Microcurrent Stimulation

Why It Is Replacing Many Other Forms of Electrical Therapy

by Joel S. Rossen, DVM

Those of you who are currently using instruments which produce microcurrent stimulation, also known as microtens (mTENS), are already aware of the remarkable effectiveness of treating pain patients using currents below 1 milliamp. This article describes the physiological effects of microcurrent stimulations. To facilitate comparison between milliamperage and microcurrent devices, 1 microamp (ua) is one millionth of an ampere or 1/1000 of a milliamp (Ma).

As recently as ten years ago the emphasis in pain management began to shift from milliamperage current towards the use of much smaller, biologically compatible currents which may have effects far beyond the simple blocking of pain perception. Even then it was already evident that small currents in the body were at least partially responsible for the phenomenon of tissue regeneration.[1]

TENS (Transcutaneous Electrical Nerve Stimulation) and EGS (Electro-Galvanic Stimulation) are modalities which are familiar to most professionals involved in the practice of physical medicine. Generally currents in the range of 20 Ma to 120 Ma are applied to block neurological transmission of pain signals and stimulate the release of endorphins in chronic and acute patients. There is very little evidence that these modalities have much therapeutic benefit beyond the simple blocking of the perception of pain.

The use of electrical currents in the field of pain management is not new. As a matter of fact, it dates back many hundreds of years before the commercial production, storage, and harnessing of electricity was achieved.

An early prescription for the treatment of gout had the patient stand on a torpedo fish (an electrically charged fish) in the surf and maintain contact until the pain was relieved.

Fortunately, with the advent of solid state electronics during the past several decades, the use of electrical stimulation has become more and more sophisticated and its effectiveness has increased far beyond the torpedo fish stage. Even so, the first generation of electrical stimulators was quite crude by today's standards, using currents and waveforms which today are known to be much less effective than their modern counterparts.

Consider: twenty years ago, during the first days of the use of birth control pills, daily doses of 10 mg of estradiol were considered normal. It was only after many years of using those doses that it became evident that they were not only unnecessary, but actually were responsible for long term side effects ranging from blood clotting problems to increased predisposition to stroke, cancer, and hypertension.

The cause of the side effects did not turn out to be the pharmaceutical itself so much as the dangerously high doses which were once commonplace. Today, safe and effective doses of contraceptives are as little as 1% of the early doses.

Similarly, in the early days of electrical stimulation, the doses of electricity applied to the patient were also significantly higher than what now appears to be necessary. Current levels in the neighborhood of 20 to 110 milliamps were and still are common. It is only during the past seven to ten years that the rationale for using microcurrents, often less than .1% of the current levels available in millicurrent devices, has become evident.

One historic use of microcurrent was in the 1984 Olympics. Joanie Benoit, then the world record holder in the women's marathon, underwent arthroscopic knee surgery only 17 days prior to her Olympic qualifying trials. One of the physicians who was working with me at the time had already achieved excellent results using a microtens device called the Electro-Acuscope to help Mary Decker Slaney with her injuries. As a result Joanie Benoit requested the same therapy. The treatment was started less than one week before the trials while she was still in considerable pain. Not only did she qualify to compete, she brought home the gold.

The stories of microcurrent use in the world of sports are many and even include Joe Montana's remarkable comeback from back surgery to lead the '88-'89 Forty-Niners to win yet another Superbowl. Carl Lewis' remarkable 1988 Olympic performances were also a victory for microcurrent as well.

The electrical medicine pioneer, Dr. Robert O. Becker, has provided us with much of the research which

explains the value of microcurrent in practice. It was Dr. Becker who first described the existence of a dc electrical signal system which controls the body's healing responses. He demonstrated that bone healing was significantly delayed in rats whose femoral nerves were transected at the same time as the induction of a fracture of the tibia as compared to those with the nerve intact. A critical finding of this study was that if the nerve was transected five or more days before the induction of the fracture, there was no delay in the healing.

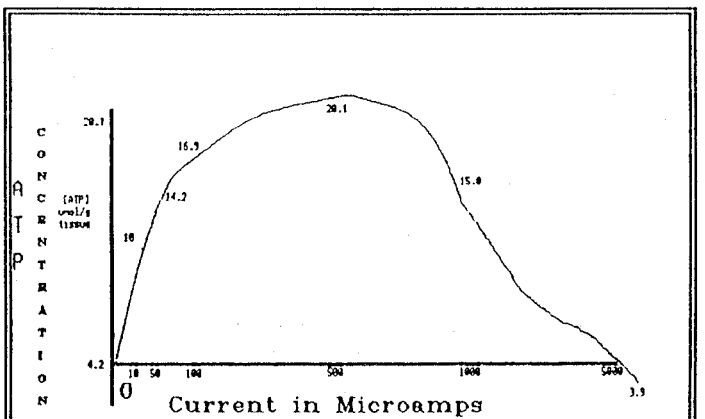
We all know that there is no nerve regeneration in five days but a microscopic look at the transected nerve gave us one of our first insights into the secrets of energetic healing and electronic communications in the body.

While there was no regeneration of the nerve itself, microscopic examination revealed that five days was sufficient to reestablish the connection of a very fine filimentious material which appeared to be primordial Schwann cell sheath. Using very sensitive equipment, Dr. Becker was able to demonstrate that once this tissue bridged the gap between the proximal and distal segments, a measurable current began to flow. This current came to be known as the current of injury and carried the encoded messages to the recovering cells to direct the healing. In days to come, decoding this current's signal may reveal the key to the techniques of electronic regeneration of severed limbs as well as the acceleration of wound healing and the management of pain (R. O. Becker, *The Significance of Bioelectric Potentials*).

There is also evidence that microcurrent may be of value in the acceleration of wound healing. An 1985 article (Carley et al., *Archives of Physical Medicine*, vol. 66, July 1985) has reported 150% to 250% enhancement of wound healing using microcurrent therapy.

Current level is not the whole story. Frequency is also very important. In addition to current levels, the frequencies of stimulation and the electrical waveforms of treatment are also becoming increasingly more sophisticated and well-defined as the science of electro-therapy approaches maturity.

Much of the work establishing the frequencies which effectively stimulate the body was done in France. Several international patents have been granted based upon the use of certain sets of frequencies for specific pain management and healing purposes. The most common frequencies used in Europe are multiples of 73 Hz, a primary resonant frequency of the body. These frequencies are 73, 146, 292, 584, 1168, 2336, and 4672. Some sources also suggest fractions of 73 including 9.125 and 37.5 Hz.



Dr. Cheng's research showed an increase of over 300% in the ATP concentration in cells stimulated with 500 uA over the ATP concentration in untreated control group. The ATP increased with stimulation using currents in the 25uA to 1000 uA range. Currents above 1000 uA actually resulted in decreased ATP concentrations. Protein systhesis and transmembrane movement of metabolites were also markedly decreased by higher currents. The control group averaged 4.2 mol ATP/gram of tissue. Prolonged currents over 5 milliamps decreased the ATP concentration levels below that of the untreated controls.

Recent advances in commercially available microtens have given us the first of a new generation of totally portable microcurrent capable personal electrical stimulators. Currently one device meets the criteria of the latest electrotherapeutic research. It is called IndicaTens™ and, in addition to microcurrent, it has a unique waveform (see figure 1) featuring three simultaneous frequencies. They are a 1) 15000 Hz carrier wave which directs the current deep into the body for consistent and rapid pain relief. 2) A choice of 9.125 or 292 Hz modulated treatment frequency and 3) a .5 Hz biphasic pulse. There is also a portable clinical version which also features eight frequencies from 9.125 to 4672 Hz.

There are a number of reasons for using a device which uses high frequency combined with specific modulated frequencies and low current.

The first reason is patient compliance. The best response to any appropriately prescribed course of electronic or medical therapy is obtained by the patient who actually fulfills the orders of the doctor. There are three primary factors which will create that outcome: 1) ease of application, 2) speed and effectiveness of the therapy and 3) patient comfort.

A well designed device will have as few controls as possible for the patient to have to manage. IndicaTens™, for example, is designed with only two controls, intensity of the current and frequency. Any patient can learn to use it correctly and effectively in five or fewer minutes.

Microtens also generally requires much shorter treatment than the millicurrent counterparts. It often requires only five to ten minute applications, rather than the long term or constant application required by most TENS devices, and only one to three daily applications is generally sufficient. Finally, patient comfort is

assured because the microtens functions best subliminally, that is, below the level of patient sensation.

Even more important than compliance is effectiveness. A double-blind study by Paul Meyer, M.D., et al., used microcurrent stimulation with the Electro-Acuscope, an excellent feedback modulated office model microtens unit, on 40 patients with low back pain for a total of 16 treatments each. Follow-up eight weeks after the discontinuance of therapy showed a 75% reduction in pain in the treatment group as compared to only a 6% improvement in the placebo group.

The extraordinary effectiveness of microcurrent seems to be explained, at least in part, by a 1982 study by Dr. Ngok Cheng, et. al., (published in *Clinical Orthopedics and Related Research*, #171, Nov-Dec 1982) on the effects of microcurrents on Adenosine Tri Phosphate (ATP) concentrations and protein synthesis in rat skin. ATP deficiencies are common in areas of chronic pain and sufficient ATP is essential to power the processes of cell respiration. ATP supplies the energy for the sodium pump, the active transport mechanism which removes metabolic waste from the cell's interior and imports metabolytes and nutrients from the blood stream into the cell.

In Dr. Cheng's study, it was demonstrated that Glycine incorporation into the skin proteins was significantly stimulated by a constant current varying from 10 uA to 1000 uA. The highest stimulatory effects were obtained with 500 to 1000 uA with glycine incorporation increased by as much as 75% as compared with the untreated controls. ATP concentrations were increased by as much as 300% to 500% in cells stimulated with CONSTANT currents between 25 uA (microamps) and 1000 uA (1 Milliamp). Marked increases in protein synthesis were also observed in the microamp range. Insofar as protein synthesis depends on adequate ATP levels, the increased ATP levels is at least partially responsible for the increased protein synthesis. Overall, the greatest stimulatory effects were obtained around 500 uA.

Higher current intensities, exceeding 1000 uA, inhibited protein synthesis with currents of 1.5 Ma. In the 10 to 30 Ma range, the cellular glycine incorporation and amino acid incorporation into the cell continued to fall, descending to levels between 10% and 50% of the untreated controls. Additionally, constant currents from 100 uA to 1000 uA increased

References

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Cheng, N., et. al.: The effects of electric current on ATP generation, protein synthesis, and membrane transport in rat skin. Clin Orthop 1982; 171:264-271.

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ATP in the cytoplasm. The ATP provides the fuel for the transmigration of metabolyte and metabolic waste across the cell membranes as well as the reestablishment of cellular bioelectronic ionic concentration gradient. What this means is that cell membrane potential, normally .85 mv in healthy tissue, is reestablished, levels of intracellular metabolic waste (i.e. lactic acid) are reduced and fresh concentrations of usable cellular metabolytes are introduced into the exhausted cell. At this point the cell can enter its regenerative phase, pain levels are noticeably reduced and tissue regenerative functions are reestablished.

For maximum effectiveness, the primary resistance must be broken down before the tissue capacitance can be charged. When using a microtens unit optimally designed for extremely rapid pain control, the first phase of the treatment must lower the electrical resistance of the area with a constant current of 1 to 6 milliamps. The second phase is the introduction of a microcurrent between 25 and 900 uA which corresponds to the current levels used effectively in the Cheng studies to affect the increase in ATP concentrations.

The future of electrical stimulation is already written. Devices with currents which more and more closely simulate the body's natural currents of injury will be developed and each generation will replace the previous one as effectiveness is enhanced by further sophistication. The ultimate goal is to establish consistent and reproducible communication between the therapist and the body's pain and healing management systems. When this communication has been achieved, management of pain may be as simple as flipping a switch.

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TAC: How critical do you feel merger was to the profession? What now?

Dr. Luedtke: Merger was an important factor in the socio-economic development of the profession and the growth of chiropractic as a non-drug, non-surgical health care delivery system. A unified national association would have had a dramatic effect on national legislation, insurance equality, marketing and education for the public. Merger was a way to have a stronger national association and to take care of the needs of our patients, and that particular vehicle has been tried and exhausted. Now we need to look at a different way of accomplishing what we need for our consumers and for the chiropractic profession and its growth.

The American Chiropractic Association pledges to continue its efforts to represent the broad mainstream of the chiropractic profession and to defend the core principles of chiropractic as the profession approaches its centennial in 1995. The ACA invites all chiropractors with open minds who desire a dialogue with co-professionals and who have a love for this profession and the people we serve, to join in establishing, maintaining and expanding the vital role chiropractic can and must play in handling the future health care needs of this nation.

The chiropractors out there can be assured that the ACA is dedicated to the principles our pioneer chiropractors fought so hard to establish. They can be sure that the ACA will stand for a separate and distinct profession.

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you what we can do for YOU, your patients and chiropractic. It is imperative to rekindle the brotherhood within the ICA to again make it a strong voice within our profession. Both sides must be understanding and forgiving, and even if the majority of voters on two occassions voted to merge, we must honor the ICA constitutions and bylaws and adhere to our beliefs and principles. There are rumors suggesting that many ICA members will now abandon a "sinking ship"...I hope this is only a rumor. Although a two-party system works, we still have ONE government. Now we have ACA/ICA and we still have two governing associations. Only history will tell if it works.

This current situation historically reminds me of the post-Civil War days, and I feel that we must call upon our "innates" to guide us and "to listen to the bigness of the fellow within." We must think chiropractic first, our patients second, and ourselves last.

As a board member of the ICA, I pledge my support to chiropractic and the protection of the vertebral subluxation complex, and I would urge all chiropractors to join a state and national association and support chiropractic from within.

I know the defeat of the merger has split the ICA membership and may have an effect on its goals, programs and future membership. This defeat will leave our profession subluxated politically and financially, and it will affect our research and legislative programs for years to come. I only hope our patients survive our subluxation.

transported amino acid analog by 30% to 40% over control levels.

The following is an explanation of some of the electronic phenomena involved with the reduction of pain and the relationship to the healing process as it relates to concentrations of ATP in the cells.

It has been shown that:

1) The electrical resistance of tissue with pathology is higher than that of the immediately surrounding normal or less pathological tissue;

2) Regeneration is a series of endothermic, electrochemical reactions. This means that electricity, in miniscule quantities, is needed by the cells to provide energy to fuel the regenerative process.

What is the combined effect of these two pieces of information?

Consider the predicament: the tissue in the area of involvement needs energy in the form of electricity (current flow of about four picoamps). The patient's body contains more than a sufficient quantity of energy to produce the desired effect. Unfortunately, the electrical resistance in the area of involvement is so high that the body's energy flow will not enter the area because the primary laws of physics require that energy travel only via the path of least resistance.

The result: Electrical energy traveling in the body will circumvent the area of pathology. It will always take the path of least resistance which is around, rather than through, the area of involvement.

Since the laws of physics are immutable, we must enable the energy to pass into the pathology while obeying the laws. In addition, we can aid our cause by increasing the body's ability to actually produce and store energy in the area of involvement. This is done by charging the tissue in a manner similar to a battery.

Tissue cells, just like battery cells, have the ability to hold an electrical charge. The greater the charge on the cell, the less resistant it is to the flow of electrical energy. Additionally, as the cell charge increases, the molecular kinetic energy in the cell increases.

Elementary physics provides the equation which reveals that at this point the electro-vibratory rate (EVR) of the cell's molecular structure must increase with the increased kinetic energy (energy of movement). An increased EVR will be coupled in direct proportion with an increased electro-conductivity (decreased electrical resistance). Finally, while functioning as a battery, the charged cell provides some of the energy which is involved in the energy flow equation.

In other words, the addition of electrical energy to an area of pathology increases the elecrical conductivity of the area and hence allows the body's own energy to enter the area and affect the tissue.

The term for the quantity of charge that a cell can maintain is "capacitance." As the general health of the cell improves, the capacitance increases. Here's how: biologically, the capacitance of the cell is directly proportional to the concentration of ATP in the cell and ranges from about .1 to 3 microfarads. Restated, ATP is at least partially responsible for binding the electrons which cumulatively represent the electrical charge and usable energy of the cell. It has been demonstrated that areas of the body which manifest pain are often deficient in ATP. It follows, therefore, that the electrical energy of these areas must be below standard because the body's electrical flow cannot penetrate the resistance. This serves as a partial explanation of why the electrical needs of those areas are not met by the intrinsic charge of the tissues.

ATP concentration serves a direct vital function in the "active transport" mechanism known as the "Sodium Pump." Active Transport means that this system, which is directly responsible for the transmembrane movement of sodium, potassium, calcium, metabolic waste and metabolytes, requires large amounts of energy to move vital ions in and out of the cell. Metabolic waste builds up in toxic concentrations when a cell is not respirating properly. Simultaneously, the intracellular, oxidizable metabolyte concentration is reduced.

The energy which is released when ATP breaks down to adenosine diphosphate (ADP) fuels the reactions which establish balanced membrane potential gradients and which bring vital metabolytes into the cell in exchange for metabolic wastes which are dumped into the general circulation to be detoxified and excreted. What we have when the sodium pump is not functioning is a hypo-polarized, toxic, starving cell. Not a pretty sight.

Reestablishment of the sodium pump occurs when the increase in intracellular current increased mitochondrial function. The work of Dr. Ngok Cheng, et. al., has shown that ATP concentrations are only affected positively when the applied electrical flow is 25 uA to less than 5 milliamp, the normal working range of the IndicaTens. Other "standard" TENS devices operate in the 20 to 80 Ma and higher ranges, far into the levels which deplete the cell's ATP and metabolic processing capabilities.

The increased EVR of the mitochondria enhances the production of