

By Paul Davis, Dipl. A. C.

There has been a trend in modern health care toward minimally invasive procedures, including reduced reliance on heroic and long term drug therapies. This trend is borne out by the rapid growth of hospital outpatient surgical departments, the physical therapy, chiropractic and rehabilitation professions, and the hospice movement. Nowhere in this trend better exemplified than the current and growing popularity of microamperage (microcurrent) electrotherapies.

Advocates of microcurrent

Because stimulation from these devices exceed nerve firing thresholds, treatment with any of the produces a definite sensation, which can range from gentle tingling to intense muscle throbbing. The output of microcurrent devices, on the other hand, is in the millions of amp, or microamp (uA) range. Thus the peak current, or amplitude, of microcurrent device set at 50uA is 1000 times lower than a milliamp device set at 50 mA.

That can be misleading, however, for in spite of this tremendous difference in peak current, the total current, or actual volume of electrons being

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A Modern Healthcare Modality

therapy claim that it accelerates healing of decubitus ulcers, non-union fractures, and traumatic injuries, as well as offering highly effective and long-lasting pain control. The former has been substantiated in numerous studies from around the world, while the latter claims are mainly anecdotal, although evidenced by widespread use for that purpose. Some of the most enthusiastic advocates of microcurrent therapy, professional athletes and their trainers, have maintained that such treatment has significantly shortened time on injury lists.

Characteristics of Microcurrents

The ampere, or amp, is the common measurement unit of electron movement past a fixed point over time. With the exception of microcurrent devices, all modern electro-therapy instruments deliver short pulses of current in the thousands of an amp, or milliamp (mA) range. Such devices include TENS, MES, interferential and high-volt pulsed galvanic stimulators.

administered to the patient per second of treatment, may be similar in milliamp and microamp devices. This is because milliamp currents have very high amplitude, but are delivered in very brief pulses, while microamp devices deliver very low amplitude currents that stay "on" for up to 50% of the time. Thus, in low frequency electro-stimulation, the total current delivered per second is similar in both milliamp and microamp stimulation. The difference is in how the current is being delivered to the body. The question then arises: what is the significance of this difference.

Digital and Analog Systems

In his landmark book, *The Body Electric*, Dr. Robert Becker describes two different electrical control systems of body. The more primitive system, the analog system, consists of subtle direct currents (DC) of continuously variable voltages that exist primarily in the brain and perineural systems of the body. The digital system consists of quickly reversing alternating currents (AC)

produced by ionic activity in nerve and muscle. The existence of both systems has been confirmed with the SQUID, an ultrasensitive device that measures, subtle electromagnetic fields.

According to Dr. Becker, the fact that salamanders, lizards and other simple creatures can easily regenerate whole limbs and organs is due to the preponderance of the analog control systems, which modulates healing, in their bodies. This system also allows birds and other migratory creatures to guide themselves by direct contact with the magnetic fields of the Earth. Human beings and other mammals have much more limited powers of regeneration because our bodies favor highly developed digital nervous systems, which allows greater abilities in complex motor skills and conscious thought. Dr. Becker has been able to experimentally cause frogs to regenerate amputated limbs through externally applied DC fields, a feat they are unable to do in nature.

This understanding of the digital and analog systems of the body can be used to postulate the differing clinical effects of milliamp and microamp stimulation. The sharp, discrete pulses of milliamp stimulators resemble digital activity of the nervous system and therefore can interact with it to temporarily suppress the sensation of pain. Microcurrents, especially in the very low frequency range in which this therapy is usually applied, seem to more closely match the DC analogy systems of the body. If indeed, it is the primitive DC systems of the body that modulate healing, this may offer an explanation for the documented healing acceleration effects of microcurrent treatment.

Experimental Evidence

There have been numerous studies appearing in professional journals over the last 25 years documenting the clinical effects of direct or low frequency currents in the microamp range. Prior to that, most

accounts of electrical stimulation concerned only intense currents capable of initiating gross mechanical effects on the body. This is no doubt partially due to the fact that precise control over currents in the microamp range was impractical without the development of modern solid state electronics.

Advancements in modern electronics, plus the landmark work of Melzack and Wall and Shealy, opened the way in the 1960's for renewed acceptance of electrical stimulation for pain control. Transcutaneous nerve stimulators (TENS) were developed for this purpose, and electric muscle stimulators were also developed to fatigue spastic muscles. Variations of TENS, such as interferential and high-volt pulsed galvanic stimulators, were introduced, with many practitioners claiming improved results with these devices.

The accepted mode of action of TENS is intense stimulation of afferent nerve fibres causing a "gating" effect on the central nervous system, or release of endogenous pain modulating substances. At commonly used microcurrent therapy setting, however, the treatment is subsensory, and usually sub-threshold for initiating the nerve action potentials believed necessary for these effects.

There have been two ways to explain this apparent discrepancy. The reported long term effects of microcurrents may be understood as being due to accelerated healing of injured cells. These effects include wound healing acceleration and increased pain relief carry-over in comparison to milliamp therapies. It is well known that when the phospholipid content of the membrane of an injured cell is broken down, a cascade of biochemical reactions are triggered, of which inflammation and pain are the outcome. It is logical that faster resolution of cellular pathology will lead to reduction or elimination of the messenger of pain.

Early American researchers ex-

perimenting with sub-threshold microcurrent stimulation had to construct their own test devices, none were commercially available in the U.S. at that time. The first commercial device outputting microcurrent stimulation was the Dermatron developed in the 1960's by Dr. Reinhold Voll of Germany. Although this device was primarily used for electro-diagnostic testing purposes, it was also used to apply therapeutic microcurrent stimulation to the body. Through the research of Dr. Voll and his colleagues, the following effects of microcurrent on the body were documented: 1) Spasmolysis of smooth muscles of the circulatory, lymphatic and hollow organ systems. 2) Tonification of the smooth muscle cells to relieve stases and spastic constriction. 3) Tonification of elastic fibres, for example, increasing lung capacity in emphysema patients. 4) Reduction of inflammatory processes through reducing infiltrative, proliferative, and exudative processes. 5) Reduction of degenerative process by restoring diffusion-osmotic equilibrium. 6) Restoration of polarization of the nerves. 7) Stimulus of ATP function of freshly injured striated muscle.

To obtain these effects, microcurrents in the 0.5-10 Hz range were applied to whole limbs or selected acupuncture points. Voll and his colleagues were able to chart specific frequencies in that range that had pronounced effects on different tissue systems. This very low frequency range, which is resonant with normal electrical activity of the human body and the frequency of the Earth, is the main domain of modern microcurrent therapy.

The next group of researchers studying the effects of microcurrent on the body worked in the realm of wound healing acceleration. A persistent problem in medicine and physical therapy has been slow or non-healing wounds and bone fractures. Many patients have lost limbs to amputation or stayed bedridden due to these conditions.

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One of the first studies documenting the positive effects of microcurrent stimulation on this problem was by the team of Wolcott et al in 1969. These researchers applied stimulation in the range of 200-800 uA to a wide variety of wounds using alternating current polarities. A control group was treated with ordinary wound care methods. The treated group showed 200-350% faster healing rates than controls, with stronger tensile strength of scar tissue and antibacterial effects in infected wounds. Gault and Gatens used a similar procedure in 1975-76 on patients with diagnoses including quadriplegia, CVA brain tumor, peripheral vascular disease, burns, diabetes, TB, fracture and amputation. Their results demonstrated healing times in the treated group about half that of the controls. Many other researchers followed variations of these models and published similar results.

Cheng, et al, published a landmark study in 1982 demonstrating what the cellular mechanisms were that supported these effects. Using varying levels of electrical stimulation on in-vitro slices of rat skin, they demonstrated up to 75% increased free amino acid levels and up to 400% higher available ATP levels in specimens treated with currents below one milliamp than in the control group. This confirmed some of Dr. Voll's conclusion mentioned above. The most significant aspect of this study was that specimens stimulated at levels above one milliamp showed depressed levels of amino acids and ATP, often less than controls. This was strong evidence of the superiority of microcurrents over milliamp currents for stimulating cellular healing. Other studies have demonstrated

the effects of microcurrent in accelerating healing of bone, tendon repairs, and collagen remodeling. A Nobel Prize went to two German scientists in 1991 for their work in detecting subtle electrical currents in all types of cell membranes throughout the body. This study opened the way for greater understanding of the mechanisms through which both endogenous and externally applied currents can affect organic functions.

Treatment Indications

There are three contemporary applications of microcurrent therapies - wound healing acceleration, pain management, and enhancement of rehabilitative exercises. Therapy is applied through hands-on point work with probes and unattended pad placements. With the first method, brief bursts of low intensity currents are applied into pairs

healing and rehabilitative work, as well as pain relief in joints, tendon and deeper tissues. Other applications of microcurrent therapies include current applied through the therapist's hands (electro-massage), and currents applied through footbaths or whirlpools for flooding large body areas.

Wound healing acceleration with the use of microamp stimulation has been documented as described above. This therapy is used in modern convalescent and nursing homes for resolving slow and non-healing ulcers and bedsores. Currents are administered through sterile gauze electrodes placed directly over the affected areas. Negatively polarized currents are indicated for infected or necrotic wounds, while positive currents are used for encouraging new tissue proliferation.

Most of the popularity of microcurrent therapies has been due to its reportedly superior or longer lasting pain control effects in comparison with traditional milliamp stimulation. At the time of writing this piece, several hospital and university

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of specific points on the body, such as trigger points, muscle origins and insertions and motor points, and acupuncture points. Total treatment times for probe stimulation ranges from a few seconds up to several minutes per area. One specialized application of probe stimulation is intra-oral probing, which is used for relief of pain and spasm associated with TMJ disorders.

Unattended microcurrent stimulation through electrode pads is generally administered for 5-30 minutes per treatment, and is often combined with probe work. Brief probe treatments are used primarily for myofascial pain relief, while unattended pad treatments are used for

studies are currently underway to test this reputation in double-blind studies.

For rehabilitative exercise microcurrent pad stimulation is frequently applied in conjunction with simultaneous bodily motion to speed rehab of injured areas. Some examples would be use with exercise bicycles or CPM units for knee rehab, cervical traction units for neck rehab, or with flexion-distraction techniques for low back injuries.

Acupuncture and Microcurrents

The other explanation of the efficacy of microcurrents in relieving pain is through comparison to acupuncture. This is especially true of

microcurrent probe techniques. The effects of acupuncture, many of which have been documented in JAMA and other professional journals, are derived from gentle stimulation of the skin surface with metal needles, heat, or manual pressure.

The ability of such subtle stimuli to have significant effects on severe symptomatology in local and distant bodily areas have been explained in many ways. A "meridian", or energy communication system connecting all parts of the body, has been described by traditional Chinese and Japanese acupuncture. Modern researchers have ascribed this system to the circulatory system (Nordenstrom), perineural tissues (Becker), fascial networks of the body (Matsumoto and Birch) and complex nervous system reflex arcs (Steigerwald).

The work of Becker and Nordenstrom in particular recognize the action of subtle electrical DC currents, via the perineural cells and circulatory system, respectively, in explaining at least part of the meridian phenomenon. Becker's hypothesis is that traditional acupuncture points act as amplifiers of signal strength of this system, and that appropriate stimulation over these points can in effect "short out" pain signals in the most efficient way. Needle acupuncture is the original microcurrent therapy, as traditional acupuncture needles generate measurable electrical charges when twirled in the skin by a doctor's fingers, and needles left "in situ" tend to drain off excess electrical energy from tense or inflamed tissues. Modern microcurrent therapy offers a simplified and non-hazardous method for modern practitioners to offer the benefits of acupuncture stimulation to their patients.

Summary

Microcurrent therapy is a refinement of traditional milliamp electro-

stimulation techniques that follow the current trend of less invasive treatments. A body of research indicates that microcurrents can help "switch on" or accelerate cellular healing mechanisms. This therapy has earned a positive reputation for efficacy in pain management and rehabilitation, and is reputed to offer patients longer carry-over effects than more intense milliamp stimulation. This is probably due to its effect of reducing cell membrane damage, which is a causative factor in pain and inflammation. Microcurrent therapy, especially through point-specific probe treatments, has an effect similar to acupuncture. Both needle acupuncture and non-invasive microcurrent probe stimulation create subtle electrical discharges in acupuncture points, which has been shown to be a powerful pain relieving method.

Further clinical studies are needed to quantify and validate the effects of microcurrent stimulation. Such studies will no doubt open the way for greater acceptance of this valuable modality in modern health care.

Mr. Paul Davis is the CEO of Microcurrent Research. This article was reprinted from a book he helped author.