practice: *Lifting your leg*

Experience the absence of momentary rest periods can quickly contribute to discomfort. Experience this concept when you do the following practice.

Stand up and slightly lift your right foot from the ground. Keep holding your foot up from the ground. This is not a balance exercise so that you can keep your balance while holding onto a chair, table or wall. Continue to slightly lift your foot for three or four minutes. Then put it down.

Most people experiences some fatigue, discomfort and even pain in the muscles that lift the leg. The reason is that the muscles have no opportunity to relax and allow blood and lymph flow to remove the metabolic waste products, nor supply the muscles with oxygen and glycogen. Yet, compare this with walking for an hour. Most people, if they do not have hip or knee injury, can keep walking without developing fatigue or pain because the muscles alternately tighten and relax to regenerate.

One component of optimum muscle functioning involves the alternation between activity and rest. The lack of muscle relaxation to a resting baseline after use is an indicator of dysfunction

that can be assessed with the Sella's (1995, 2003) assessment protocol. In this protocol the person is asked to tighten a muscle for 9 seconds then relax it for 9 seconds, and repeat this five times. If the muscle tension does not return to a resting baseline level, it indicates that the muscle may not regenerate and probably contributes to the etiology of myalgia. The focus of treatment with SEMG biofeedback would be teaching the person to relax the muscle before tensing the muscle. The diagnostic power of Sella's assessment is illustrated by a 45 year old female somatic therapist, who was well trained in body movement and awareness and volunteered to be assessed. She was asked to raise her shoulders minimally until she became aware of the tension. The co-contraction of her right forearm extensors and the lack of return to the relaxed baseline in the upper right trapezius muscle indicated dysfunctioning as shown in Figure 3. She confirmed this by reporting that she experienced ongoing stiffness and pain in her shoulders.

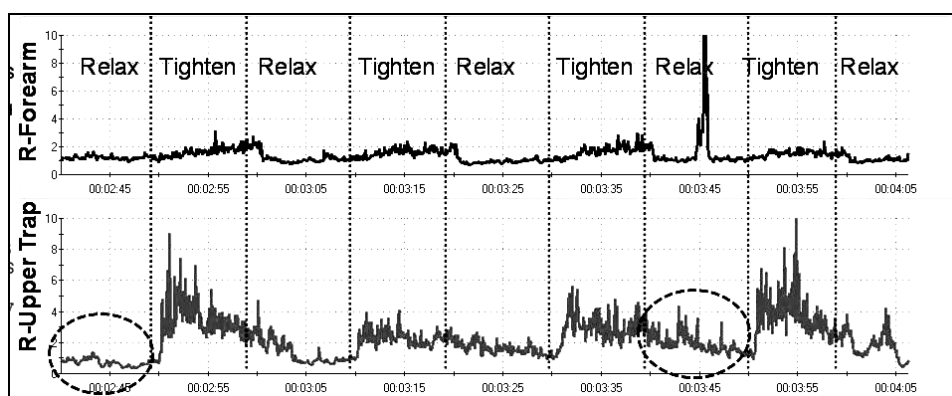


Figure 3. Example of dysponesis illustrated by the co-contraction of the right forearm extensors and the trapezius muscle (r-upper trap) not relaxing after lifting the shoulder until she felt the minimal sensation of tension. After each minimum contraction the right upper trapezius did not return to baseline as illustrated by comparing the first to the fourth relax condition.

The SEMG feedback made the unaware and unseen muscle tension aware and visible. The treatment strategy could teach the person to relax the muscle before using it again. The length of biofeedback training to achieve mastery varies and can range from one session to 20 sessions especially if the dysponesis is integrated in habitual performance patterns. The utilization of SEMG for dysponesis assessment and reduction is illustrated in the following two case examples 1) to improve health at work when packing apples and 2) to enhance performance while working out in the gym on an elliptical exercise machine.

1) To improve health at work when packing apples³

You told me before, that I have to relax my shoulders. Now, I see the graphics of the SEMG and I realize why! What a difference in tension

--45 year old employee

A 45 year old woman sought treatment because she experienced neck/shoulder pain during the last three months. As she described her symptoms to the therapist, she realized that her pain began when she started with her job in a vegetable store. She was afraid that she would have to stop working at her job because of her increasing neck and shoulder pain.

The biofeedback assessment

After describing her symptoms, SEMG triode electrodes were placed on the right upper trapezius and right medial deltoid muscles and amplified with Myoscan Pro sensors (bandpass filter 100-200 Hz) and recorded with Thought Technology, Ltd, Procomp Infinity system using version 4.1 software. After SEMG signals were calibrated, the client role played how she did her job at work. Her job consisted of picking up apples from a crate, putting them in a paper bag, turning around and placing them in a paper bag on the scale.

The SEMG showed that the shoulder tension, as indicated by the increased SEMG of the upper trapezius and deltoid muscles, did not return to baseline nor had momentary SEMG gasps, as shown in figure 4.

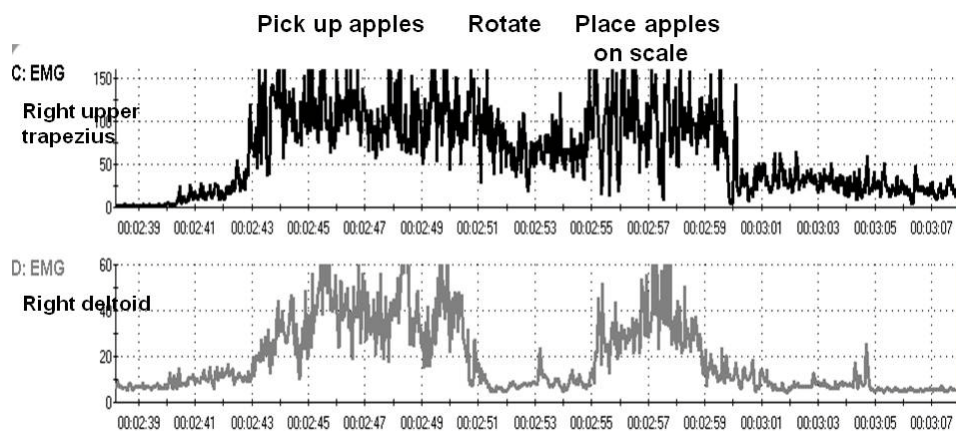


Figure 4. SEMG recording while simulating picking up apples, rotating and then putting them on the scale (by permission from Booiman & Peper, 2008).

³ This case was adapted from Booiman, A.C. & Peper, E. (2008). Het gebruik van biofeedback door oefentherapeuten, *Bewegreden*, 4(2), 34-38.

Biofeedback training and coaching

After the SEMG recording, the therapist taught the client how to change her working position so that she could relax her shoulders and arm. The SEMG feedback showed the client how to do the same job without tightening her shoulders and relaxing the shoulders between each movement. The therapist gave her posture suggestions and she repeated role playing this task until she could do this without excessive shoulder tension and relax the muscles after use as is shown in Figure 5.

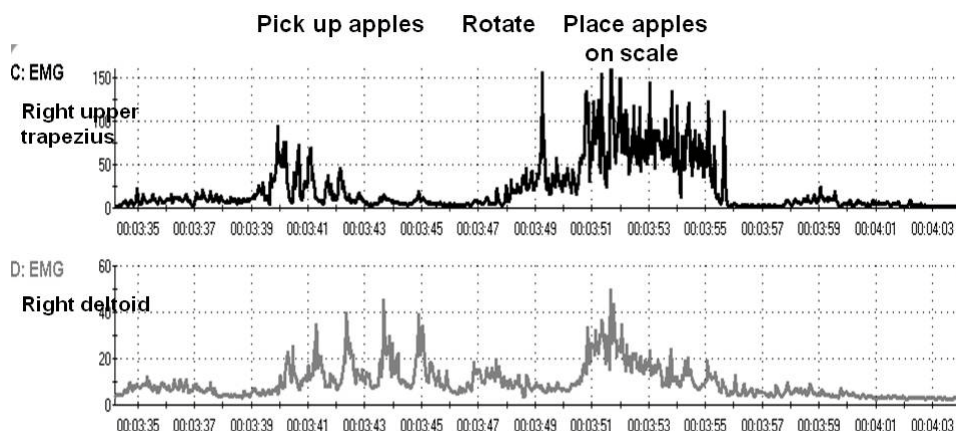


Figure 5. SEMG recording while simulating picking up apples, rotating and then putting them on the scale with relaxed shoulders and relaxing the muscles after use (by permission from Booiman & Peper, 2008).

The SEMG data showed that she relaxed her upper trapezius and deltoid muscles directly after use. Each time she picked up an apple from the crate she relaxed as shown in the SEMG recording from the right deltoid. In addition, her upper trapezius SEMG showed regenerative SEMG return to baseline after picking up the apples and after putting them on the scale.

Clinical benefits of reducing the shoulder dysponesis

After this treatment session she reported a significant decrease in headache and less exhaustion after a day's work which was the result of having learned improved posture and reduced dysponesis. The feedback had given her an internal awareness how she previously tightened her shoulders and arms and how she could do the same task with less tension. At the one year follow up, she reported a significant decrease in her neck/shoulder complaints and was able to continue her job without neck and shoulder problems.

Initially, many clients worry that performing a task with less dysponesis would interfere with their job performance; however, the opposite usually occurs. At the beginning, the person is slower because they are focusing on their body and learning the skill; however, once the skill is mastered, they usually can do it quicker and in a more relaxed way. When clients experience

this, they are more willing to implement new ways of working into their daily working activity. For the client packing the apples, through her experience in the therapeutic session, she developed the courage to talk to her supervisor about changing her working pattern and request ergonomic changes that allowed her to work more efficiently.

To enhance performance working out in the gym on an elliptical machine

I would much rather put my effort into productive exercise as opposed to exerting unnecessary energy which did nothing more than to hinder my abilities and efforts to work at my fullest potential. This awareness will be beneficial in improving my posture while working out, reducing my stress and fatigue and hopefully making the workout more enjoyable with less strain on my body.

--Marie Tallard

A healthy 51 old woman attending a biofeedback training program was assigned homework to indentify misdirected efforts and to reduce it. While doing her homework, she observed minor episodes of dysponesis but did not think that it significantly impacted her daily life in any way. However, the next morning when she did her usual workout on the elliptical machine in the hotel fitness room, she suddenly noticed that her shoulders were extremely tensed and she was gripping the handle bars with all of her might.

Discovery of dysponesis

She was amazed by this discovery because she had never realized that she needlessly tightened her shoulders, arms and hands while doing exercise which only required the use of the arms for balance purposes. This braced posture and position on the elliptical machine felt very familiar. Observing and reflecting about her dysponesis as a homework exercise, she became aware of the associated thought and emotional patterns. She realized that this problem originated several years ago when she fell from the treadmill while running. Since that time, she has been slightly afraid of falling and more cautious while using the equipment. Although, she pushes herself to exercise daily because of the health benefits, it is an ongoing struggle as she despises working out. She realized that this negative thought patterns may also contribute to the physical stress that she feels when exercising.

After becoming aware of her tight muscles and her hands gripping the bar, she tried to relax her shoulders and arms. She then struggled with her continual loss of attention and awareness of the tension. The moment her attention and awareness drifted, she would fall back to her dysfunctional pattern of gripping the handlebars with every ounce of strength.

Biofeedback training

The next morning during an actual workout on the elliptical machine she monitored her shoulder and arm tension with SEMG using a portable SEMG biofeedback device (Myotrac produced by Thought Technology, Ltd with the bandpass filter set from 100 to 200 Hz) as shown in Figure 6.



Figure 6. Working out on the elliptical machine. Left figure shows the normal tense pattern with her shoulders raised and hands gripping the bars; right figure shows the relaxed pattern. The position of her elbow/arms is relevant in reducing the muscle tension. SEMG was recorded from the right and left upper trapezius and forearm flexors muscles.

She initially placed the triode electrodes right and then left upper trapezius muscles. The auditory feedback provided immediate feedback of her shoulder muscle contractions. Any auditory signal meant that dysponesis was occurring. With the auditory feedback, she immediately reduced the tension in her shoulders. She quickly realized that, although the problem was rectified in the shoulders, it was still present in her arms. She then moved the electrodes to her arms and was able to reduce the muscle tension in the arms ⁴

Her mastery in controlling the SEMG activity of her upper trapezius and forearm extensors was monitored without giving her feedback. The SEMG triode electrodes were placed on the right

⁴ In this case, the shoulders can be relaxed because the hands are holding the side bars of the elliptical machine. We generally do not recommend this type of elliptical machine because it limits the natural cross-crawl movement patterns and often causes the person to tense their shoulders and back. An improved elliptical machine that mimics the normal walking movement patterns encourages the person to move their arms as well as their legs. In that case, the upper trapezius muscles would be activated as the arm goes forward and relax when the arm comes back. This cross movement crawl pattern enhances hip, spine and shoulder coordination.

and left upper trapezius and right and left forearm flexor and amplified with Myoscan Pro sensors (bandpass filter 100-200 Hz) and recorded with Thought Technology, Ltd, Procomp Infinity system using version 4.1 software.

She was instructed to workout on the elliptical machine in her normal /tense and newly learned relaxed pattern. During her habitual normal tense workout as compared to her relaxed workout at the same workload intensity, her SEMG from her left and right upper trapezius and left and right forearm muscles showed high muscle activation as compared to the relaxed workout and her right side showed more muscle activity than her left side as shown in figure 7.

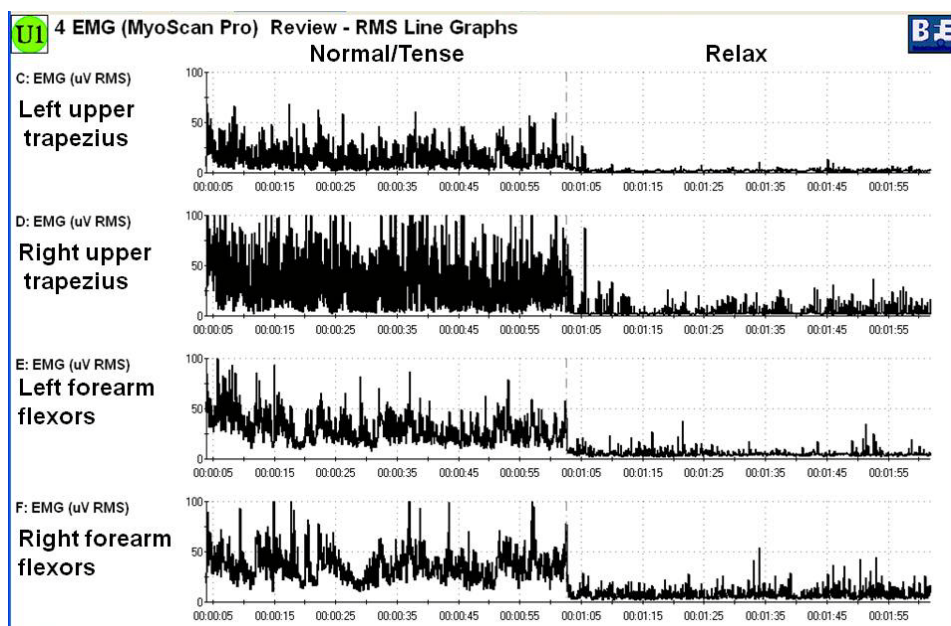


Figure 7. SEMG during Normal/tense versus Relax workouts on the elliptical machine. During her habitual workout the left and right upper trapezius as well as the left and right forearm flexors are continuously activated while during the relaxed workout, the SEMG is much less active and returns continuously to baseline. In both conditions the right side shows more SEMG activity than her left side.

The SEMG data also showed that during the normal/tense workout, the SEMG did not return to baseline. The none return to baseline can be seen more easily when the SEMG μV amplification range is changed from 0 to 100 μV in figure 6 to 1 to 10 μV in as shown in figure 8.

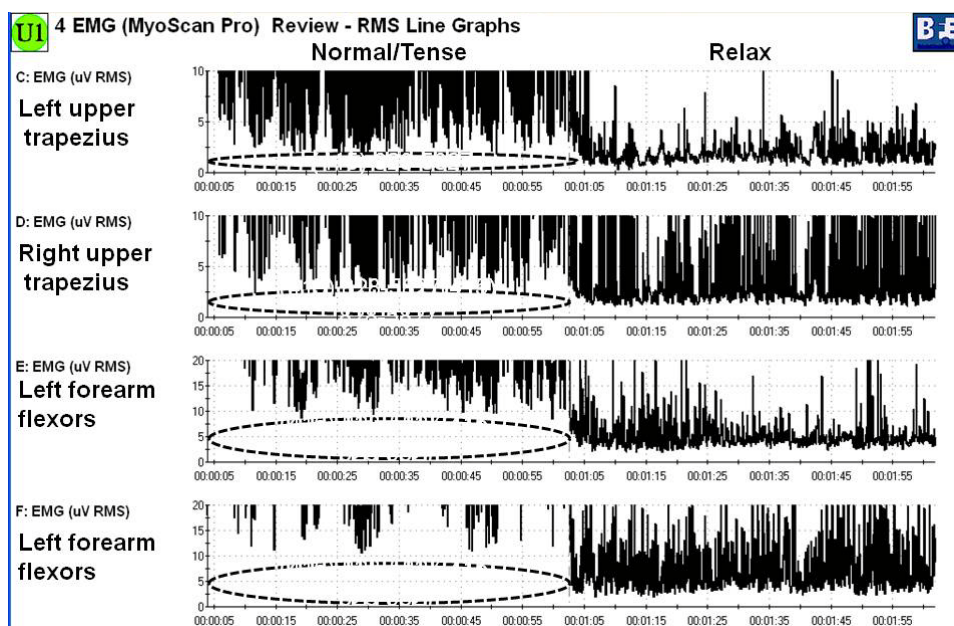


Figure 8. SEMG set between 0 and 10 μ V to show the SEMG activity. During the Normal/Tense habitual workout, the SEMG shows no SEMG gap or momentary rest periods, while during the relax workout the SEMG continuously returned to baseline which indicated that the muscles momentarily relaxed.

The performance benefits of reducing shoulders and arms dysponesis

By reducing the dysponesis in her shoulders and arms, she noticed that much less effort was required to complete the same workout and she decided to step it up to the next more challenging workout level. She was able to complete the workout program at a higher level and noticed less fatigue upon finishing. The following day she worked out without the biofeedback equipment and continued to be aware of and reduce dysponesis. As the workout progressed, dysponesis was minimal and she stepped up her workout to the next level.

She was extremely encouraged by this discovery and her efforts to “fix” the problem. She realized that she would much rather put her effort into productive exercise as opposed to exerting unnecessary energy which hindered her abilities and efforts to work at her fullest potential. This awareness and the ability to drop her shoulders was beneficial in improving her posture while working out, reducing stress and fatigue and making the workout more enjoyable with less strain on her body. She reported that this was very encouraging, “I am 51 years old and am not willing to accept that I am not capable of making physical improvements.” As she said,

My task will now be to maintain this awareness in order to break this bad habit 100% of the time and to transfer this discovery to other areas of my workout as well as to my daily life. When this goal is achieved and new habits are permanently formed I believe the benefits will be obvious in my everyday life and not just in the gym.

At a two month follow-up, she continues to observe her dysponesis during workouts and daily activities. At her home gym, she was able to keep her shoulder and forearm muscles relaxed while doing the elliptical workout and she has made steady and significant progress. She has been able to increase the difficulty of her workout to include numerous periods of high intensity movement and extend her workout by fifteen minutes daily without feeling tired. More importantly, she has generalized the concept of dysponesis awareness and reduction into other areas of her life. For example, she became aware that gripping the steering wheel made her feel much more stressed while driving and when she relaxed her shoulders and arms, she felt much calmer and able to handle the difficult driving situations. In addition, she has become much more aware of poor posture and tenseness while writing, working at the computer, working with clients, cooking, sewing, reading, sleeping and even relaxing. Her awareness of these situations has helped her to take control and make the necessary changes to reduce the physical stress that she encounters every day. This in turn has helped to alleviate mental stress and fatigue.

Discussion

The two case examples illustrate the efficacy of the evidence based SEMG biofeedback approach in the analyses and reduction of dysponesis. The success of this approach is based upon the following components:

- The biofeedback training assumes mind, body and emotions integration and an awareness that thoughts, memories, and emotions affect the physiology. This is based upon the psychophysiological principle stated by Green, Green & Walters (1970) that "Every change in the physiological state is accompanied by an appropriate change in the mental emotional state, conscious or unconscious, and conversely, every change in the mental emotional state, conscious or unconscious, is accompanied by an appropriate change in the physiological state."
- Identification and reduction of dysponesis during simulated or actual task performance (e.g., picking up apples at work and working out on the elliptical machine). The training focuses upon changing the use of a person's body so that the dysfunctional patterns are changed and eliminated when the people perform their tasks. It is through actual motor learning during the performance of the task that success occurs.
- SEMG biofeedback motivates clients because it shows their dysfunctional patterns and offers a skill acquisition approach to reduce their dysfunctional patterns. It can also show direct benefits of changing the alignment, posture, and relaxation of the muscles to reduce dysponesis. Through the immediate feedback experience and mastery, clients experience success and that gives hope for further improvement.
- Clinical success is significantly enhanced when the client generalizes the skill. Thus, the awareness of dysponesis followed by the reduction of dysponesis needs to be practiced in

the daily activities at home, at work and while performing sports and hobbies. This can be enhanced through teaching clients to keep logs and self-monitor. People can be encouraged to change their behavior not only during a training session, but also in their real life.

In summary, dysponesis is a contributing factor in the development and maintenance of illness. Learning to be aware of and reducing dysponesis may significantly improve health. SEMG monitoring and feedback documents muscle dysponesis and can teach clients voluntary control to inhibit dysponesis. The external feedback develops the internal somatic/sensory awareness. We recommend that children and adults are taught dysponesis awareness and inhibition to prevent illness onset; since, prevention is much easier and much more cost effective than treatment.

I am amazed how many areas of my life need improvements. My awareness has been most helpful in changing my actions.

--Marie Tallard

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