

INTRODUCTION TO Manual Biofeedback

– Part 1 of a 3 Part Series –

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Throughout the past 30 years of clinical practice, nothing satisfies me more than seeing a patient get better immediately. Fundamentally, all of us in health care professions want our patients to improve and to live more healthfully. But because getting positive results is too often slow and arduous, most health care professionals and patients become resigned to accept chronic problems or resort to symptomatic treatments such as pain medications, muscle relaxants, sleeping pills, surgery, etc. I consistently avoid recommending symptomatic treatments and strive to find and treat the underlying cause of problems.

Over the years, I have utilized various aspects of biofeedback in my clinical practice, including treating patients with common muscle deficits, patients with brain and spinal cord injuries, professional athletes, musicians and others. My experience includes both genders in all age groups. Most of my work relied on some form of biofeedback with the purpose to: 1) obtain relatively rapid patient responses; 2) enlist patient participation in their recovery; 3) prescribe specific home-care training; 4) increase patient independence, 5) reduce health care costs; 6) broaden treatment locations (home-care, “on-the-field” athletic care, corporate coaching, etc.); 7) prevent future injury, re-injury, disability or reduced quality of life in patients undergoing rehabilitation; and 8) prevent injury, disability and reduced quality of life in otherwise healthy individuals. While these eight goals may seem lofty, having seen them achieved often enough, I’m compelled to share this powerful treatment approach I call *manual biofeedback*.

Manual biofeedback, a relatively simple and effective neuromuscular therapy, expands the scope of traditional EMG-type biofeedback and other hands-on physical therapies. The full spectrum of manual biofeedback includes physical assessment and treatment of a wide range of neuromuscular dysfunction caused by brain, spinal cord and local injury. It emphasizes active patient participation throughout the rehabilitation process. In place of electrodes and mechanical sensors used in most computerized biofeedback devices, manual biofeedback integrates the practitioner’s sensory system as the primary sensor. The process is similar and in some cases, identical to traditional manual muscle testing, neurological evaluations and other procedures commonly used in clinical practice.

Neuromuscular dysfunction is typically accompanied by muscle imbalance, defined here as a combination of abnormal muscle inhibition (“weakness”) and abnormal over-facilitation (tightness). Manual biofeedback addresses muscle weakness, helping the tight muscle relax to improve muscle balance. These concepts are discussed throughout all three parts of this article.

BACKGROUND

Biofeedback is a natural mechanism built into our nervous system and has been a key feature in evolution with early humans using it instinctively for survival. For example, sensing uncomfortable temperatures humans sought ways to adapt through clothing, shelter and fire, and walking on rough surfaces led to the use of protective footwear. Today, taking our temperature with a thermometer is a common form of biofeedback. In the 1930's, Mowrer (1938) may have been the first to develop a biofeedback instrument by inventing an alarm-based device for treatment of enuresis. The term *biofeedback* was coined in the 1960s by scientists who used more advanced instrumentation to train human subjects to consciously alter body function through sensory input to the brain.

The many variations of biofeedback-type therapies currently used in clinical practice are designed to help assess and treat neuromuscular dysfunction. These techniques are utilized by medical doctors, physical therapists, chiropractors, psychologists and other healthcare practitioners. In addition, various biofeedback techniques have been used for pain control, stress management, improving gut function, reducing hypertension and hypotension, and to help reduce symptoms of depression. Many patients, families and other previously untrained individuals are also taught to use simple biofeedback for personal health needs. Kegal exercises, for example, are used to help improve pelvic muscle function, and have been successful in helping those with sexual dysfunction, urinary incontinence, uterine prolapse and other conditions. Electromyographic (EMG)-type biofeedback therapies are increasingly common in clinical practice to help treat and rehabilitate patients with skeletal motor deficits. Muscle electrodes monitor the degree of muscle contraction through a computer interface, helping patients learn to increase their muscle function. While effective in the clinical setting, EMG biofeedback requires a high degree of technical skill, the acquisition of relatively expensive equipment, and limits therapy to a specialized clinic.

With an understanding of the neuromuscular physiology and the experience of using various types of computer-based biofeedback, it was clear this treatment could be done manually. Furthermore, I understood that many of my former treatment successes occurred because I had provided the necessary biofeedback that normalized neuromuscular function. Now, I consider manual biofeedback the culmination of the past three decades of my clinical experience.

THE USE OF MANUAL BIOFEEDBACK

Manual biofeedback can help improve poor muscle function due to brain and spinal cord injury, and local muscle problems. It can be applied to a wide range of patients, including those with common aches and pains, to those with more serious physical ailments, including special-needs children and disabled adults. In addition, manual biofeedback is especially useful as a preventive tool to help avoid neuromuscular imbalances that can potentially increase morbidity and mortality, and reduced quality of life.

The majority of people with physical ailments fall into at least one of three categories:

1. *Local muscle dysfunction* is the most common cause of muscle-related physical problems. This is often associated with some form of trauma to the muscle itself, such as the result of a fall, an overstretched (so-called "pulled") muscle, or a twisted

ankle. Micro-trauma is even more common; it's the accumulation of minor physical stress affecting a muscle, often unnoticed while it's happening, eventually causing a more obvious muscle imbalance. Too much sitting, repetitive motion injury and walking in poor-fitting shoes are common examples of micro-trauma causing muscle dysfunction. Local muscle problems can result in a wide range of symptoms, from minor annoying discomfort to serious or chronic pain or disability. While these problems are typically thought of as "local," they are clearly associated with some level of brain dysfunction because of the sensory and motor relationships between muscle and brain.

2. *Brain injury* can occur at any age, even before birth. Trauma, reduced oxygen or nutrient supply, and infections can easily cause brain damage resulting in poor muscle function. Cerebral palsy, Down syndrome and stroke are specific examples of serious brain injury. Some of these injuries can cause relatively minor physical problems, such as just being uncoordinated or "clumsy."
3. An incomplete *spinal cord injury* is often due to physical trauma such as from a serious neck or back injury, but a tumor or infection can also be a cause. A spinal cord injury can adversely affect the nerves innervating a specific muscle or muscles reducing their function. Like a brain injury, spinal cord injuries can cause a wide range of problems, from relatively minor physical ones, to very serious disabilities.

One common problem in virtually all these injuries is abnormal muscle inhibition, often called muscle "weakness." Three common terms used to describe muscle function include *weak* and *tight* when referring to abnormal muscles, and *strong*, associated with normal muscles. In this context, weakness is not necessarily associated with the lack of power, but rather, muscle dysfunction due to neurological deficits. Increases in muscular power, which can also increase the size of the muscle, typically occur after muscle function is improved and the patient begins utilizing more muscle movement in everyday activity.

In addition to the terms weak and tight, various other names more accurately define muscle dysfunction:

1. The first is a physiological definition noted above. Weakness could be described as *abnormal muscle inhibition*; and tightness, *abnormal over-facilitation*.
2. A second example comes from a recent National Institutes of Health consensus meeting that defined muscle weakness in children. These include the word weakness, along with *ataxia*, *apraxia* and other names based on developmental and neurological features.
3. A third example rates muscle function on a scale of 0 to 5. Zero to 4 is associated with weakness, with 0 having no detectable muscle contraction and 4 associated with mild weakness. A rating of 5 is considered normal.
4. Tight muscles are generally referred to as *hypertonic*, with three specific types being spasticity, dystonia and rigidity.

In this discussion, I'll use the terms weak and tight to refer to abnormal muscles, and strong when referring to normal muscles. Manual biofeedback addresses the full spectrum of

muscle function – from muscles with no detectable activity, or zero contraction, to those muscles with normal function (where improvement are associated with increases in the number of muscle fibers stimulated).

Most importantly, when a brain, spinal cord or local muscle injury occurs, there is usually a specific pattern of weak and tight muscles that follows. The primary problem is thought to be muscle weakness. This weakness immediately causes another muscle, typically the antagonist, to become tight. The tightness is the most noticeable sign of disability and often the most symptomatic regarding pain. For example, the biceps muscle flexes the elbow, and its antagonist, the triceps, extends it; when one weakens the other typically tightens. In a patient with a stroke or other brain injury, a flexed elbow position (and often other flexors) is a common sign of disability. The temptation is to “treat” the tight flexor with medication, Botox injections, or even surgery. But the abnormally inhibited (weak) triceps may be the primary cause of the abnormally tight biceps. In most cases, there are several, or sometimes many muscles involved in this process. The use of manual biofeedback attempts to reverse this pattern, helping the weak muscle get stronger and helping the tight muscle to relax.

The pattern of muscle inhibition occurs *normally* when an antagonist is contracted, and we can easily feel this difference in normal muscles. While sitting, place one of your hands under your thigh, with your elbow bent. Then, pull up with your hand to contract the biceps, and maintain that contraction. With the fingers of the other hand feel the tightness in the biceps. Now feel the back of the arm, the triceps muscle, and feel how loose it is, very much like a weak muscle.

This similar but *abnormal* pattern occurs when an injury causes muscle imbalance. Manual biofeedback primarily addresses muscle weakness, which in turn helps relax the tight muscle or muscles. Muscle imbalance, the combination of weakness and tightness, results in a vicious cycle of poor muscle function and reduced movement that often leads to pain, disability or both.

While treatment for common local muscle imbalance has been popular for many years, until recently, it was assumed that more serious brain and spinal cord injuries could not recover well, if at all. As a result, many patients with these neurological injuries were not successfully treated and often untreated. But over the last 30 years neuroscience contributed to the increasing acceptance of what many clinicians knew for a long time; the brain and spinal cord, at any age, has potential for repair, even in cases of severe damage.

One goal of manual biofeedback is to enhance neural plasticity in patients with brain injury (including cerebral palsy, stroke and traumatic brain injury), spinal cord injury, and common local muscle problems. The neurological mechanisms responsible for the clinical improvements observed with the use of these approaches are not entirely clear. Feedback activation by sensory means, including visual, auditory and proprioception with the use of biofeedback, may stimulate or recruit unused or underused synapses for motor control possibly creating new sensory engrams with resulting improvement in neuromuscular function.

Manual biofeedback can help promote continuous improvement in physical activity in those with acute and chronic problems, helping to enhance physical movement in almost anyone with muscle dysfunction. Increased movement is a powerful therapy in itself. It not only helps locomotion, posture, independence and other physical factors, but can also help improve most other areas of the body and brain, including speech, vision, balance, memory and even intellect. Modulation, the balance of excitation and inhibition, between the cerebellum and cortex from efferent and afferent transmission between muscles and brain can improve cerebellar activity. Because of the numerous cerebellar-cortical interconnections, integration of vision, communication, language and cognition are positively influenced through movement. Essentially, manual biofeedback helps the brain and body work together to increase balanced muscle activity and thus better brain function and vice versa, turning that vicious cycle of poor muscle function into a upward spiral of improved function. In addition, because muscles have other important functions, such as energy production, circulation and immune activity, increasing physical movement enhances overall health.

Manual biofeedback procedures include three important steps: assessment, treatment and movement.

1. Assessment helps determine which muscle or muscles require treatment;
2. Treatment helps the muscle contract and function better;
3. Movement of the muscle and related structures must be incorporated into the patient's daily life to further improve overall function.

Manual biofeedback emphasizes active, versus passive, patient participation throughout this three-step process; often referred to as "task-oriented" versus "static" therapy. Many forms of hands-on assessment and treatment protocols may be considered static therapy – they take place with patients sitting or lying, and otherwise not enlisting certain levels of conscious neuromuscular activity, including upper motor neuron recruitment. While improving muscle function in the clinical setting is a significant first step in successful therapy, achieving this statically may incorporate less neurological activity, and may have less long-term clinical value, especially if the patient does not properly follow up with physical movement. Huang, et al. (2006) reviewed numerous studies of task-oriented versus static therapy and concluded that the effect of static-oriented biofeedback training on the patient's daily life, such as walking, eating, reaching, etc., appears less effective than task oriented therapy. Many of these studies even concluded that little, if any, clinical effect took place, even when muscle function improved during the therapy session.

During both assessment and treatment, manual biofeedback utilizes procedures very similar or identical to standard muscle testing. Muscle testing is a commonly employed procedure first introduced in 1949 to evaluate muscle weakness in polio patients. Since then, many forms of muscle testing methods have evolved, for both evaluation and treatment. Manual biofeedback incorporates the best of these into one system.

CONCLUSION

Manual biofeedback is a relatively simple and effective neuromuscular therapy that encompasses a variety of therapies including traditional EMG-type biofeedback, various forms of physical therapy, manual muscle testing-based approaches and other hands-on remedies. When addressing primary imbalances, it can reduce the need for many other treatments. The full scope of manual biofeedback includes physical assessment of disability and treatment of a wide range of neuromuscular dysfunction caused by brain, spinal cord or local injury, and emphasizes active patient participation.

Part 2 in this series will describe a specific form of Manual Biofeedback called *respiratory biofeedback*, including the step-by-step procedure. Just as the use of manual biofeedback for muscle dysfunction is similar to EMG-type approaches, respiratory biofeedback has a stronger focus on the brain, helping to increase production of alpha waves much like EEG-type biofeedback or neurofeedback. This procedure can also help improve the breathing mechanism, increase oxygenation to the brain and, through these changes, improve muscle function throughout the body. As such, respiratory biofeedback should be considered before treating other individual muscles.

Part 3 will include a detailed explanation of how manual biofeedback is used on skeletal muscles. All three parts, plus a fourth part showing how to use manual biofeedback on the major muscles throughout the body will be available on DVD in February 2009.

Dr. Philip Maffetone is an internationally recognized researcher, educator, clinician and author in the field of exercise, sports medicine, food and nutrition and biofeedback. He is the author of *Complementary Sports Medicine* (Human Kinetics, 2000), *The Maffetone Method* (McGraw-Hill), *Fix Your Feet* (Lyons Press), and many others, with books also published in German, Italian, Korean and Japanese. During his 30-year career, which included 20 years in private practice, Dr. Maffetone has been a respected pioneer in the field of complementary medicine, bringing the latest advances to healthcare professionals around the world. In 2003, he was presented with the prestigious Statuette award by the International Academy for Child Brain Development. Dr. Maffetone was named Coach of the Year in 1995 by *Triathlete Magazine*, and in 2000 was honored by *Inside Triathlon* magazine as one of the top 20 most influential people in endurance sports worldwide. Dr. Maffetone continues to lecture on diet, nutrition and stress management, and teaches biofeedback to health practitioners. He became a songwriter in 2003, working with some of music's legends including Johnny Cash, Rick Rubin and the Red Hot Chili Peppers. His website combines his educational material along with his unique music: www.philmaffetone.com.