

MOVEMENT DISORDERS ARE CAUSED BY ABERRANT MUSCLE MEMORIES

ABSTRACT

Movement disorders may be mitigated by restoring aberrant muscle memories aka motor learning. TREMOREX [TX] therapy is based on the universally accepted fact that voluntary muscle memories may be improved with practice and the yet to be accepted fact that reflexes execute muscle memories that may likewise be improved. Stabilization reflexes countervail unintended movement from interfering with intended movement. But when they fail to do their job, or worse yet cause rather than prevent unintended movement, all movement is in disorder.

**TREMOREX restores stabilization and
retrains voluntary movement on a stable platform**

TREMOREX PROJECT

Journey

The TREMOREX project commenced with Dan's incidental discovery that sanding a wood chair stopped his parkinsonian symptoms in their tracks and continued with activity involving extensive research, designing and building six experimental devices, recruiting participants with Parkinson's Disease or Essential Tremor, performing frequent training sessions over protracted periods, collecting thousands of measurements and contemporaneous observations, recording before and after videos, formulating hypothesis based on accepted scientific facts and theories, obtaining several patents for hand-held and wearable devices and methods that mitigate movement disorders, developing a website, www.tremorex.com, featuring this body of work, all with the objective of developing a TX device and therapy that restores movement the way movement is designed to be restored.

TX is a highly effective, persistent, movement disorder therapy that is drug free, non-invasive, natural, and causes only positive side effects.

Results

The results are unprecedented, profound, and chronicled on the website. When have you seen a 6-minute light exercise mitigate hand and leg tremor, and restless leg syndrome by 98% for 18 hours in the first exercise session and last longer - from days to months to perhaps perpetually, as exercise sessions continue and when have you seen systemic restoration of movement disorder symptoms like hypomimia, gait, rigidity, freezing, and cognitive deficits to acceptable or superior performance?.

NEVER! It has never happened before TREMOREX!

BACKGROUND

Medical therapy

Drugs are the best-known medical therapy for mitigation of movement disorders. However, in addition to disastrous side effects and possible drug dependency issues, they can cause movement disorders. Levodopa and dopamine agonists are known to cause proprioception deficits and drug induced dyskinesia. In general, a drug taken to mitigate one symptom is likely to exacerbate other symptoms. For example, the same drug, beta blockers, used to suppress essential tremor, is used to limit blood pressure. One cannot treat one without inadvertently treating the other. Unintended treatments are called side effects. Drugs modulate or attempt to "help" or "substitute" endogenous processes that become aberrant or deficit. It is not unlike perpetually using a wheelchair to ambulate in lieu of walking. Walking gets weaker, atrophies, and forgotten over time.

Use it or lose it

Deep Brain Stimulation [DBS] requires a surgically implanted pacemaker type device. Experts are unclear how DBS works, but by sending high frequency electrical impulses into specific areas of the brain it can mitigate symptoms. DBS is regarded as a last resort means of mitigating movement disorders.

Alternative medicine

People automatically rehabilitate by adopting compensatory measures. For example, irregular posture and movement is assumed to avoid falling. People crouch or lean forward, outstretch hands, position feet apart, and avoid unnecessary movement to keep their center of gravity low and over a large base of support. They deploy defensive movements like moving slowly, avoiding sharp turns, and walking backwards. They shuffle their feet while walking so that both feet are always in contact with the floor. Freezing reduces the risk of falling. Other measures include behavioral changes like avoidance of difficult motor tasks and movements. For example, do not stand and reduce risk of falling, have someone else thread the needle and perform other tasks beyond their capability.

Physical therapy centers on exercises, devices, and education that improve a person's strength, flexibility, range of motion, endurance and coordination thereby improving a person's ability to move more safely, confidently, and perform everyday activities.

Patients are trained to perform challenging maneuvers like Tai Chi, execution of fine motor skills like placing pegs in a pegboard, how to compensate for imbalance, and how to use assistive devices that provide alternatives to normal movement. For example, braces, crutches, walkers, and wheelchairs provide functional alternatives to normal walking. Handheld or worn devices target specific symptoms like tremor or balance deficits and provide damping or offsetting forces that countervail unintended movement. Training devices help train people to use alternative biological methods of mitigating symptoms. For example, a device perturbs a user's balance, and the user learns how to anticipate and prepare for it by tensing muscles, assuming defensive postures and responding with voluntary compensatory movements. Vibration devices commenced in the 19th century when Jean-Martin Charcot, known as "the founder of modern neurology," observed his patients experienced movement disorder [parkinsonian symptoms] improvement after riding in horse and buggy carriage. He developed a vibrating chair to treat his patients. Over the years, a plethora of devices have been developed like vibrating helmets, whole body vibration platforms, vibrating treadmills, and wearable devices.

COMPENSATORY MEASURES

Whether adapted automatically or as a prescribed treatment, drugs, assistive devices, rehabilitation therapies and nearly all training devices, are compensatory measures that cause alternative environments the biological system must adapt to. For example, the training and use of voluntary movement to compensate for deficit automatic movement, diverts cognitive resources from thinking to control of movement normally handled by reflexes. Movement is slow, staccato, deliberate, and carefully planned as muscle contractions are consciencely rather than automatically controlled. When the brain becomes preoccupied with micromanaging functions normally delegated, cognitive demands must wait. That is why people with movement disorders appear to not being able to walk and talk at the same time.

Diversion of cognitive resources has consequences

In another example, using assistive devices like a cane or walker reduces and modifies demand on neurons, muscles, and muscle memories, causing them to atrophy and muscle memories to adapt to an abnormal way of walking.

Aberrant movements become the new “norm”

Compensatory measures change the environment that biological processes must adapt to. An aberrant environment leads to an aberrant biological system. Paradoxically, the more effective the treatment, the more ineffective and aberrant biological processes become. Such treatments may mitigate symptoms but rarely restore or correct underlying causes of movement disorders.

Aberrant environment = Aberrant movement

BIOLOGICAL SYSTEMS

Compensatory measures may be the only recourse for some people however, biological systems can heal themselves

Restoration is a form of self-healing

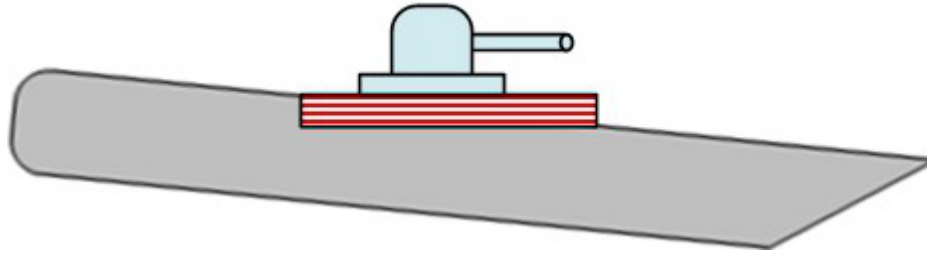
Biological systems can adapt to environmental conditions, be trained, and thereby restored.

Plasticity makes restoration of movement disorders possible. It is a process and capability of the biological system to make instantaneous to long-term changes in cells, organs, systems, and behaviors to protect, repair, and adapt to environmental conditions. Neuroplasticity is the modification of the nervous system by changing the structure and thereby the functionality of individual neurons and their connectivity to other neurons and effectors. Plasticity can strengthen or weaken biological components as needed. For example, muscles get larger and stronger or smaller and weaker as they adapt to the workload placed upon them. Perhaps the most important feature of plasticity is that changes to individual components are made in concert with each other to achieve acceptable performance of movements. Practicing movements [motor tasks], with intent to improve them, knowledge of performance, and under challenging conditions can restore or improve them to superior levels. That is the natural way biological systems are designed to be restored, and plasticity produces long-term, persistent changes, restorations, and perhaps cures.

Plasticity = adaptation to environmental conditions

MOVEMENT SYSTEM

Stabilization systems automatically prevent unintended movement from interfering with intended movement. They use closed loop mechanisms that sense and respond to perturbations. There are many manmade examples of such systems. Buildings are stabilized against earthquakes, active suspension systems stabilize an automobile against variations in road surface, and battleship guns are mounted on stabilized platforms that isolate them from the movement of the ship. Whereas the ship may pitch, roll, yaw, and move in response to wind and shifting weights, the platform does not. Sensors detect the ship movement and actuators attached to the platform produce forces that countervail the ship movement.



In this manner, aiming the gun is greatly simplified as it is mounted on a stable rather than a moving platform. But what if the stabilization system fails? Aiming of the gun must include anticipation and compensation for ship movements in addition to the target movements.

Biological stabilization systems use reflexes that sense unintended movement and countervail it by executing muscle memories. Limbs are maintained in a stable and ready to respond state by opposing stretch reflexes that alternately contract muscles causing the limb to oscillate about an intentional position. Normal tremor is hardly perceivable, large tremor is deficit and often simply referred to as tremor. Balance is maintained by reflexes in response to vestibular sensors that detect imbalance and cause muscle contractions to dynamically align the center of gravity over the base of support. Whereas neuroscience often describes the purpose of the Golgi Tendon Organ is to prevent excessive muscle contractions for the protection of muscles and tendons, it is hypothesized herein, to serve the vital purpose of maintaining muscle contraction forces to countervail muscle loads that would cause unintentional movement.

Reflexes do more than protect, they provide stabilization

When stabilization systems fail to do their job, or worse yet, cause rather than prevent unintended movement, intended movement is impaired. Aberrant reflex muscle memories cause voluntary muscle memories to become aberrant because they attempt to adapt to an unstable platform. Motor skills are extremely difficult to maintain when stabilization systems become deficit. A person with tremor, rigidity, imbalance, or inability to automatically sense and respond to unintended movement may practice a motor skill and never achieve adequate performance.

It is virtually impossible to develop or maintain motor skills on an unstable platform

Movement is a system wherein reflex and voluntary movements interact with each other, share mechanisms and interface with other systems. For example, walking is voluntary, intentional movement, the execution of multiple voluntary muscle memories that 1. Continuously change the center of gravity, the size and position of the base of support, and their relationship to each other, thereby perturbing balance effectuating balance reflexes, 2. Reposition limbs that effectuate stretch reflexes, and 3. Shift weight that effectuates muscle tension reflexes. Walking would be countervailed, opposed, by

reflexes, but for the system's ability to distinguish between forces caused by intentional movement which are not to be countervailed, and forces caused by perturbations to stabilization which are to be countervailed. The same is true for all movements. For example, balance reflexes may cause postural changes effectuating stretch and tension reflexes that would attempt to countervail balance movements but for selective countervailing. Balance movement is not countervailed by the other reflexes whilst perturbations to stabilization are. Furthermore, all movements share vital components. For example, the same neurons, interneurons, proprioceptors, and muscles used for stabilization are used to plan and execute voluntary movement. It should come as no surprise that deficits anywhere in the system, especially in proprioceptors, adversely affect all movements.

Movement is a system of many moving and interacting parts

TREMOREX

TREMOREX is the first therapy designed to specifically train and thereby restore reflex stabilization muscle memories thereby providing a stable platform upon which voluntary muscle memories are restored.

Restore aberrant muscle memories that cause movement disorders

Voluntary Muscle Memories may be described as voluntary movements that are formed, remembered and improved with practice.

Practice makes perfect

Reflex muscle memories can also be improved with practice. However, whereas there is a plethora of training methods, devices, and treatments to restore, improve, supplement, and/or substitute for deficit voluntary muscle memories, essentially none exist for reflex muscle memories.

Develop training specifically for reflex muscle memories

Furthermore, voluntary muscle memories respond to conscious decision and reflex muscle memories respond to stimulus of proprioceptors that are sensory neurons unique to movement.

Stimulate proprioceptors the way they are designed to be stimulated

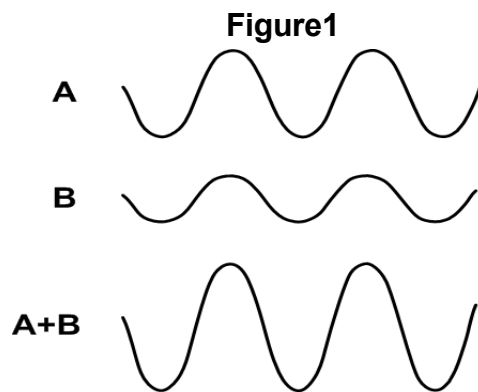
Train Reflexes

There are two basic versions of the TREMOREX apparatus. A hand-held device and a wearable device that is firmly attached to a user's torso. Both configurations have adjustable parameters including movement frequency, amplitude, and rotational direction. Both may be positioned to target reflexes. For example, the handheld unit directs the movement via prescribed exercises and the wearable unit may be positioned relative to the user.

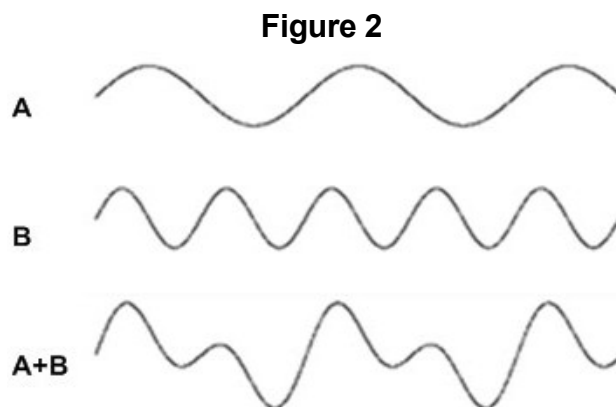
The TREMOREX apparatus delivers repetitive forced movement that stretches muscles effectuating stretch reflexes, perturbs balance effectuating balance reflexes, and varies the load on muscles causing tension reflexes. The apparatus provides:

1. Perturbations that cause stretch, balance, and muscle tension reflexes, under challenging conditions, to practice their ability to countervail unintended movement.
2. Movements are set to the reflex frequency to entrain, summate and thereby amplify reflex movement.
3. Movements are symmetrically correct replicas of the aberrant reflex movement, an ideal movement, to guide and train the timing, strength, and balance of opposing muscle contractions.
4. Movements that cause repetitive stabilization practice, at the optimum high rate, and for protracted periods.

Referring to Figure 1, the desired summation occurs when the TREMOREX and tremor frequencies and phase are the same. The resultant movement, bottom trace, is the sum of both movements.



Referring to Figure 2. When the movement frequencies differ, the resultant movement will be a complex summation of forces. Figure 2 shows the summation of 2 frequencies, one of which is twice the other. The resultant wave form is not a replica of the tremor and would be further distorted if the frequency amplitudes were different. Every summation of 2 forces occurring at different frequencies and amplitudes will yield a complex movement.



If the perturbation frequency is greater than the tremor frequency, both opposing muscles will experience tetanic muscle contraction. The muscles do not have time to fully relax before being called upon to contract again. Movement becomes erratic, ceases, or becomes rigid.

The intent is to practice the reflex movement, not a derivative movement that can do more harm than good

Note: Interestingly, whereas vibration has been known to mitigate movement disorders for nearly 2 centuries, its effectiveness has been limited because the applied vibration was never synchronized to the tremor frequency, nor has it been a guiding ideal movement for reflex muscle memories to learn by.

Synchronize the frequencies

Train voluntary movement

Retrain aberrant voluntary movements that have adapted to an unstable platform to a stable platform. Voluntary movement and thereby the brain is relieved from having to compensate for defective stabilization. Movement is vastly simplified and improved whilst the brain is free to think.

Train the movement system

The movement system must function under environmental conditions it is designed to encounter. As movements interact with each other they should be practiced concurrently. Users may use the apparatus to train reflexes whilst performing normal daily activities or prescribed motor tasks to train voluntary movement. The best exercise to train ideal movement is ideal movement.

. Train the system and the biological components will improve Individually as needed, and more importantly, in concert with each other

OPPORTUNITY

There remains an opportunity to enhance performance further as several parameters have not or have been minimally manipulated for effectiveness. That is why I am contacting people that should have significant interest, neurologists, persons with movement disorders and support organizations. Perhaps you're one of them, perhaps you may wish to participate in this "industry first" innovation. Perhaps you want to experience medical history in the making.

Industry first – Medical history - Perhaps

You are invited to visit the website www.TREMOREX.com and contact me ggcimo@sbcglobal.net with commentary, questions and/or challenges.