NEUBIE

A New Paradigm in Electrical Stimulation

By Garrett Salpeter, Founder of NeuFit

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INTRODUCTION

The NEUBIE® ("Neuro-Bio-Electric Stimulator") device uses a unique type of direct current (DC) electrical stimulation. As part of the NeuFit® Treatment System, it can provide a faster and more powerful form of neuromuscular re-education, improve mobility, and reduce pain. Overall, this approach has been shown to lead to better overall outcomes for patients recovering from injury, surgery, chronic pain, or neurological challenges (1).

The device is unique among electrical stimulation devices for several reasons, the most important of which is the neurophysiological effect of the waveform. Because of the unique effects of the waveform, the device is able to harness the power of DC to accelerate the physiological processes of healing and repair (2-7), and have unique effects on the neuromuscular system (7-10).

Here, we will share our hypotheses that describe how the NeuFit Treatment System is used specifically to accelerate recovery from pain and injury. We'll distinguish between this treatment system and what is traditionally done with electrical stimulation, and go into detail on our approach for neuromuscular re-education. Then we'll share some case studies that show examples of NeuFit in action.

The Neubie is FDA cleared for these intended uses:

- Neuromuscular re-education
- Increasing blood flow
- Maintaining or increasing range of motion
- Reducing spasms
- Preventing blood clots after surgery
- Preventing atrophy
- Managing or relieving pain

Neurophysiology & The NEUBIE Device

In this discussion, there is one underlying premise to keep in mind: many limitations are really self-imposed protective mechanisms. Most humans are capable of more strength and more range of motion (ROM) than they currently show, but the nervous system often limits these outputs because of fear. Whether it's due to poor habits or responses to trauma, over time the brain tends to impose "governors" on the body. These governors manifest as the body "shutting down" or inhibiting certain muscles to weaken them, keeping certain areas tight as part of a "guarding" response, or even sending the signal of pain itself as an attempt to limit movement. Using the NEUBIE can help retrain those governors so that the body can start to move more, with less pain, and be able to heal more efficiently.

To understand how the NEUBIE works, it is helpful to start by understanding the issues with traditional electrical stimulation. Virtually every electrical stimulation device on the market (TENS, Russian Stim, Interferential, etc.) uses alternating current (AC). When turned up to a high enough level to affect change in the neuromuscular system, an AC signal causes the body to engage in protective co-contractions. This approach may end up reinforcing the compensatory and dysfunctional movement patterns that impede the body's natural healing processes, contribute to the cycle of chronic pain, and reduce mobility and movement efficiency.

In contrast, the NEUBIE has been engineered to have the opposite effect. It combines two wave forms that allow us to take advantage of the known benefits of direct current (DC) on tissue healing (2-7) and the nervous system (7-10), while eliminating the skin burns that historically accompanied the use of DC. An illustration of the primary waveform is included in Image 1. This precise DC signal is also able to reduce the protective co-contractions, so that the stimulation can be combined with movement during the re-education process. This combination allows us to harness the potential of electrical stimulation to positively affect reflex patterns (11-14), brain activity (15-17), muscle output (19-20), and pain (21-23).

Another important aspect of being able to move during treatment is that you get to introduce safe, eccentric contractions much earlier on in the rehabilitation process. Research has shown that eccentric contractions are so important for teaching the body to decelerate safely and, during the healing process after an injury, to regrow tissue along the appropriate lines of force. This effect on tissue healing leads to better quality tissue and less scar tissue (24-26).

We have also observed an important difference in the effect on the autonomic nervous system. Traditional AC devices will often elicit a stress response. They can increase sympathetic nervous system (SNS) tone and decrease heart rate variability (HRV). In contrast, we have seen that using NEUBIE technology typically promotes higher parasympathetic nervous system (PNS) tone and leads to greater HRV (1), which puts the body into a state in which it can recover more effectively.

Neurophysiology & The NEUBIE Device (cont.)

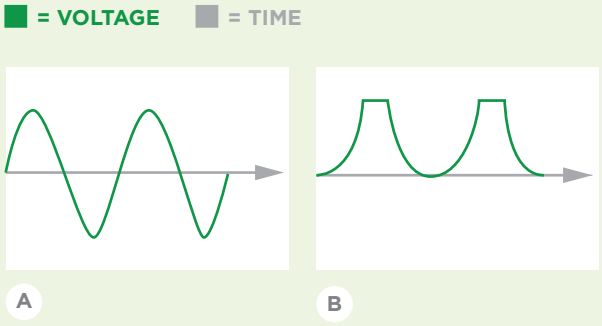

IMAGE 1

An illustration of the different types of current. Image (A) shows a traditional AC signal, approximately sinusoidal. Image (B) shows one of the two NEUBIE® waveforms, which is a pulsed DC waveform. It has an exponential rise and fall, so that it most closely matches the way charges transfer naturally across neurological membranes. This is part of how it harmonizes with the human body and is able to minimize the protective responses that usually cause the body to fight against stimulation.

Using the NEUBIE for Neuromuscular Re-Education

These unique effects allow us to use NEUBIE in novel ways. As part of the NeuFit Treatment System, for example, the device can be used to map the body to identify areas where the body is governing or limiting ROM, speed of movement, and muscle output. These parts of the body show up as "hot spots," which manifest as areas that react more strongly to the NEUBIE current and typically have some subjective discomfort. Here's how it works:

Mapping the Body

In the mapping process, one electrode is stationary while the other is scanned around on the body. The process is illustrated in Image 2A. Wherever this scanning electrode is on the body, it will stimulate all of the electrically-sensitive tissue in its vicinity. It could stimulate the sensory receptors that report information on movement, position, temperature, chemical state, vibration, etc. It may also stimulate some of the motor units and cause contraction, but the contractions will be much less than with traditional, AC stimulation. We can, therefore, focus more on the sensory, or afferent, side of the nervous system.

Because the muscle spindle (MS) and golgi tendon organ (GTO) are the fastest afferent pathways, signals on these pathways will be the first to be acted upon by the central nervous system (CNS). These pathways lead to two different types of "governors" on movement, excessive tension and deficient activation. We believe that these pathways play a major role in this process of neuromuscular re-education, so it's worth taking a moment to understand each of them.

IMAGE 2A
Setting up for the mapping process. Here, one electrode is grounded on the lower back and the other is being scanned around the upper body.

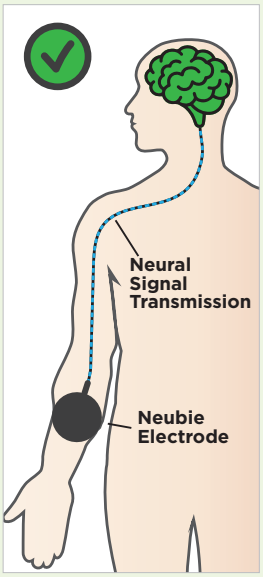

IMAGE 2B
When scanning over a healthy area, the afferent signals are not threatening to the brain and there is no need to protect.

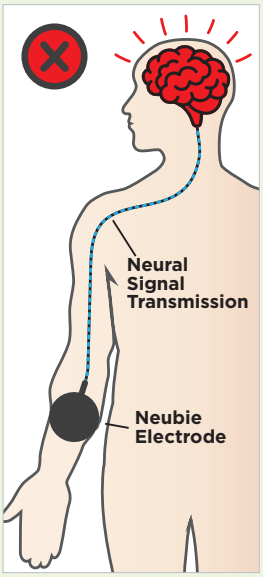

IMAGE 2C
When scanning over a dysfunctional, hypersensitive, or otherwise compromised area of the body, the signal is perceived as threatening and the CNS generates a protective response that may include a pain signal.

Muscle Spindles & Excessive Tension

If the body is carrying excessive tension in muscles, not allowing them to eccentrically elongate as they should, that tension will be modulated via the MS pathway. The MS pathway constantly monitors muscle length. As soon as that muscle lengthens to the perceived threshold of danger, the stretch reflex kicks in to contract the muscle. This is a protective mechanism designed to prevent the muscle from straining or tearing. It is useful, but often it is set too conservatively and causes excessive, inappropriate muscle tension.

Golgi Tendon Organs & Deficient Activation

If muscles are being under-activated, they will not be as available to turn on and do their jobs of protecting the body and creating movement. Activation of a muscle creates tension, and it is this tension that is monitored in the GTO. The GTO, in turn, reports to the CNS. Whenever that tension reaches its threshold, the CNS inhibits that muscle to prevent it from contracting too hard and tearing itself off the bone. Of course this is important, but it is also often set way too conservatively. In this state, the GTO pathway leads to the inappropriate underutilization of muscles.

As the scanning electrode is moved around a client's body to stimulating sensory pathways, these are two of the most important pathways that will be impacted. And based on how the body responds, we can gain some insight into whether either of these governors is present.

When stimulating tissues and muscles that are functioning well, the CNS receives signals from that area of the body and does not perceive any problems as in Image 2B. With no perception of threat or danger, the CNS does not have any need to send a protective signal or trigger an output of pain. Stimulation in these areas, therefore, typically feels pleasant.

When stimulating tissues in the vicinity of dysfunction, the signal being sent from one of these areas will likely be perceived by the CNS as threatening. If the stimulation is given in an area with excessive tension, then the signal will trigger the same MS mechanism described above. The body responds with a strong "Contract!" signal and the sensation will likely feel much more intense to the client. Since there is often an additional quality of subjective discomfort associated with this reaction, we infer that there is more happening than just a contraction or the stimulation of a motor point. Because discomfort is associated with the reaction, we conclude that the process is exposing a more deeply-rooted guarding reaction in the CNS, which is why the reaction includes an element of subjective discomfort. This is the response of Image 2C.

Likewise, if the area being stimulated is one of deficient activation, there can also be a more intense reaction. If the CNS receives a signal that more load is on a muscle than it believes is safe, the CNS will identify that load as a threat. In response to the threat, the CNS creates numerous protective responses in an attempt to protect the area. These responses can include compensatory contractions, and even a signal of discomfort or pain. Similarly, this reaction leads us to conclude that the CNS perceives this added load as a threat and must therefore be inhibiting or limiting output of that area of the body.

In addition to identifying dysfunctions like inhibition or excessive tension, we believe that local hypersensitivity could also cause the body to react more strongly in certain areas. So if there is local

inflammation, increased C-fiber activity, or structural distortions present in the tissues, these factors could all lead to the experience of a “hot spot.” The good news is that we do not necessarily have to make this distinction, as all hot spots can be addressed the same way.

Practitioners and clients both tend to appreciate this process because of the speed and precision with which they are able to identify the highest priority treatment areas. This information can then be used to guide therapists and other professionals as they use the NEUBIE in the Re-Education process.

NeuFit Treatment Process & Outcomes

As the next step in the NeuFit Treatment System, those spots that were found during Mapping are now used for treatment. Rather than being stimulated passively like traditional e-stim, NEUBIE stimulation is combined with various movement protocols as part of an active treatment process.

Typically, treatment is initiated by turning the current up to a level at which it feels uncomfortable to the patient and elicits the same protective or compensatory responses that were found in the Mapping process. As the patient learns to move through the current, he or she usually sees their compensatory movements and feelings of discomfort diminish. That change is typically accompanied by the feeling that they can handle more current.

In this process, the patient's nervous system learns to accept greater levels of afferent input with less perceived threat and protective responses. When power levels that previously caused pain or intense protective responses can be accepted more easily, this indicates a shift in the patient's processing of the underlying neurological signals. This shift is an example of adaptation.

After just their first few minutes of this Re-Education process, most clients experience tangible improvements in function, like greater ROM and strength output, less pain, and enhanced quality of movement with a sense of ease. The improvements occur both within a session, and cumulatively over multiple sessions.

Because they often occur in just a few minutes, the immediate changes are different from those that usually result from training or rehabilitation. With strength training, for example, the body typically increases strength by adding new muscle tissue over time. That additional muscle tissue improves the ability to generate force. Yet in a NeuFit Treatment Session, clients often improve strength in a matter of a few minutes. It's an impossibly short amount of time for the body to build new muscle, so the changes are obviously functional rather than structural.

In the case of intra-session strength improvements, the body is simply learning to activate more of the muscle that was already there, lying dormant. The tissues that were being actively inhibited are now dis-inhibited, so that they can work at a level closer to their current capacity

A similar dynamic occurs with improvements in ROM. In one session, for example, the body does not have enough time to remodel its tissues to gain more length in those physical structures. Rather, it is reducing the amount of protective tension and learning to relax those tissues so the body can move through greater ROM.

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Results & Sample Case Studies

The effects of the NeuFit Treatment System have been demonstrated so far with tens of thousands of clients and in numerous case studies. Many case studies show reductions in recovery time of 50% or more when compared to traditional methods for patients recovering from a wide range of injuries and surgeries. This process has also accelerated progress in fitness and athletic performance. It has been used with athletes and non-athletes alike, and in children as young as 4 years and adults as old as 95 years.

Here we will cover several exemplary case studies to demonstrate the ways NEUBIE has been used in practice and the types of results this work has been able to achieve.

Acute Injuries

A common example of an acute injury, torn muscles usually require 8-12 weeks to recover. Part of why it takes so long to recover is that the body actually impedes its own healing process. After the trauma of a muscle tear, the body contracts the tissues in the vicinity of the injury. Though this contraction is protective if that tissue is attacked, it also creates tension that restricts blood flow and nutrient delivery into the area. The raw materials that are so necessary for healing are being blocked from getting to the place where they're needed. In this state, healing takes longer.

The NeuFit Treatment System allows practitioners to locate those post-traumatic, protective patterns of tension and start to re-educate those tissues to restore more optimal tone. In other words, it reduces spasms and 'releases' the 'tight' tissues. After releasing some of that tension, the body can send more resources to the damaged area so it can heal faster. Many patients dealing with torn muscles have seen that this can lead to a profound reduction in healing time. For example, the gentleman shown in Image 3 was able to recover weeks ahead of schedule. Instead of 8+ weeks, he was back to bench pressing 95% of his 1-rep max just 10 days after tearing his pec muscle.

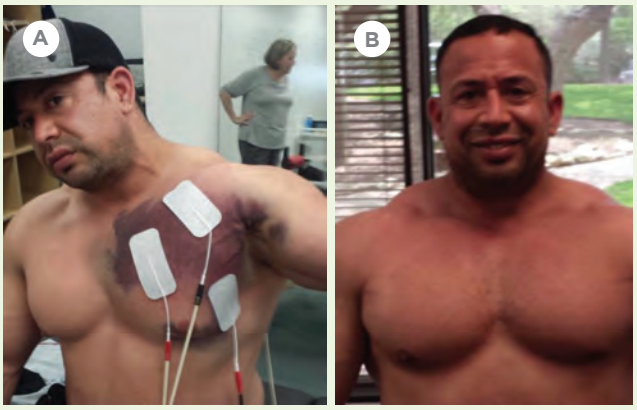

IMAGE 3
Ivan M., a local competitive bodybuilder and power-lifter, tore his pec muscle. You can see the ecchymosis and bruising in (a), which shows his first treatment 2 days after the injury happened. He received 5 treatments, and by the 10th day had the appearance of (b), was bench pressing 95% of his 1-rep max, and had no pain or restrictions in ROM..

Post-Surgery Recovery

Just like after acute injuries, the body has a strong protective response to the trauma of surgery. The body responds to this trauma in the same ways described so far: it shuts down tissues in some areas and creates excessive tension in others.

After surgery, the NeuFit Treatment Process can re-educate those protective neurological patterns to restore function much faster than traditional methods. For example, Image 4 shows a local business owner who had his first treatment after surgery to repair his shoulder labrum.
This rehab process - like the recovery from many surgeries - is typically marked by a slow recovery of ROM.

In this case, the patient was able to make weeks' worth of progress in his first NeuFit Session. Why? Not because the joint capsule changed or he got enough load on his tissues to cause them to restructure. He simply changed the neurological signal to those tissues, so that they could move more. As shown in Image 4, this process allowed him to regain about 30° in just his first session. After this session he was already weeks ahead of schedule, and this rate of progress allowed him to resume his gym workouts almost 2 months ahead of schedule.

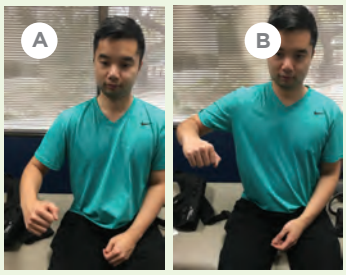

IMAGE 4
Thanh P. had surgery to repair the labrum of his right shoulder, and came to NeuFit for his first treatment session 5 days after surgery. Starting with the abduction ROM shown in (a), he was told to expect to gain 10-15° per week doing traditional PT. With NeuFit, however, he saw an increase of over 30° in just his first session.

Chronic Pain

Though pain is still a mysterious phenomenon, we have learned many things about it in the past few decades. One of the biggest facts about pain is that it is an active output signal of the brain. The brain actively creates this pain signal in an attempt to cause that person to change behavior. In other words, if your arm hurts, it's your brain's way of saying "don't move your arm."

We also know that pain is just a response to threat. It does not necessarily mean any damage is present. Chronic Pain often follows inappropriate rehabilitation from previous traumas, and can linger long after the original injury has healed. It can also be idiopathic in nature.

One commonality is the guarding response by the body, which is a protection mechanism like the ones we've been describing. This guarding can keep pain habituated or "locked in," and contributes to the difficulty in breaking through long-standing pain.

Image 5 shows examples of clients who had chronic pain for at least 1 year, and the ranges of motion that became limited during that time. The second image in each pair illustrates the changes in pain-free ROM after just one session with the NEUBIE. You can see how their first NeuFit Session helped these people increase their ROM, and subsequent sessions allowed them to continue their progress and get back to their target levels.

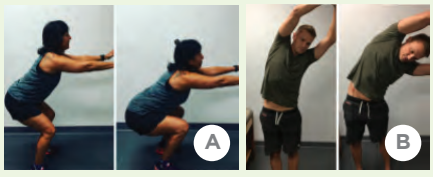

IMAGE 5
These images show the changes in pain-free range of motion experienced in one NEUBIE® session by clients who had at least one year of chronic pain. The client in (A) experienced tremendous relief from her knee pain, and the clients in (B) and (C) experienced relief from back pain.

CONCLUSIONS

We believe that the NeuFit Treatment System and NEUBIE technology offer a breakthrough in the rehabilitation of injuries and chronic pain. This approach has already enabled thousands of people to achieve results faster or to a greater degree than they thought was possible.

In this white paper, we shared our current hypotheses based on over a decade of experience. As we complete more rigorous scientific studies, we are excited to quantify the results that our practitioners are seeing and also being able to understand more clearly the underlying mechanisms of action. We look forward to sharing these with you, and please check www.neu.fit/research for the most recent updates.

In the mean time, we hope that the takeaway message of this white paper is ultimately an empowering one: most of us humans already have higher levels of function and greater healing ability. And with the right strategies, it is possible to tap into those abilities to improve treatment outcomes.

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