

Biofeedback for Movement Disorders (Dystonia with Parkinson's Disease): Theory and Preliminary

Thompson, M.; Thompson, L. Journal of Neurotherapy 2002 Win; 6/4: 51-70

ABSTRACT: Background: This paper presents a theoretical framework for using a combination of EEG biofeedback plus regular biofeedback with clients who have movement disorders. Method: A case study is included that describes intervention and results with a 47-year-old woman with the dual diagnosis of Parkinson's disease and dystonia. The rationale for adding biofeedback interventions to traditional medical treatment hinges on the fact that muscle spindles, which are involved in muscle movement and tone, have double innervations, cholinergic and sympathetic (Passatore, Grassi, & Filippi, 1985). Both of these systems can be operantly conditioned using biofeedback. There were two learning goals: (1) increase the production of 12 to 15 Hz activity since this sensor motor rhythm (SMR) is associated with decreased firing of the red nucleus and the red nucleus, in turn, has links to the muscle spindles (Sternman, 2000); (2) train for calm, relaxed autonomic nervous system functioning (decreased sympathetic drive and parasympathetic ascendance) because this may also have a beneficial effect on muscle tone by means of influencing muscle spindle activity (Banks, Jacobs, Gevirtz, & Hubbard, 1998). Training for balanced autonomic system functioning is facilitated by diaphragmatic breathing at a rate of about six breaths per minute. Diaphragmatic breathing results in respiration and heart rate variability, presented as a line graph, following the same sinusoidal pattern when viewed on a biofeedback screen, a pattern termed respiratory sinus arrhythmia (RSA, Budzynski, 1989). This dual training of neurofeedback to enhance SMR activity and RSA biofeedback for relaxed autonomic nervous system (ANS) functioning was done for 30 sessions over a six-month period.

Results: Training was associated with significant reduction in dystonic movements. Additionally, the client became able to use diaphragmatic breathing to cue herself to turn on a mental state associated with increased SMR production and thus control incidents of freezing, a common problem in advanced Parkinson's disease. With twelve more sessions over the next 18 months, the improved quality of life has been maintained. **Discussion:** This work is reported to put forth a theoretical model of why neurofeedback plus biofeedback is helpful in movement disorders and to encourage research in this area.

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- **Parkinson's Disease**

"Parkinson's is a real disease. How can Neurofeedback help?" This is not an unreasonable question, and the answer to this question reveals a lot about what Neurofeedback is actually about. The organization of movement involves the orchestration of many parts of our neuronal network. Each of these parts is in turn subject to regulation by other parts of the network. In Parkinson's we are dealing with a highly localized neuronal loss in one branch of the network. Remediation for us lies in training the brain generally so that other regulatory pathways are strengthened in compensation.

The brain actually does a lot of this on its own. It is known, for example, that by the time symptoms arise in Parkinson's the person has probably already lost the use of some 75% of the neurons in the substantia nigra. So a mere 25% was sufficient to yield smooth and controlled willed movements. When even further neuronal loss occurs, is all hope lost? Apparently not. Of course one now also has available techniques such as Deep Brain Stimulation to override the misbehaving neuronal activity. But we can also work more naturalistically by coaxing the neuronal networks into better regulation despite the localized deficit. Neurofeedback could be tried before Deep Brain Stimulation is considered. One might, for example, be able to postpone brain surgery for a number of years, and just that delay should constitute a significant saving.

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Neurofeedback is direct training of brain function, by which the brain learns to function more efficiently. We observe the brain in action from moment to moment. We show that information back to the person. And we reward the brain for changing its own activity to more appropriate patterns. This is a gradual learning process. It applies to any aspect of brain function that we can measure. Neurofeedback is also called EEG Biofeedback, because it is based on electrical brain activity, the electroencephalogram, or EEG. Neurofeedback is training in self-regulation. It is simply biofeedback applied to the brain directly. Self-regulation is a necessary part of good brain function. Self-regulation training allows the system (the central nervous system) to function better.

- [What is Neurofeedback used for?](#)
- [How does Neurofeedback work?](#)
- [Who provides Neurofeedback & where can I find a provider?](#)
- [How is Neurofeedback used to train an individuals unique brain?](#)
- [Is Neurofeedback considered a cure for any condition?](#)
- [What conditions is Neurofeedback successful in helping?](#)
- [Do the effects of Neurofeedback training really last?](#)
- [What is the success rate of Neurofeedback?](#)
- [What happens if Neurofeedback clients are taking medications?](#)
- [Is Neurofeedback a reimbursable treatment under my insurance?](#)

Knowledge Module: Muscle Mechanics, Biofeedback, and Pain

Don Moss, PhD, and Rich Sherman, PhD

Overview: Muscles play a critical role in the onset and worsening of many painful conditions including chronic back pain, pelvic floor pain, and tension headaches. Improving muscle health, correcting poor posture, and learning muscle relaxation can reduce frequency and severity of pain.

Muscle Disuse Syndrome:

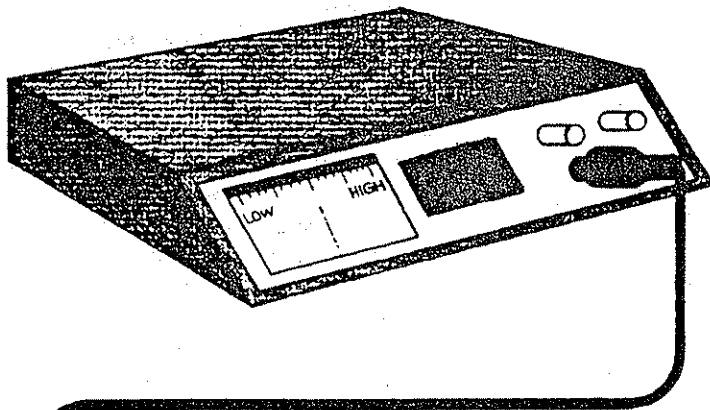
When patients hurt with chronic back pain, the natural reaction is to avoid activities associated with pain. Many patients become increasingly sedentary. The result is atrophied, weak, and shortened muscles. The "range of motion" for each muscle group becomes

restricted. Once muscles become unhealthy, it takes less strain or tension to trigger increased pain. Unused muscles also fatigue more quickly. Unhealthy muscles also harbor more trigger points and tender points, sites of heightened pain and sensitivity in the muscle.

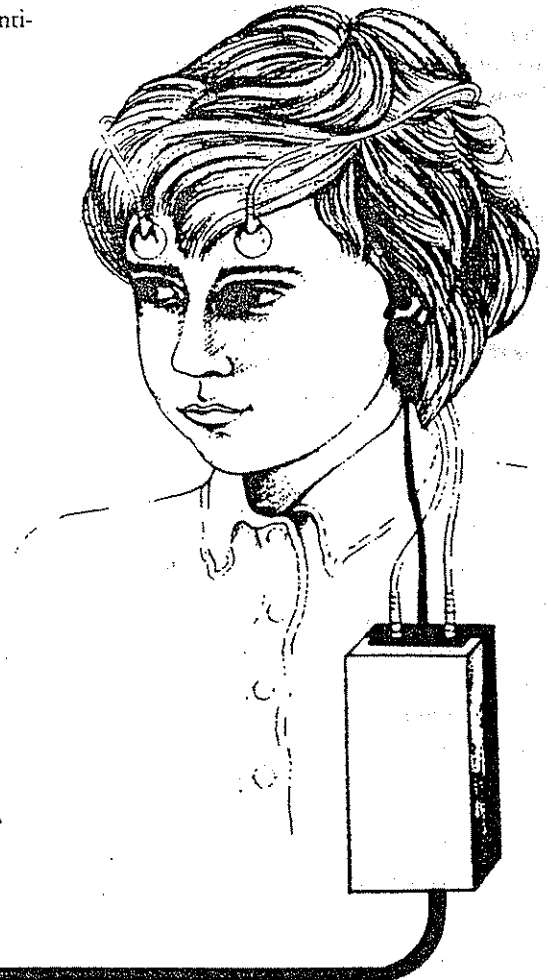
For example, when muscles in the pelvic floor are not kept in shape – usually due to generally low levels of activity, they get slack over the years. They can also be stretched during pregnancy and delivery as well as damaged by episiotomies. Urinary inconti-

nence, chronic pain in the groin, and pain with intercourse can result.

Stretching exercises can assist the individual to strengthen and lengthen muscle fibers. This will increase muscle flexibility, range of motion, and tolerance for activity. Active lifestyles are helpful so that activity can be built into one's frequent work and recreational



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habits. It is easier to remain active if the activity is built in an enjoyable way into one's everyday routines. Frequently, special exercises recommended by therapists and muscle tension biofeedback from appropriate muscles can be helpful in regaining appropriate levels of tension and function.

Muscle Bracing and Assymetries

Patients experiencing pain often cope by bracing against the pain, or by distorting posture. How is your postural alignment when you sit and stand? Examination may show more tension on one side of the body than on the other. Do you feel more tension, pressure or pain on one side of the back, shoulders, or neck? Correcting such misalignment is important. If you cannot easily correct posture and alignment, it may be necessary to use physical therapy or biofeedback to strengthen the weak side or relax the over-activated side of the body.

Shoulder and Neck Muscle Tension

Much back pain and many headaches begin with tension building up in the neck and shoulders. Even when other genetic, hormonal, dietary or biochemical factors are identified, tense shoulder and neck muscles may play a triggering role for a new pain episode. Tense muscles may produce back and neck pain, or the muscle tension may spread up the neck triggering head pain. Learning to reduce the tension in the muscles of the upper back, shoulders, and neck is a necessary tool for pain reduction.

Emotional Expression and your Muscles

Emotional arousal also increases muscle tension. Frowning creases the forehead. In anger we clench the jaw and tighten the shoulders. In fear we may brace against danger. Each emotion is expressed in a typical pattern of tensed muscles and posturing of the body. When human beings live with chronic negative emotions, in stressful jobs or in troubled marriages, both the emotional state and the accompanying muscle tension become destructive.

Emotional Suppression and Muscle Tension

Just as expressing emotions produces tension, efforts to block feelings also produces muscle tension. Many persons use muscle bracing to suppress or deal with painful emotions. We describe such persons as "armored" against feeling, and the armor includes tense muscles and rigid posture. Learning to deal more constructively with anger, fear and other negative emotions is helpful in restoring muscle relaxation and postural health. Learning to relax the muscle armor is also important.

Repetitive Motion, Maladaptive Postures, and Tension

It is not only stress and emotion which cause muscle tension. Working on an assembly line, spending long hours at a computer terminal, or excessive bending and lifting also produce extensive muscle strain and chronic tension. Many employees ignore the early signs of muscle strain and continue to adopt the same uncomfortable postures hour after hour, until injury or pain occurs. Intermittent stretching and relaxation of the muscles can alleviate the chronic muscle problems. Changes in the workplace to modify one's position while working, and the angles of motion can also help. Ergonomics is the study of work sites, jobs, and work activities to minimize injury and pain problems.

Failure to Recover from Tension

Animals often display a "stress response" when they are threatened. Their body mobilizes for emergency action, with tight muscles, rapid heart rate, the release of adrenaline and stress hormones, and many other changes. Animals are also able to recover and relax their bodies after the stress passes. Human beings tend to keep thinking about problems, and often maintain tense and defensive postures for hours and days after a problem passes.

The Role of Exercise, Muscle Stretching, and Muscle Relaxation

Exercise and an active life style, with a minimum of pain, are the goal of treatment and rehabilitation. Stretching exercises, muscle relaxation training, and postural awareness are tools to restore muscle health. Physical therapy and biofeedback are also useful tools to help restore normal relaxed flexibility and strength in your muscles. Once your muscle health is restored, regular exercise and active recreation will maintain that health.

Biofeedback and Muscle Control

Human beings normally have voluntary control through the central nervous system over muscle activity. One can deliberately lift a hand or raise a leg. However, human beings have little experience in identifying and controlling many muscle groups. Headache and back pain patients often carry high levels of muscle tension in the shoulders, neck and head, yet often are not able to judge the level of tension. They may assess themselves as relaxed, even when shoulder muscle tension is ten times higher than normal levels. Similarly, they find it difficult to relax muscle activity in the upper body.

A surface EMG (electromyograph) biofeedback device uses sensors placed on the surface of the skin, to read the electrical activity in the muscle beneath the skin. The more electrical activity, the more tense the muscle group is. The biofeedback device may use a meter to show the current level of tension, or send a signal with a bar graph, a beeping sound, or a visual display on a computer screen. In each case, the person who receives immediate information about the level of tension in a muscle group can learn to better assess that tension himself or herself, and can also learn to relax the muscle. That process is helpful for headache and back pain patients, whose high muscle tension often worsens pain.

For additional information about Biofeedback, Neurofeedback and related Self-Regulation Training contact:

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Visualize the way you usually spend your day. Then list the draining aspects of your day — those places/activities/people/conditions that diminish your energy:

Activities/conditions/ places/people that . . .	AT HOME	AT WORK	AT PLAY
ANNOY YOU			
ANGER YOU			
DISTRACT YOU			
DEPRESS YOU			
WORRY YOU			
WEAR YOU OUT			
BORE YOU			
FRUSTRATE YOU			
PLAGUE YOU			

PERSONAL FILLERS

Visualize the way you usually spend your day. Then list the vitalizing aspects of your day — those people/places/activities/conditions that renew your energy and well-being.

Activities/conditions/ places/people that . . .	AT HOME	AT WORK	AT PLAY
EXCITE YOU			
CALM YOU			
FREE YOU			
BRING YOU JOY			
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VertiGuard® D / VertiGuard® RT

VertiGuard® RT

Therapeutic device for vibrotactile neurofeedback in order to improve the gait, stance and balance performance

The system VertiGuard® RT is a neurofeedback device to rehabilitate and treat patients with a balance deficit. Vestibular disorders (e.g., Meniere's disease, vestibular neuritis), stance and gait disorders after stroke or brain tumour, hip/knee prosthetics etc. can be treated. Special emphasis is put on the treatment of presbyvertigo, i.e. vertigo in the elderly (who are prone to falls).

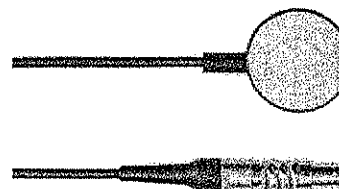
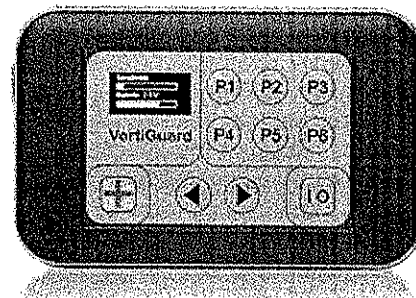
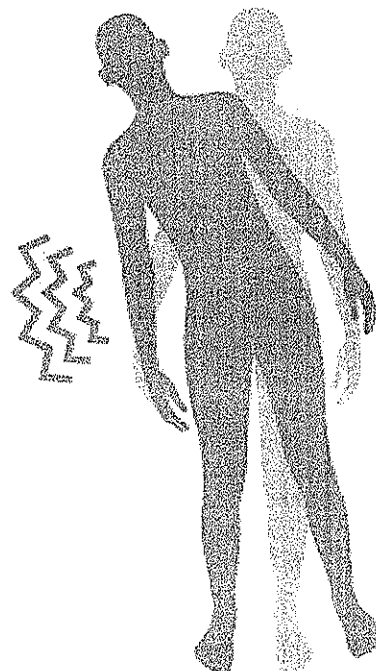
While the patient has to perform special exercises – corresponding to her/his individual balance deficit – a vibrotactile (feedback) stimulus is applied around the hip through four vibrators at the belt corresponding to the extent and direction of body sway. This additional (feedback) information can be processed by the brain so that a normalized stance and gait stability can be achieved in a shorter period of time compared to normal training programs.

Application in sports to improve balance are strongly recommended as well.

The mode-of-action

The system is designed to record the body sway in the roll and pitch planes. While the patient performs some vestibular exercises, he obtains a vibratory signal through the hip belt in dependence of the body sway: The greater the sway, the stronger the vibration. The signal output of vibration is determined by the comparison of the recorded parameters with normative data within the system (age- and gender-related). The sensitivity of the sensors can be individually adjusted.

[additional information](#)





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VertiGuard® RT - additional information

The VertiGuard® RT is a vibrotactile neurofeedback system. It is battery-driven and carried with a belt around the hip. The VertiGuard® RT consists of a central unit and four vibrators evenly distributed around the hip. During exercises, the central unit records the body sway and activates one of the vibrators which corresponds to the (primary) direction and (excess) extent of body sway (as compared to normal controls and/or preset levels). The vibration stimulus is increased in dependence of the exceeding body sway. The system can be programmed for a total of 6 exercises individually. These exercises can be activated by pressing the corresponding button (1-6) of the central unit. A fine tuning for the individual capability of each patient is possible (additional control). Those exercises which are the most powerful ones for improving balance are selected after performing the Balance Deficit Test (BDT, see VertiGuard® D). The latter system determines the most relevant exercises for the training of postural control. Within normal limits, no feedback signal is generated. Only excessive movements activate the vibrating signals. However, they can be finely tuned to the patient's demands. The balance exercises can be used in a clinical setting as individual training, but also in private practice or as home training. Group training (e.g., in rehab units) is also possible.

Recent studies show that a vibrotactile balance training can be compared to an auditory biofeedback training with respect to the rate of success (Basta et al. 2008). On the other hand, the VertiGuard® RT can achieve significant improvements of postural control already within the first week of balance exercises (Basta and Ernst 2008). This might be based on the direct sensory perception of the vibratory stimuli into the direction of excessive body sway. Moreover, auditory stimuli can be challenging to be correctly perceived by the elderly. The fine tuning of body correction after vibrotactile stimulation can be more easily performed.

Literature

Basta D, Ernst A. (2008) Moderne Rehabilitation von Gleichgewichtsstörungen mit Hilfe von Neurofeedback-Trainingsverfahren. [Modern rehabilitation for vestibular disorders using neurofeedback training procedures]. HNO 56: 990-995.
Basta D, Singbartl F, Todt I, Clarke A, Ernst A (2008) Vestibular rehabilitation by auditory feedback in otolith disorders. Gait & Posture 28: 397-404.

