# Low-Volt Pulsed Micro-Amp Stimulation

## Part I

*"Weak stimuli increase physiologic activity and very strong stimuli inhibit or abolish activity.*
*-Amdt-Schulz law (Dorland 1985)*

by Robert I. Picker, MD

Could the theory of Rudolf Arndt (1835-1900) and Hugo Schulz (1853-1932) apply to modem clinical electrotherapy? This theory seems to address the assumption that microamperage (uA) currents are better at enhancing cellular physiology processes than are currents of higher amplitude. This article is not intended to prove the case for microcurrent stimulation. The validation needed to establish the clinical efficacy for micro-amperage currents will be left for research to accomplish via studies that are currently underway at several U.S. universities. These studies are designed with strict controls that will qualify them for publication in refereed journals. Such studies may well take one to two years or more for publication. Meanwhile, it is the purpose of this article to present an overview of information related to bioelectricity and micro-amp stimulation.

Low-volt pulsed micro-amp stimulation is also known by the acronym MENS (microcurrent electrical neuromuscular stimulation), although the acronym does not reflect the fact that the current density is not sufficient to excite motor nerves. It has a well-known first cousin, high-volt pulsed current, a widely used and well-accepted modality. The similarity is that both modalities can deliver total current output in the micro-amp range. It takes 1,000 micro-amps (1,000,uA) to equal one milIiamp (1 mA). Any electrotherapeutic device that delivers less than 1,000 uA is by definition a micro-amp device. The differences do, however, merit consideration.

High-volt devices use a fixed voltage between 150 and 500 V. On the other hand, the voltage of the new low-volt micro-amp stimulators is variable and is automatically adjusted moment to moment based on an internalized circuit-meter monitoring the percentage of conductivity through the tissue being treated. This impedance-sensitive voltage adaptability is an essential feature of any constant current generator. Constant current technology is designed to use only as much voltage as necessary up to a designated maximum peak to achieve the constant current (amperage) selected by the operator. As an area of increased resistance is encountered, the voltage increases commensurately to maintain the desired current flow (based on Ohm's law). Thus the two microamp stimulation devices in question have different solutions to achieving tissue penetration with small currents. High-volt therapy ensures penetration by driving the current with a fixed voltage in a generous quantity, although the voltage is not adaptable to the specific tissue resistance encountered. The high-volt stimulator is not constant current because the current (amperage) is reduced by increased tissue impedance. Low volt micro-amp stimulators that incorporate constant current technology, on the other hand, can overcome tissue resistance utilizing much less voltage (typically 10-60 V) because they are sensitive to the impedance properties of the tissues being treated.

Another related difference between the two types of micro-amp stimulators is the duration and intensity of the pulses. High-volt stimulation is characterized by brief pulses, 5 to 200 microseconds in duration, of sufficiently high intensity to create excitation of sensory and motor nerves. In contrast, low-volt micro-amp stimulation is spread over an extremely long pulse duration. In fact, many low-volt micro-amp stimulators utilize a 50-percent duty cycle, meaning that no matter what frequency (pulses per second) is selected, the current is on for 50 percent of the time and off for 50 percent of the time. Thus the pulse duration is exactly equal to the interpulse rest interval. A better understanding of how these two devices differ in their delivery of micro-amp currents can be ascertained by examining the comparison chart.

As the reader can surmise from the chart, by modifying the parameters of both instruments it is possible to create fairly comparable total current output. In comparison with traditional low-volt milli-amperage muscle stimulation devices, the total current output of high-volt stimulation is very low (ie, less than 1.5 mA). The total current charge per pulse with high-volt stimulation, however, is typically squeezed into only 100 microseconds or less (.01 percent of the total time period), whereas the total current charge of the new low-volt micro-amp 50 percent duty cycle stimulator is spread over a full half second (50 percent of the total time period). A recent textbook on high-volt stimulation states, "High peak intensity is one of the more recognizable characteristics of high voltage stimulators" (Alon and DeDomenico 1987). However, by markedly reducing the peak current of the micro-amp current delivery so that it is no longer sensory but rather is subsensory in nature, some proponents of micro-amp stimulation believe that the body may more comfortably and perhaps more efficiently accept this electrical energy into its own electrophysiological healing systems.

An analogy seems worth considering: When listening to a voice, a single, sharp, piercing shout might equate in terms of total decibels per unit of time to a very long, soft whisper. Yet do we perceive and receive it the same, despite this radical difference in peak intensity? The aptness of such an analogy is certainly open to question and will not be satisfactorily answered until more research is conducted on this entire topic. It is hoped that present and future studies will test the following hypothesis: that micro-amp currents more closely approximate the naturally occurring bioelectric currents in the body, and therefore more effectively augment the body's tissue healing and repair.

What do researchers say about the healing ability of micro-amp stimulation? Neil Speilholz, Phd, PT, research associate professor of rehabilitation medicine at New York University Medical Center, summarized the results of studies on tendon repair in experimental animals conducted at his laboratory. "It's interesting to note in this study,'" he says, "that the group with the 10 times higher current (400 uA) certainly didn't have stronger tendons. In fact, they were actually not as strong as the 40 uA group. My gut feeling is that the higher you go, the less beneficial the effect ... I wouldn't be surprised to find that milli-amps actually turn out to be counterproductive" (Spielholz 1988, personal communication).

Several studies have documented the enhancing effects of micro-amps on wound healing (Carley and Wainapel 1985; Assimacopoulos 1968; Wolcott et al 1969; Gault and Gatens 1976; Barron et al 1985; Alvarez et al 1983; Nessler and Mass 1985; Stanish 1984; Kloth and Feedar 1988). Other studies have demonstrated the positive effect of micro-currents on tendon repair in animal models. Nessler and Mass's (1985) study of microelectrically stimulated tendons demonstrated 91-percent higher proline uptake than control tendons after 7 days of stimulation, while hydroxyproline activity was increased by 255 percent versus controls. Upon histological examination, Nessler and Mass confirmed that tenoblastic repair was enhanced by micro-amp stimulation.

William Stanish, MD, Physician for the Canadian Olympic team, found that implanted electrodes delivering 10 to 20 uA of current hastened recovery of injured athletes suffering from ruptured ligaments and tendons. Using microcurrent stimulation, Stanish shortened the normal 18-month recovery period to only 6 months (Stanish 1984).

Micro-amp stimulation has also been called "biostimulation" or "bioelectric therapy" because of its ability to stimulate cellular physiology and growth. In a study with important implications for micro-current electrotherapy, Cheng et al (1982) studied the effects of electric currents of various intensities on three variables critical to the healing process: adenosine triphosphate (AT?) generation, protein synthesis, and membrane transport. At 500 uA, ATP generation in rat skin increased by almost 500 percent, which the authors concluded was a "remarkable increase." What happened with a more intense stimulation? Between 1,000 and 5,000 uA (1-5 mA), ATP generation nose-dived, and at 5,000 uA it dropped below baseline control levels.

A very similar picture emerged with amino acid transport and protein synthesis. Amino acid transport was increased by 30 to 40 percent above control levels using 100 to 500 uA. As the current was increased, these biostimulatory effects were reversed, with currents exceeding 1,000 uA reducing a-aminoisobutyric acid uptake by 20 to 73 percent and inhibiting protein synthesis by as much as 50 percent.

Is this study an electrophysiological demonstration of the Amdt-Schulz law? The results give the scientifically oriented clinician pause for thought. Have we been electrically "shouting" at the body with milli-amps when we would be better advised to "whisper" to it with micro-current stimulation more consistent with its own natural bioelectric healing systems?

**The body electric**

One of the most noted researchers in the field of bioelectricity is Robert 0. Becker, MD. Becker's book, *The Body Electric,* is receiving considerable attention by both the lay public and health professionals. Becker theorized that a naturally occurring "current of injury" is measurable in the body and hypothesized that this current was conducted via the Schwann and glial cell sheaths surrounding neurons to an area of injury, thus triggering tissue repair and regeneration. Recent research into injury currents has surprisingly distant roots, going back to the measurements of wound potentials and injury currents made by Dubois-Reymond during the Civil War in 1860. Illingsworth and Barker (1980) some 120 years later measured the current generated by the amputated stump of a child's fingertip. These stump currents were found to be micro-currents within the 10 to 30 uA/CM2 range. Their findings were repeated by several researchers (Borgens et al 1979; Barker, Jaffe, and Vanable 1982; Borgens et al 1980), although only recently have we been able to understand the implications of these findings and to therapeutically apply these micro-currents.

Becker has also found that the human body is normally polarized positively along the central spinal axis and negatively peripherally. The polarity gradient set up by the voltage potentials differential is the electromotive force driving the bioelectric circuits in the body and the current of injury. Based on the findings of Becker and Borgens, some proponents of micro-amp currents advocate the use of the positive pole proximally, often at the origin of the spinal nerve root, and the negative pole distally. Indeed, enhancing naturally occurring bioelectric stump currents by applying micro-amp stimulation in the proper direction of polarity does appear to enhance the healing process, whereas regeneration can be inhibited by orienting the current in the reverse direction (Vanable et al 1983).

**The bioelectric battery**

In 1983, Swedish radiologist Bjorn Nordenstrom, MD, published a 358-page book covering more than 20 years of research, entitled *Biologically Closed Electric Circuits: Clinical, Experimental and Theoretical Evidence for* an *Additional Circulatory System.* In this book, Nordenstrom outlines a theory, based on his research, of how the body turns on it's bioelectric circuits to accomlish healing. Nordenstrom proposed that bioelectricity is conducted through the microcapillary circulatory system in the body. When injury occurs (or with normal muscle use), a positive charge builds up in the area and sets up the voltage potentials difference, which serves as a "bioelectric battery" waiting for the switch to be turned on. This bioelectricity is then switched on by a change in the electrical insulation properties of the capillary membranes. As the membranes become less permeable to the flow of ions and more electrically insulated, the flow of intrinsic bioelectricity is forced to take the path of least resistance, which is through the bloodstream. Thus the bioelectric switch is closed, and injury currents are directed to the site of pathology through the bloodstream. This explanation of injury currents is compatible with Becker's work and offers an alternative explanation. Both Becker and Nordenstrom believe that unraveling the secrets of bioelectricity will allow medical professionals to harness this power for therapeutic use.

**Polarity selection**

Micro-current electrical stimulation has been used as an effective treatment for nonunion bone fractures for several years (Brighton 1981; Friedenberg 1966; Friedenberg 1971; Yasuda 1953). The cathodal (negative) current has been shown to be successful in stimulating bone deposition and repair if applied at the fracture site as an indwelling electrode. Consistent with this empirically successful clinical approach to stimulating bone repair is the observation that injury to bone produces negative voltage-potential gradients in the area of injury relative to the undamaged bone. Short-lived potential differences are also induced by stressing the bone with a mechanical load. Areas of compressive stress are electronegative relative to the unloaded portion of the long bone (Fukada and Yasuda 1957). Preferential binding of positive or negative ions within fluid channels in the bone as it is stressed creates naturally occurring "piezoelectric" streaming potentials. It appears as though negative currents of an intrinsic (piezoelectric) or extrinsic source can stimulate bone growth, repair, and remodeling.

To date, the best research evidence in favor of micro-amp stimulation supports negative micro-currents as being more effective with bone and nerve repair and regeneration, while anodal (positive) micro-amp stimulation appears more effective in healing skin lesions. Contradictions appear in the literature regarding optimal polarity with tendon injuries (Owoeye, Speilholz et al 1987; Stanish 1988). In light of these clinical considerations, a maximally effective microcurrent instrument should probably include the capability of both anodal and cathodal monophasic stimulation, as well as "Tsunami" or sine wave pulse trains that switch polarities every two to four seconds (Wing 1979) for a more general treatment or when optimal therapeutic polarity is in doubt. As we learn more about the specific effects of positive and negative polarities, we will be able to more accurately fine-tune micro-current therapy to enhance its clinical efficacy and healing potential.

Enthusiasm for low-volt pulsed micro-amp stimulation is growing, and more research in this intriguing area will surely be welcomed by the health professions. Micro-current stimulation may prove to be an advance in our ability to assist the body with its own bioelectric healing. If so, it will most assuredly find a place in the electrotherapeutic arsenal of most therapists

*Part two of this article will appear in the MaylJune issue of* Clinical Management. Clinical *applications of low -volt pulsed microamp therapy will be* examined.

**Note:**

The HealthTouch output is maximum 20 micro-amps, positive, negative or bipolar, square wave and 2, 10 or 100 cycles per minute. Exactly what current research indicates will produce the maximum healing effect in the body.

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# Low-Volt Pulsed Micro-Amp Stimulation

## Part 2

by Robert I. Picker, MD

Part One of this article presented an overview of the current state of knowledge of micro-amp electrical stimulation. It was proposed that subsensory microampere currents of similar amplitude to the body's own inherent biological electricity may augment tissue repair and regeneration. In Part Two, we examine the clinical applications of low-volt pulsed micro-amp electrical stimulation, commonly referred to as MENS (micro-current electrical neuromuscular stimulation).

The subsensory nature of the currents utilized with low-volt micro-amp stimulation often produces some initial skepticism among therapists unfamiliar with it. This skepticism is supplanted by enthusiasm when the clinical efficacy becomes apparent, usually within the first one to three treatment sessions. Although documentation of this modality has not yet appeared in refereed journals, several university studies are currently in progress. There is no shortage of anecdotal and testimonial enthusiasm, including positive feedback from many of the world's top athletes and sports teams. Dr. John OHara, an orthopedic surgeon in Los Angeles, California, and a founding member of the American Orthopedic Society for Sports Medicine, was quoted in an article about MENS in the August 14, 1987, issue of *USA Today:*

I know 15 to 20 skeptical therapists who became converts within one week to 10 days of using the machine. They're almost unanimous in saying it's the best modality they've ever encountered in terms of diminished pain and swelling.

**Cautions and contraindications**

Because the level of electricity used with low-volt micro-current stimulation is infinitesimally small and actually is within the range of the body's own physiological currents, this modality stands out in terms of comfort and safety. Adverse side effects are rare. Infrequently a patient may report lightheadedness during the treatment that usually dissipates immediately upon cessation of stimulation. Any electrical stimulation may cause slight irritation, but irritation is much more infrequent with micro-amp stimulation than with traditional mlli-amperage stimulation.

The Food and Drug Administration (FDA) allows low-volt pulsed micro-amp stimulation to be marketed as a Class 11 device as distinguished from a Class III experimental device. Warnings and precautions apropos to conventional milli-amperage devices are also listed in the micro-current manufacturers' warnings and cautions, although the amperage levels utilized with micro-current devices are far below those of traditional devices. Contraindications include the presence of an electronic demand-type cardiac pacemaker or use on a patient with cancer because of the possibility of stimulating neoplastic cells. The FDA has stated that safety during pregnancy has not yet been established. Other suggested warnings include use on patients with suspected heart problems or epilepsy. Caution is urged with transcerebral application, use over the laryngeal and pharyngeal muscles, transthoracic application over the heart, treatment over the carotid sinus, or treatment over any areas with a tendency to hemorrhage.

**Clinical applications**

Low-volt pulsed micro-amp stimulation has several general indications, including pain, swelling, inflammation, atrophy, and wound healing. The beneficial effects for atrophy are secondary to the pain relief provided, because muscle contractions generally do not occur with micro-amp stimulation.

The immediate electroanalgesia that occurs with subsensory micro-amp stimulation usually within three to five minutes of application is an unsolved puzzle at present. Conventional theories regarding the "gate control" means of achieving pain relief (Melzack and Wall 1965) are of questionable applicability with micro-amp stimulation. Can we close "gates" to pain via micro-amp stimulation (hyperstimulatory electroanalgesia) without any sensory afferents being electrically stimulated? Is it possible to trigger release of endorphins or enkephalins at subsensory levels of micro-amp stimulation? Are we byperpolarizing nociceptors, making them relatively refractory and less irritable? Could we perhaps be facilitating the rapid enzymatic degradation of kinins, the local inflammatory biochemicals? Is micro-amp stimulation able to directly affect local microcirculation to quiet inflammation? Some informal experimentation I have done using micro-amp stimulation and thermography seemed to point towards this latter theory. There certainly is no shortage of challenging questions about micro-amp stimulation awaiting research answers.

Short-term electroanalgesia, although it can facilitate the success of a rehabilitation program, does not seem to be as reflective of the cumulative tissue repair and regeneration process as do the carryover effects noted 24 to 48 hours after micro-amp treatment.

It is worthwhile to look at several parameters of this treatment and how we can adjust them to achieve optimal results for both short-term and long-term results. Immediate analgesic effects are achieved more rapidly by keeping three key parameters; micro-amperage, frequency, and waveslope ramp-time-at the higher end of the spectrum for this modality (ie, 200-600 micro-amps, 30 pps, and sharp ramp-time). The carry-over results to the next treatment 24 to 48 hours later, however, are more pronounced with the lower. settings ie, 10-100 micro-amps, 0.3 pps, and gentle ramp-time [Wallace, Manual, 19881). Is this an indication that the more closely we approximate nature's own subtle bioelectric currents, the closer we will be achieving long-term healing enhancement?

As studies in Part One indicated, endogenous bioelectric currents have been repeatedly found to be in the micro-amp range, variously reported between 4 and 300 uA/cm' (Illingsworth and Barker 1980; Barker, Jaffe, and Vanable 1982; Borgens 1980; Vanable, Hearson, and McGinnis 1983). Clinicians using ultra-low micramp electrotherapy are familiar with the next-day carryover effects, whereby a patient may not notice any immediate analgesia but the next day reports remarkable subjective improvement corroborated by objective examination revealing reduced pain with palpation, diminished swelling, normalization of skin coloration, and improved range of motion. This delayed response seems to indicate that some other mechanism is operating above and beyond a temporary neurochemical mediated analgesic effect.

Other than the previously mentioned contraindications and cautions, low-volt pulsed micro-amp stimulation can be tried on most injuries, especially painful ones, whether they are acute or chronic. An acute injury can be expected to respond more readily than an intractable chronic pain problem to any therapy, including low-volt micro-amp stimulation. A surprising number of patients with chronic pain, however, do respond to this modality. Dramatic results have been seen with cases that are 10 to 20 years old. Practitioners experienced with this modality have learned never to say never in ruling out hope for potential improvement. There is nothing to lose, barring contraindications, by trying low-volt micro-amp stimulation on a patient for three to four treatments to see if a beneficial effect will occur. The frequency of visits should be daily or as often as possible. Adequate frequency of treatments is one key to success with this modality.

Average treatment time with low-volt micro-amp stimulation is 15 to 20 minutes, although this time could double in length for isolated nerve root pain or on large muscles such as the quadratus lumborum (Wallace, Manual, 1988). Roughly half the allotted treatment time is attended using probes and manual therapy; the second half is usually unattended using pads.

An approach to achieve both immediate pain relief and optimal carry-over effects is the following. Start with higher analgesic settings with manual micro-amp therapy and finish with lower parameters, as mentioned above, with pads for maximal carry-over results.

An increasing number of practitioners (Kleven 1988; Wallace, Seminar, 1988) recommend keeping the micro-amp stimulation subsensory, whether using the relatively high or low parameters. Most patients' sensory threshold (where the current is barely felt) is between 200 to 300 ua, although this varies with the current density (surface area) of the method of application and the skin resistance of the individual patient. A point needs to be emphasized: Although we are beginning to develop parameters for ideal utilization of low-volt micro-amp therapy, settings that work on one patient for a certain condition may need modification for another patient with the same condition. Such variability between patients requires that therapists not get too locked into rote formulas for treatment, but use protocols only as guidelines allowing for individual modification.

Most therapists agree that low volt micro-amp stimulation is the most versatile and creative modality they have used. The permutations and combinations of ways to use the various methods of current delivery challenge the therapist's flexibility, imagination, and clinical skills. Some of these methods and guidelines are outlined below.

1. Point stimulation

Utilizing manual probes is usually the first stage of treatment. Probes can either be moistened cotton swabs held in a hollow probe tip or solid cylindrical probes. The solid cylindrical probes can be used as a roller massager with conductive gel or lotion. There are several basic techniques for point stimulation.

*High conductance points* Various points familiar to therapists experienced in traditional electrical stimulation may be located and stimulated. Such points include motor points, acupuncture points, and trigger points (Mannheimer 1980; Travell 1983). These points may be located with a galvanic skin resistance feedback meter built into the stimulators (the 'feedback' mode) or by monitoring the percentage of conductivity during stimulation if the instrument has that capability. These points can also be located by palpation delivered simultaneously with micro-amp stimulation delivered manually. At maximal current intensity, the operator can locate motor points by noting which points produce sensation for both patient and therapists Once these points are located, the current can be turned down to subsensory levels.

According to Dr. Robert Becker (Becker 1985), acupuncture points may be neurophysiological amplifiers in a Schwann cell and glial cell direct current bioelectric system throughout the body. Electro-acupuncture stimulation using subsensory micro-amp currents may be a more appropriate therapeutic approach than the temporary sensory hyper-stimulator neurological overload ('gating) of traditional milli-ainpere point stimulation.

*'Swirl the dragon"*

This traditional acupuncture technique involves using both probes, moving them around the circumference of the area of pain, circling around it slowly, and sending the current through the injured tissue sequentially from many different angles. The results may be either immediate or delayed.

Golgi tendon organ *(GTO) technique*

Probes are placed simultaneously on the origin and insertion of a muscle, which is then stimulated for 5 to 20 seconds. Manual pressure with the probes can be simultaneously applied to attempt to either lengthen or shorten the muscle. This method sends the current parallel to the alignment of the muscle fibers probe to stimulate either the muscle motor point or the musculotendinous junction.

Enhancement of muscle *reeducation (EMR) technique* This method is not classical muscle reeducation, since micro-amp stimulation does not generally trigger muscle contractions. The theory behind this technique is that it changes the bioelectric voltage potentials across muscle cell membranes, allowing for more efficient membrane transport and metabolic processes; thus delayed carry-over effects are noted several hours after the treatment.

The EMR technique involves working the two point probes perpendicular to the alignment of the muscle fibers. With the muscle squeezed between the two probes, it is stimulated for five seconds.

The probes are then moved onehalf inch farther down the muscle for another five-second stimulation until the entire muscle has been treated in this manner from one end to the other The EM technique, although slower than the GTO method, appears to produce more effective pain relief than the GTO. method (Wallace, Seminar, 1988).

**2. Electromassage**

This can be delivered several different ways, with either a metallic cylindrical massaging probe or a hands-on method sending current through the hands and fingers of the therapist. The latter method is subsensory for both patient and therapist and often is favored by therapists who prefer using various hands-on methods including friction massage, myofascial release, acupressure massage, and other manual techniques. Manual techniques may be enhanced by using a hand electrified with micro-amp current and can be accomplished -by putting one conductive pad on the patient and one on the back of the therapist's hand or forearm while doing the techniques. This method is used by therapists who do not ordinarily emphasize electrotherapy in their practice. With this approach, both can be done simultaneously.

The creative therapist may also place the operator's dispersive pad on an area of his or her body where he or she may be suffering from overuse inflammation, such as on a wrist or elbow. Many therapists have reported that their own problems have benefited in this manner while they are simultaneously helping their patients.

**3. Unattended treatment with pads:**

A major portion of the treatment time with low-volt micro- amp stimulation can be spent with appropriate pad placements typical of TENS treatments, specifically on motor points, trigger points, and acupuncture points (Mannheimer 1980). On a more sophisticated double-channel device, it is possible to deliver two independent, intersecting currents penetrating through a single area, whether at the same or different frequencies.

**4. Combination techniques:**

Therapists can use a two-handed technique with both independent channels simultaneously to deliver intersecting micro-amp currents via electromassage.

The imaginative therapist can manually direct these intersecting currents into a designated target area of the body. Current will run from the therapists fingers to the dispersive pads, although the current will take the path of least resistance through the treated tissues, tending to avoid fat and bone. For this reason, maximum current density should be focused directly on top of and through the area needing treatment for most of the treatment time.

Using various combinations of techniques, a therapist can change the method of current delivery every few minutes, with repeated re-assessment of pain via Palpation and range-of-motion evaluation. Because of the multitude of options available and the versatility of this modality, especially if it has two channels, the therapist is best advised not to continue with a single approach or method if results are not apparent within five minutes. The exception to this rule is with large muscle groups or nerve root pain as discussed above. Some pain relief, however, usually will occur immediately. Rapid re-assessment of the patient after each method is the key in directing the therapist to the most effective techniques and current parameters for that patient. Some therapists purposely delay laying a patient down (pain level permitting) until key points have been stimulated in functional positioning (standing or sitting) for easier reassessment every 15 to 30 seconds (Stragier 1987).

In addition to the electromassage technique mentioned above, the following combined methods have been used.

A. One probe is held on either the origin or insertion of the muscle while the roller probe massages the belly of the muscle. The roller probe can also be held in the hand while the fingers do the massaging

B. Two to four bipolar pads can be applied in an unattended manner while point probes are simultaneously used manually. Two different body areas can be treated at the same time using this method, or all the above (four pads plus two point-stim probes) can be used simultaneously on a single area.

C. One or two pads (different channels but the name polarity) can be immersed in water on part of an extremity, while the dispersive pad(s) of the opposite polarity are outside the water on part of the same extremity.

D. Varying polarities: The most advanced low-volt micro-amp devices provide either fixed monophasic polarities or polarities that reverse at regular intervals. Although debated in the literature (Owoeye, Spielholz et al 1987; Stanish 1988), many users believe that the positive pole has a more anti-inflammatory physiological effect, while the negative pole has a vasodilative effect, which can be helpful with muscle spasm and contracted scar tissue. The positive pole is used more often with acute injuries and the negative pole with chronic neuromuscular symptoms.

E. Micro-amp stimulation with movement: A therapy technique that has produced very favorable results combines low-volt micro-amp stimulation with long, slow stretching. The electrical stimulation is kept at subsensory levels and is used simultaneously with both active and passive stretching exercises. This method has produced excellent results on some of the world's top athletes who have endorsed this modality.

F. Muscle assessment: One of the most interesting ways to use low-volt micro-amp stimulation is not just as a treatment but also as an assessment tool (Wallace, Manual, 1988). One muscle at a time can be stimulated to see if it is contributing to the patient's problems from a biomechanical aspect. A brief stimulation of 15 seconds with subsensory micro-amp current can produce revealing answers to questions regarding the underlying muscular causes of some acute and chronic conditions (see case history). Potentially involved muscles can be methodically stimulated every 15 seconds, focusing on origin and insertion, and then rapidly reassessed by appropriate range of-motion evaluation. Both agonist and antagonist muscles should be tested, as well as key muscles from head to toe that may be throwing the body out of healthy biomechanical balance. It may be surprising, for example, to find that relieving a hypercontracted pectoralis minor, abdominals, or iliopsoas, or even a muscle as distant as the sartorius, can help relieve chronic neck pain in less than a minute by correcting forward head posture (Stragier 1987). After such, the therapist can then focus stretching exercises, manual therapy, and further micro-amp stimulation on areas revealed to be the keys to the problem.

This micro-amp modality calls upon all the sophisticated skills of a physical therapist, including a thorough knowledge of musculoskeletal anatomy and biomechanics. These devices are not well-served by being promoted as a panacea, but rather are tools that challenge us to properly evaluate medical conditions and treat them appropriately as part of a comprehensive treatment program. Practitioners who have taken advanced training seminars on low-volt micro-amp stimulation usually come away with great regard for how much more there is to be learned about this modality.

Dat**a on clinical results:**

Lynn Wallace has gathered statistics on the response rates of various types of injuries to micro-amp therapy. Table 1 summarizes the results for 450 cases (more recently expanded to 818 cases). Fifty percent of these cases were acute, 30 percent were subacute, and 20 percent were chronic. Thirteen different locations of painful injuries were treated with micro-amp stimulation (Wallace, Manual, 1988). Low-volt pulsed micro-amp stimulation was the only modality utilized. Pain levels were assessed with an analogue pain scale before and after each treatment.

Approximately 50 percent of the immediate analgesia was found to wear off by the beginning of the subsequent treatment if it was performed soon enough (within 24 to 48 hours). Net carry-over improvement in subjective pain relief was approximately 25 to 30 percent per treatment.

No control group was used in this pilot study conducted in a private-practice setting. As mentioned previously, controlled studies currently in progress at several universities will test the effectiveness of low-volt pulsed micro-amp stimulation.

**Case history:**

A 31-year-old male office worker presented with a history of eight months of lumbar pain radiating down the right lower extremity (Wallace, Manual, 1988). After gradual onset, these symptoms became progressively worse, especially after activities such as swimming. The patient originally sought help from primary care physician, who proscribed muscle relaxants and -pain medication that were of minimal help. The patient was referred to a neurosurgeon. The results of diagnostic tests, including x-rays, a CAT scan, and a discogram, were negative. The patient was diagnosed as suffering from discogenic disease. Anti-inflammatory medication was given. Surgery was considered. The patient asked the neurosurgeon for a referral to physical therapy, and an assessment was done at the therapist's office. The examination revealed full lumbar flexion with no pain noted with repetitive flexion testing both standing and lying down. A slight loss of lumbar extension was noted, as well as mild strength deficiencies. Both hamstrings were tight, as were both hip flexors, more so on the right than on the left. Lumbar and radiating extremity symptoms increased with resistance testing of the right iliopsoas.

Micro-amp stimulation was then used diagnostically to assess the problem. Fifteen seconds of treatment of the right iliopsoas, origin to insertion, produced an instant reduction of 50 percent of the patient's pain in the lumbar region and elimination of pain and numbness in the leg. This response confirmed the suspicion that the symptoms were related to an extremely tight ihopsoas.

The patient immediately gained confidence in the assessment and complied with a home program emphasizing gentle, long, slow iliopsoas stretching. The patient's symptoms were resolved in two weeks. A six-month follow-up examination revealed no relapses.

This case illustrates how micro-amp stimulation can be used both diagnostically and therapeutically and how it can play a key role in the total picture of physical therapy, complementing a therapist's diagnostic skills and enhancing the accuracy of the assessment while offering a powerful treatment tool to correct the problem.

By necessity, this article can only scratch the surface of the potential clinical uses for low-volt pulsed micro-amp stimulation. Interested health professions will surely anticipate publication of the results of the studies currently being conducted on this modality. Low-volt pulsed micro-amp stimulation may well become a standard tool in the modality arsenal of most therapists in the years to come.

Table 1

| Category | # of cases | % 1st treatment response | # treatments until pain free |
|---|---|---|---|
| Forefoot | 48 | 94 | 4.3 |
| Rearfoot | 24 | 83 | 4.5 |
| Ankle | 32 | 100 | 4.0 |
| Posterior Leg | 17 | 94 | 3.2 |
| Shin splints | 19 | 100 | 3.5 |
| Hamstring | 20 | 100 | 3.5 |
| Thigh (anterior) | 16 | 100 | 3.2 |
| Spine, lumbar, nonradiating | 75 | 99 | 3.7 |
| Spine, lumber, radiating | 56 | 95 | 4.5 |
| Spine, cervical, nonradiating | 19 | 100 | 3.2 |
| Spine, cervical, radiating | 32 | 97 | 4.5 |
| Shoulder | 57 | 98 | 5.9 |
| Elbow | 34 | 94 | 3.4 |

**Note:** The HealthTouch uses the direct stimulation of trigger and tender points based on traditional acupuncture protocols. This also allows treating conditions that are non-painful or non musculoskeletal in nature.

*Robert Becker, MD, is the director of research and education for MONAD Corporation, 460 Reservoir St Pamona, CA 91767, a manufacturer of microcurrent electrotherapy instrumentation.*

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