Introduction to Microcurrent and Guide to Its Greatest Effectiveness

PART I
Introduction and Physiology

Those of you who are currently using instruments which produce microcurrent stimulation, also known as Microtens™ (μTENS™), are already aware of the remarkable effectiveness of treating pain patients using currents below 1 milliamp. This article describes the physiological effects of microcurrent stimulation and outlines the basic techniques for using microcurrent stimulation to its best advantage. In addition, I will also use the first section of this booklet to outline a comparison between milliamperage and microcurrent devices. By the way, 1 microamp (μA) is one millionth of an ampere or 1/1000 of a milliamp (Ma). I will use the AcuData® MicroStim 400 as the training unit because it is the one I am the most familiar with and I have adequate photographs of the device to illustrate the technique section. This is not the users' manual for the MicroStim 400 ar any of AcuData's treatment devices. In fact, this treatise is applicable to nearly any microcurrent stimulator.

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 a decade ago, it was already evident that small currents in the body were at least partially responsible for the phenomenon of tissue regeneration. One of the finest current works on the phenomena of regeneration using electrical stimulation is the book, The Body Electric, by Robert O. Becker MD. I refer you to that publication if you wish to study a detailed treatise of the regenerative effects of microcurrent stimulation.

Standard millicurrent 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 20Ma to 120 Ma are applied to block neurological transmission of pain signals and stimulate the release of endorphins and other neurotransmitters for the relief of chronic and acute pain. There is very little evidence that these early 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 accomplishment of the commercial production, strorage, and harnessing of electricity. For example, an early prescription for the treatment of gout required the patient to 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, which used currents and waveforms which today are known to be much less effective than their modern counterparts, was quite crude by today's standards,.

Consider, twenty years ago, during the first days of the use of birth control pills, daily doses of 10mg of estradiol were considered normal. It was only after 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 the increased predisposition to stroke, cancer,and hypertension.

The cause of the side effects did not turn out to be the drug itself so much as the dangerously high doses which were once commonplace. Today, safe and effective doses of contraceptives are less than 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 safe and effective. 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 tenth of 1% of the current levels available in millicurrent devices, has become evident.

One historically prominent use of microcurrent was in the 1984 Olympics. Joan 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 microcurrent device called the Electro-Acuscope to help Mary Decker Slaney with her injuries. As a result Joan Benoit's trainer requested the same therapy for her. The treatment was started less than one week before the Olympic qualifying trials while she was still in considerable pain. Not only did she qualify to compete, she ultimately brought home the gold in a spectacular Olympic finish.

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 victories were a victory for microcurrent as well.

The electrical medicine pioneer, Robert O. Becker MD 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. In a study with Dr. Steven Smith, Dr. Becker 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 5 or more days before the induction of the fracture, there was no delay in the healing.

We all know that there is no significant 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 communication in the body.

While there was no regeneration of the body of the nerve itself, microscopic examination revealed that five days was sufficient to re-establish the connection of a very fine filamentous 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 carries 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 accelleration 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 accelleration of wound healing. An 1985 article (Carly 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 also seems to be quite important. In addition to sophistication of current levels, the frequencies of stimulation and the electrical waveforms of treatment are also becoming increasingly sophisticated and well defined as the science of micro-electro-therapy approaches maturity.

Much of the work establishing the effects of various frequencies on 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 commonest frequencies used in Europe are multiples of 73 Hz. These frequencies are 73, 146, 292, 584, 1168, 2336, and 4672. Some sources also suggest fractions of 73 including 9.125 and 37.5Hz.

Recent advances in commercially available microcurrent stimulators have given us the first of a new generation of totally portable microcurrent equipped personal electrical stimulators. One device which meets the criteria of the latest electrotherapeutic research is called IndicaTens™ and is also marketed under the tradename of MicroTens™. 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 clinical version of the device which also features frequencies which vary between .3 and 4672 Hz as well a positive and negative DC modes.

There are a number of reasons for using a device which uses high frequency combined with specific modulated frequencies and ultra 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 practitioner. There are 3 primary factors which will create that outcome:

1) Ease of application, 2) speed and effectiveness of the therapy and 3) patient comfort.

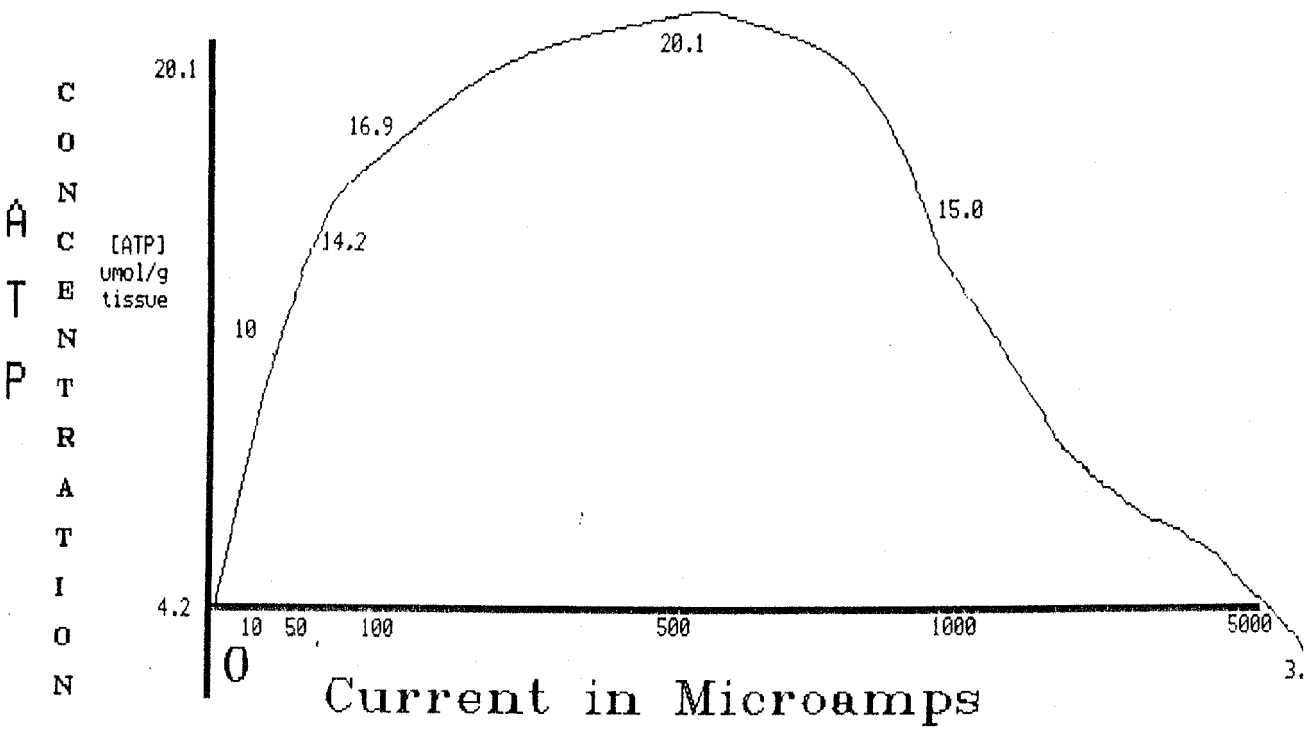
For example, the MicroStim 400 (AcuData's clinical microcurrent unit) is designed to be used for very short periods of time, usually only 1 to 10 minutes per application. Relief is generally experienced within only a few minutes from the begining the therapy. For patient comfort, the entire stimulation occurs subliminally. The amount of current used is so small that the patient will not feel the stimulation during the therapy session. As a matter of fact, the device is designed and the instructions state that if the patient can feel the stimulation at all, it MUST be turned down for maximum effectiveness. Finally, the MicroStim™ 400 has a home version microstimulator, the MicroTens™, which permits the patient to continue the therapy at home in between the clinical sessions.

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

Microtens™ also generally requires much shorter treatment than its millicurrent counterparts. It often requires only 1 to 10 minute applications, rather than the hours or days of treatment which are usually required by most millicurrent TENS devices. With microcurrent, only 1 to 3 short daily applications is generally sufficient. Finally, patient comfort is assured because the Microtens™ functions best when used subliminally, that is, below the level of patient sensation.

Even more important than compliance is effectiveness. No matter how well a patient follows directions, if an ineffective therapy have been prescribed, it simply will not work. A double-blind study by Paul Meyer MD, et. al. used microcurrent stimulation with the Electro-Acuscope, an excellent feedback modulated office model microcurrent unit, on 40 patients with low back pain for a total of 16 treatments each. Follow up 8 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.



This graph summarizes the effects of direct microcurrent on ATP concentration in Cheng's study. It displays that the increase in ATP concentration peaks at around 500μA with a 500% increase in the [ATP] as compared to the untreated control group . In addition, at currents above 6 Ma, the [ATP] dropped below that of the untreated control group (the baseline), indicating a long term decrease in [ATP] concentrations in patients treated with conventional (millicurrent) TENS.

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 μA to 1000 μA. The maximum stimulatory effects were obtained at 500μA 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 μA (microamps) and 1000 uA (1 Milliamp). Marked increases in protein systhesis were also observed from stimulation in the microamp range. Insofar as protein systhesis depends on adequate ATP levels, the increased ATP levels must be at least partially responsible for the increased protein systhesis. Overall, the greatest stimulatory effects were obtained around 500mA.

Higher current intensities, exceeding 5000μA (5 milliamps), inhibited protein systhesis with currents of only 1.5 Ma. In the 10 to 30 Ma range, the cellular glycine incorporation and 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 100μA to 1000μA increased transport of 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 non-inflammed abnormal tissue is higher than that of the immediately surrounding normal or less pathological tissue;

2) Regeneration and respiration are series of endothermic, electrochemical reactions. This means that electricity, in miniscule quantities, is needed by the cells to provide energy to fuel both the respiratory and regenerative processes.

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 4 picoamps). The patient's body contains more than an adequate quantity of energy to produce the desired effect. Unfortunately, the electrical resistance in the area of involvement tends to be 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. If there is inflammation in the area, the higher conductivity of the inflamed tissue will cause the body's natural current to flow through the inflamed tissue, hence reducing the available current to the surrounding tissues as well as further heating up the inflamed areas because of the increased current through already over-electrified tissue.

Since the laws of physics are immutable, we must enable the energy to pass into the deficient pathological tissue while continuing to obey 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 the way a rechargable battery is charged. The ATP concentration in the areas which are stimulated is increased and hence, the tissue's inherent ability to hold electricity is enhanced.

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 electrovibratory 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 electroconductivity (decreased electrical resistence). 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 charge to an area of pathology increases the electrical conductivity of the area and hence allows the body's own energy to enter the area and effect 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 usuable 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 met neither by the intrinsic charge of the local tissues nor by the charge and electrical flow from more highly charged remote 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 trans-membrane movement of sodium, potassium, calcium, metabolic waste and metabolites, 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 metabolite concentration is reduced.

Energy which is released and becomes available when ATP breaks down to Adenosine diphosphate(ADP). This provides energy to fuel the reactions which establish balanced membrane potentials. The same set of reactions bring vital metabolites 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 hypopolarized, toxic, oxygen deprived, starving cell. Not a pretty sight.

Re-establishment of the sodium pump occurs when the increased available intracellular energy results increased mitochondrial function which in turn increases intracellular ATP concentrations. The work of Dr. Ngok Cheng, el al., has shown that ATP concentrations are only affected positively when the applied electrical flow is in the range from 25μA to less than 5 milliamps, the normal working range of the MicroTens™ 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 ansd energy available to the mitochondria enhances the production of ATP in the cytoplasm. The ATP provides the fuel for the transmigration of metabolite and metabolic waste across the cell membranes as well as the re-establishment of cellular bioelectronic ionic concentration gradient and protein systhesis. What this means

is that cell membrane potential, normally -85mv in healthy tissue but generally much lower in unhealthy cells, is re-established, levels of intracellular metabolic waste (i.e. lactic acid) are reduced and fresh concentrations of usable cellular metabolites are introduced into the exhausted cell. At this point the cell can enter its regenerative phase, pain levels are noticably reduced and tissue regenerative functions are re-established.

For maximum effectiveness, the primary resistance must be broken down before the tissue capacitance can be charged. When using a microcurrent 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 from 25μA to 6 milliamps. The second phase is the introduction of a micro-current between 25μA and 900 μA which corresponds to the current levels used effectively in the Cheng studies to effect 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 will often be as simple as flipping a switch.

PART II
Treating Using Microcurrent Therapy

The 80's saw the rise of the new generation of electrical stimulation, Microcurrent. Although it has been in the field now for over twelve years, microcurrent stimulation is just now starting to be understood, even by those who have been doing it successfully for over a decade. Part One of this treatise was designed to give an overall picture of the physiologic effects of microcurrent. The precise mechanisms by which microcurrent stimulation works may be better understood if described metaphorically as well as electronically. In Part II, I will attempt to do both. Once you develop a clear picture of the electronic outcome you are creating, you will discover that microcurrent pain management is both an easy and remarkably effective modality.

At this point there is still much to be revealed by nature about the effects and the mechanisms of microcurrent stimulation. This paper is designed to explain the mechanisms as I understand them and to make it as easy as possible to obtain consistent and excellent results in the treatment of pain with MicroTens™.

At its simplest, there are two electronic tissue responses you will be creating; using the Chinese terminology, these two responses are called stimulation (tonification) and sedation (dispersion). The terms tonification and stimulation are interchangeable, as are the terms sedation and dispersion.

The following explanation is a combination of Eastern and Western medicine, metaphor, and scientific research. As such, while you may be presented with ideas which appear to be in conflict with your traditional Western training, the two philosophies are actually very much in agreement. The way in which the concepts are explained may create a transitory illusion of philosophical disparity. If you keep an open mind and just let the pictures happen, the agreement between the Eastern and Western medicines will become clear.

ENERGY BALANCE STATES:

To begin the process, we will divide the conditions for which you may wish to use microstimulation into three classes; excess (congestion or inflammation), deficiency, and mixed.

DEFICIENCY:

Deficiency conditions are those in which there is a lack of energy in the area of pathology. These conditions are classified as cold conditions. The area is often cold to the touch and the blood supply is compromised. These areas have low electrical conductivity (high resistence) and are usually chronic. Muscle spasms are common in the deficient areas.

Deficient tissue will show cold when examined with thermography and deficiency is a common sequela if not actually a symptom of chronicity. It is like what happens when you try in vain to start your car over and over again. If the problem is some dysfunction outside the energy supply, say a bad solenoid, the battery eventually is depleted to the point where, even if the solenoid were to be replaced, there would not be enough energy to start the vehicle. Hence, after the primary pathology, the solenoid, is repaired, a secondary (energy deficiency) pathology would be in place. Re-establishment of the

electrical charge at the battery level would be necessary for the vehicle to function again. A trickle charge on the battery is what is necessary to restore function. As you will see, the trickle charge scenario is very close to what actually occurs when a patient is treated with microcurrent stimulation.

TONIFICATION is the process which is used to treat deficient tissues and SEDATION is the process used to treat congested tissue. Please note, this is not to imply that microcurrent stimulation is actually acupuncture, it is just that the acupuncture metaphors which have been developed over the past 5000 years may be successfully applied to enhance your understanding of the micro-therapeutic process.

CONGESTION:

Excess (congestive) conditions are those where there is an over-concentration of the body's energy in a given area. The area is often hot, acutely injured, red, and inflammed. These areas shunt the body's electrical energy away from the pathologically deficient areas of the body. They have high electrical conductivity (low resistence-see below). The high conductive parts of the tissues actually heat up just like a toaster's heating element glows red when high current is passed through the element.

Most conditions which have a congestive or inflammatory component actually are a combination of the two states and will require techniques for both the tonification and sedation. We will get to that later.

THE TISSUE'S PROPERTY OF ELECTRICAL CONDUCTION:

Electrical conduction is the ability of a medium to pass electricity. Electrical resistance is the ability of a medium to block the movement of current. One is the reciprocal of the other.

Tissues which are either congested or deficient may be evaluated by using one of several devices which have been designed for the specific purpose of evaluation of the resistance at the skin-electrode interface. The best of these devices display their feedback as conductance measurements which are displayed in relative rather than absolute units. These instruments have a function which is labeled GAIN and which is essentially a sensitivity setting. The GAIN allows the devices to be instantly customized (calibrated) to display the appropriate range of conductance which is dictated by the patient's electrical status at the time of the therapy.

Please note that the precise units which are displayed by these devices is insignificant. What is important is that the GAIN allows the therapist to track the changes which have been induced during the therapeutic session by observing the changes in conduction.

Also, you may hear talk of tissue resistance. Tissue resistance is the reciprocal of conductance. Simply put, as resistance decreases, conductance increases and vice versa. A unit with a conductance readout will display increasing numbers as the tissue's resistance is overcome. The difference between displaying resistance and displaying conductance is simply a point of view. Like whether the glass is half full or half empty.

A much more detailed explanation of the effect of the GAIN is offered later in this paper.

THE PRESUPPOSITIONS OF MICROCURRENT THERAPY:

To make this philosophy the easiest to understand, I offer list a series of presuppositions which will provide a framework for the therapy. You do not need to believe any of the presuppositions for the therapy to work but knowledge of them may make your results and responses easier to understand.

The presuppositions are as follows:

1.) Electricity travels via distinct pathways in the body. These pathways travel via the neurological, osteological, and myological systems as well as through the subcutaneous and connective tissue matrices.

2.) Each cell manifests the property of capacitance which is the ability to hold an electrical charge.

3.) Adenosine Tri Phosphase (ATP) is one of the primary molecules responsible for the cell's capacitance.

ATP contributes to the active transport mechanism which is one of the cell's primary homeostatic systems. It is used for establishment and maintenence of the cell's membrane potential, which is a particularly critical parameter for nerve cell firing, and for the removal of metabolic waste. It also provides the energy for transporting metabolic substrate into the cell to provice for cellular energy needs.

4.) Deficient tissue is that which has lowered intra-cellular concentrations of ATP.

Subsequently, deficient tissue has an abnormally low electrical charge and high electrical resistance. This may be due in part to the electrolytic imbalances which occur when the cell is unable to transport electrolytic substrate across the cell membrane. ATP is also important in the cell's processes of respiration (i.e. the Krebs cycle) and in the process of the establishment and maintanence of membrane potential (polarization) which is critical for the proper firing of nerves. By the way, microcurrent has been shown to increase the intra-cellular concentrations of ATP by up to 500%. Millicurrent does not have this ATP enhancing effects.

5.) Deficient tissue will exhibit low conductance readings.

Deficient tissue is often cold to the touch and will show decreased temperture when tested with thermography. Deficiency is a common sequela of chronicity. It is like what happens when you try to start you car over and over again. If the problem was some dysfunction outside the energy supply, say a bad solenoid, the battery eventually is depleted to the point where, even if the solenoid were to be replaced, there would not be enough energy to start the vehicle. Hence, after the primary pathology, the solenoid, was repaired, a secondary (energy deficiency) pathology would be in place. RE-establishment of the electrical charge at the battery level would be necessary for the vehicle to function again.

6.) Congestion refers to the tissue's energy state and does not refer specifically to localized hyperemia (although hyperemia is common in a congested area) nor does it refer to mucous accumulations in this context.

Congestion means that there is too much electrical energy in the area. Areas of congestion are generally smaller than areas of deficiency although congestion is just as devastating to the health of the patient. The congestive state results from high electri-

cal conductivity in the tissue causing excess electrical flow in the area which produces tissue over-heating.

Even in areas of extreme congestion, the tissues in the areas immediately surrounding the congested tissue are generally in the state of deficiency. As long as the congested state remains, energy bound for the nearby deficient tissues will be misdirected and will not arrive at the target tissue.

7.) Congested tissue is that which has inflammation. It is generally hot to touch or to a thermographic test.

8.) There is actually a "normal" energy state for tissue. The "normal" state is relative to the overall energy balance of the entire patient and is not a precise absolute or constant although there is a normal range.

9.) Electrical resistance is generally higher in areas of pathology than in normal tissue. If the area is "deficient" the conductance readings on the CONDUCTANCE readout will be lower than in areas of in congestion and normal tissue. Tissue with an active inflammatory process will have high conductivity although there will be low conductive areas of deficiency around areas of congestion.

10.) Inflammation will create the appearance of high conductance, even though there is will be tissue of a deficient nature immediately surrounding the inflammation. In order to treat (charge) the deficient tissue in a generally congested area, it is necessary to first eliminate or decrease the congestion by the process of dispersion (sedation).

THE ELECTRO-PHYSIOLOGICAL METAPHOR.

Before resuming the electronic techniques of the therapy, I would like to present the therapy metaphorically. I believe that the ability to make clear metaphorical pictures will aid considerably in the application of the therapy.

I often visualize that the patient as a garden. In the area of pathology there is a bed of flowers and the flowers are badly in need of water. The patient's tissue is the soil medium in which the flowers grow. The therapeutic outcome is to saturate the soil with water. The goal is the rehydration of the plants. This must be done without disrupting or damaging the garden in any way.

The garden must be watered not only on the surface, but deeply as well. On the surface the ground may be soaked by showering a fine, light, mist of water throughout the area as well as watering directly on the surface of the plants. The roots of the plants must also be rehydrated. In the garden there are some watering holes or canals which are deep holes which go down to the roots. If I pour water into the watering holes (acupuncture points) the water will go deep and spread out throughout the base of the root system (meridians). The root system will then carry the water up into the flowers where it will be dispersed throughout the garden as needed.

As stated above, for adequate watering, I need to have the soil saturated at the surface, and I especially have to break up and soften a number of very hard dry areas near the surface which are preventing the natural rains from penetrating into the soil. These are areas which are analogical the the electrically highly resistent tissues.

Restated for clarity, the dry areas are equivalent to the low conductive sites which must be charged from the surface to allow the body's energy to flow freely throughout the

area of involvement. The goal is to thoroughly water the entire garden both superficially and deeply to adequately rehydrate the plants. Using a misting device or a soaker hose is the equivalent of using microcurrent to charge the area. The result is that the entire area will have increased conductance when charging is complete.

By the way, areas of inflammation are analogous to canals in the soil which gather water and shunt it away from the area where it is needed. A deep canal (very high conductivity) has the ability to move massive quantities of water through an area without leaving any of the vital fluid in the areas of need to work its magic. Treatment of these areas is done by using a high frequency stimulation which will eventually cause the canals to saturate and then overflow into the surrounding soils. It is as if you were watering the area with a shower massager which, by its pulsing, helps to overcome the resistence or dryness and gently breaks up and soaks the clumps of dirt which are dried and hard.

For a negative contrast, you may choose to water the area with a fire hose. That is the equivalent of using a very high voltage and current setting. While it will soak the entire area and it will do it quickly, the result may not be what is desired. Once the current is applied, there will be so much disruption in the area that replanting the garden will certainly be necessary.

ELECTRONIC DISPERSION AND TONIFICATION:

When treating electronically, the dispersion process is done by treating the area with a high frequency (greater than 20Hz) and a negative polarity. Metaphorically, you can envision the negative current as one which removes energy from an area. (negative decreases).

Conversely, stimulation (tonification) is done with a low (generally 10hz or lower) frequency and a positive current. Again, you can envision the area as being filled using a positive current just as it is emptied by a negative clurrent.

Stimulation of any area over an extended period of time will send that area consequetively through the states of congestion, normalcy, deficiency, normalcy, congestion, etc. It does take much longer to push tissue through the threshold of congestion back toward normal than it does to charge or tonify deficient tissue.

Choosing the ideal frequency:

Frequency selection may be the most important part of the therapeutic process. Different frequencies have been reported in the literature to have varying effects on the body. There are basically 2 different kinds of frequencies, HIGH (dispersive) and LOW (tonifying). The low frequencies are any which are below 20 Hz. High frequencies, for our purposes, are those with a frequency of 30 Hz or above. 20 to 30 Hz is the transitional frequency range.

TONIFICATION:

The low frequency range is to be used on any pain problem with the following characteristics:

Chronic, cold, degenerative, or involving muscle spasm or tightness. For example, with a degenerative disease such as osteoarthritis, use the low frequencies. Chronic back pain, for example, or chronic pain of any type should be stimulated with the low frequency. The purpose is to bring energy to the area and charge the tissue. The exception is when there is inflammation in the area in which case you must sedate the area first. The ideal frequencies for tonification are .3 and 9.1 Hz. Tonifying stimulations can often be quite short. Generally less that 1 minute on stimulation is all that is necessary to tonify a small area.

SEDATION:

The HIGH frequencies (above 30HZ) should be used for inflammatory conditions and those of an acute nature, especially acute traumatic injuries. Any HOT condition qualifies for treatment with the high frequencies. For example, a recent trauma or any type of inflammatory condition such as rheumatoid arthritis would be a candidate for HIGH frequency stimulation.

COMBINATION:

Many situations or conditions dictate the need for a combination of both high and low frequency stimulation. A classic example would be the treatment of a tennis elbow (lateral epicondylitis of the elbow); The muscles which insert or originate on the lateral epicondyle generally are tightened or shortened in their muscle bellies and have inflammation at the tendons at the epicondyle. The treatment here is a 2 step process. First, the epicondyle and the surrounding tendons are treated with a high frequency, usually about 292 Hz. The purpose of this is to reduce (disperse) the inflammation. **NOTE:** It is always recommended to manage the inflammation first.

Inflammation often causes (or is caused by) localized areas of high conductivity. What is actually happening is that, at the inflamed site, there may be fascial planes or focal areas of inflammation. During the measuring phase of the treatment, the inflamed tissue carries the body's current as well as the instrument's measuring current through the fascial planes rather than through the muscles themselves. Because the inflammed tissue offers a specific pathway with resistence which is lower than that of the surrounding tissue (greater conductivity), the measuring and hence the treatment currents travel only through the inflammed areas. As the treatment at the high frequency stimulates the area of involvement, the highly conductive nature of inflammed area

decreases.

After sufficient stimulation (often 1 to 20 minutes at high frequency and negative polarity) the practitioner will generally observe a decrease in the conductivity of the area being treated. This is related to the inter-consuming-supporting and the inter-transforming relation of YIN and YANG. As is stated in the text, Essentials of Chinese Acupuncture, "Once a certai limit is reached, a change to the opposite direction is inevitable and the quantitive changes lead to qualitative change. " The cycle of YIN/YANG and CONGESTION/DEFICIENCY is pushed beyond threshold and the one transforms to the other. Continued stimulation will eventually push the tissue through threshold again and the cycle of congeston and deficiency will start again.

This means that after the period of hyper-stimulation, (known as sedation) the conductance reading will be lowered and it may then be necessary to raise the gain to bring the pre-treatment conductance level back up to the required 80 to 85% of scale. (340 to 370 for a device with a 400 unit full scale or 80-85 on a device with a 100 unit scale).

Although the long term goal of the treatment is to raise the conductance of the area, do not dismay. You are on the right track. The short term goal of a treatment in an area on congestion or inflammation is to lower the conductance. The conductance will eventually bottom out, usually within 2 to 20 minutes. Once the conductance finally stops decreasing, it will begin to raise. Continue treating at the high frequency for as long as the conductance keeps increasing. When the conductance is as high as it will go it will start to decrease.

After using the high frequency, switch to the low frequency. Continue treating with the low frequency for as long as the conductance continues to increase. Eventually you will reach a point where no amount of stimulation in a given area or at a specific point will increase the conductance any more. This is the end point for the treatment at this particular location and possibly for the entire area of involvement if the surrounding tissues also will not not increase in conductance.

Another common scenario in areas of inflammation is that, at first, the conductance increases, then it decreases, then it increases again. This happens when the tissue takes a charge first. Let me explain a little bit about the process of sedation. Sedation (decrease of the electrical charge in a given area) occurs when an area is stimulated past a certain threshold. You can also create the sedation effect by treating for an extended period of time with the low frequency. Even though the low frequency is the stimulation mode, eventually an area will have all the stimulation it can take and it will suddenly discharge, leaving the area sedated. Without becoming unnecessarily graphic, I offer sex as an analogous metaphor. This is a do it yourself metaphor. Consider that in a sexual encounter the experience is characterized by an increase in stimulation to a certain point at which the state on stimulation peaks and then suddenly reverses direction. Over time, the direction of sexual energy flow will once again begin to increase.

Back to our treatment of the epicondylitis: After treatment of the areas of inflammation, next move the treatment site to the bellies of the muscles which are involved. This is important. The tendonitis did not just occur on its own. It is secondary to to some major single traumatic event or it may be from an accumulative traumatic series of events. The classic condition known as TENNIS ELBOW is generally of the latter type.

After a period of time doing any repetitive activity, such as hitting or serving a tennis ball or turning a screw ten thousand times or shovelling dirt for several hours, the result

may be an activity related injury. In this type of injury there will be two phases to manage. The first is the inflammatory phase described above. The second is the muscular spasm, tightness, and ischemia as well as lactic acid accumulation which occurs in the associated muscle bellies.

The management of the muscle belly part of the treatment (the cold part) is done with low frequency only. Use .3,or 9.1 Hz frequency to help bring energy into the area and improve the local blood and electrical circulation. One of the primary causes of chronic tendonitis is repetitive trauma to the tendon when a joint tries to reach full extension numerous times with great force. If the muscle has been shortened even a little due to spasm or scarring secondary to muscle pulls and tears, there will be stress somewhere every time that joint approaches full extension. Since the tendons at the muscle's origins and insertions have a much smaller diameter than the muscle and are far less elastic, they are prone to damage from excess tension and will develop an inflammatory condition called tendonitis. Because of poor blod and electrical supply to this area, it is common for this condition to become chronic.

Tendonitis is generally a secondary symptom, secondary to the stress which occurs when the muscle reaches its maximum extension and centrifugal force pulls the joint further than the muscle will allow. In particular, if the muscle is spasmed (shortened), the stretch will reach into the inelastic tendons because full extension of the joint will be beyond the extensibility of the muscle. The logical place for the trauma to effect the system then is in the non-elastic tissue of the tendon. The inflammation occurs anywhere along the tendon and often where the tendon attaches to the periostium. There may also be an associated periostitis.

POLARITY:

For most therapy a bipolar or biphasic pulse is the most efficient. If you are treating specific points with the outcome of either sedation or stimulation, a direct polarity may accomplish the outcome the fastest. For tonification, use a positive current and for sedation of a point use a negative current. This polarity is measured with respect to the point being stimulated. That is, to treat a point with positive current (to tonify) , have the positive electrode on the point and the negative one on the body and the reverse is true for sedation.

THE ROLE OF MUSCLE SPASM:

I believe that most pain is directly related to muscle spasm. I agree that the spasm may be secondary to some other cause such as nerve impingement or trauma, but I still think management of the spasm is a critical aspect of the therapy.

When I say muscle spasm, I refer to any time the muscle in any area of the body is in any degree hypertonic. This includes the smooth muscle in the walls of blood vessels as well as quad, bi and triceps. As a matter of fact, the most important are probably in two groups, the paraspinal muscles (because of their effects on spinal nerves and on the meridians which are associated with the various spinal levels) and the vascular musculature. The smooth muscle of the vascular walls will, of course, effect the levels of oxygenation to whatever organs they serve. As is well known, ischemia is quite a painful condition whether it be in the coronary artary or in a small vessel serving only a single small muscle.

Regarding the effect at the spinal levels of the various muscle groups. At most levels of the spine, there is a pair of points, on the Bladder Meridian, called the associated

points. Each pair of associated points is related to one of the 12 standard acupuncture meridians. An imbalance at this level will result in an imbalance in the associated meridian. The associated points will be tender when the meridian that is associated to them is out of balance. When that imbalance is a deficiency, the tenderness at the point will be deep and when the imbalance is congestion, the tenderness will be superficial.

Below I will describe a number of ways to treat a muscle. Many of these techniques are also useful in other parts of the body.

1. Use the trigger and the non-trigger probe together through the bellies of the involved muscles. This is done by placing the electrodes on one side (lateral) and the other medial to the muscle belly. You can start at either the proximal or the distal end of the muscle.

After the probes are positioned, the gain is adjusted to give a conductance reading of 350 to 370 and then a 2 to 5 second stimulation is applied with the desired outcome of increasing the conductance reading from mid 300s to 400. Each time the LCD Display peaks at 400, lower the gain (sensitivity) until the LCD once again displays a 350 to 390 readout. Then stimulate again.

When you can no longer create an increase from 330/390 to 400 even with several second stimulations, move 1/4 inch towards the other end of the muscle belly and begin the process again. Sometimes you will find that you can create only small changes, like from 395 or 398 to 400.

If you cannot make even a small increase in the conductance reading, you are complete with the precise section of tissue that you are working on. Repeat until you reach the other end of the muscle. Repeat with every muscle which either originates or inserts at the involved joint.

2. Treat the muscle with an LED indicator electrode as the dispersive electrode plus the trigger probe. Put the Indicator Electrode on the center of the muscle mass. Search the muscle for the area of lowest conductivity and, with the trigger probe on the LCS (low conductive site) increase the GAIN until the conductance reads 350-390. Then stimulate the LCS until the reading reaches 400. Lower GAIN until 350-390 is displayed and repeat. When stimulation of this LCS is completed, move the trigger probe and search for and find another area of low conductivity. Treat it in the same way. If you are using a device which has no LED indicator electrode, this technique is obviously not for you or you may do it with a trigger probe and a non-trigger or reference electrode.

3. **HIGH CONDUCTIVE POINTS.** An additional way to treat this muscle is to search for very highly conductive points. You can think of these points as acupuncture points, trigger points or just electrical conduits into the deeper tissue.

Set the FEEDBACK just high enough that when you touch one of these points, there is an audible feedback and when you touch any of the immediately surrounding tissue, there is no auditory feedback. The lack of/ auditory feedback will also coincide with a decrease in the conductance reading.

Then stimulate the point using low frequency for about 3 to 6 seconds. What you expect is; 1) more highly conductive points will surface in the same general area and; 2) conductancereadings for the area immediately surrounding the point you stimulated will increase. Both methods of stimulation (high and low conductive sites) are valid. Your treatment will be even better and more effective if you use both methods on every case.

4.) Use a hand held ground, LED electrode or non-trigger probe plus the trigger probe. If you use the LED electrode or non- trigger probe, place it on an acupuncture point which is reputed to have the effect you are looking for or place it over the area of pathology. Once the first electrode is placed, turn the FEEDBACK up so that the auditory feedback only sounds when a high conductive point is touched. Set the FEEDBACK so that when you move the trigger probe even slightly off the point, the auditory feedback stops. This usually means that the FEEDBACK is set between 7 and 10. If necessary, the feedback must be then balanced with the GAIN setting as follows. If you touch an area which seems to be high and gives an auditory tone over a large area, (more than 1/4 inch diameter), lower the GAIN. As you lower the GAIN, the area of auditory feedback will reduce until it is only point (< 1/4 ") sized. The tissue which continues giving feedback is the high conductive point.

The GLOSSARY:

There are a few electronic terms which would be useful to understand in respect to electrical stimulation. These terms, when viewed using the water metaphor, will demonstrate to you why microcurrent is such an important parameter in effective electrical stimulation.

VOLTAGE: This correllates to the pressure behind the water. There may be a large amount of pressure present with very small amounts of current (small quantities of water). If the pressure is high, even very small amounts of water may come out with a driving force. Imagine, for example, putting your finger over the end of a hose to increase the distance that the water will go. That is the effect of pressure or voltage. If the pressure is high, it will cut a hole in the dirt faster, with the same quantity of water that will not even dent the soil under lower pressure. If the pressure is too low, there will be very little effect at all or the effect may simple be very slow.

CURRENT: When there is a low current (low quantity of water) even a high voltage will not do much, if any, damage. On the other hand, add a high current to the high pressure and the resultant stream of water will cut through very hard materials. Imagine, even with the pressure quite low, that a large hose is being used to water the garden and many gallons of water are flowing out of the nozzle into the garden. Since the pressure (voltage) is low, the water may be just falling out of the end of the hose, but it si falling out in large quantities). This type of treatment would still seriously disturb the soin and the plants as well.

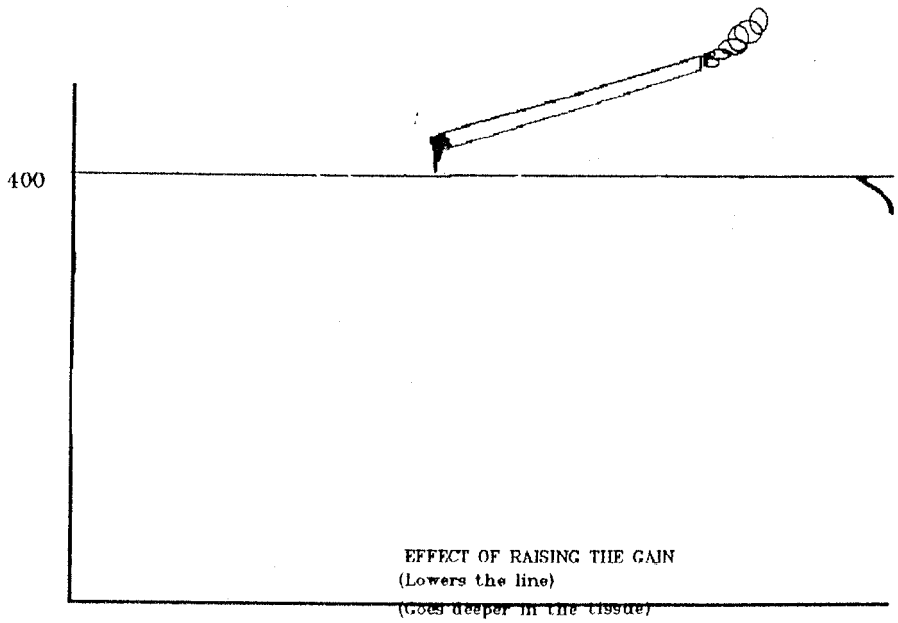
Finally, take the combination, though, of low voltage (15 to 30v) and low current (5 to 500 mucroamps). The result will be a current which will saturate the soil slowly, gently, and thoroughly without disrupting the soil. This corresponds to the effect of microcurrent stimulation.

An area of inflammation acts as a drain to the current being applied. Our goal is to store energy in the area of involvement. Treatment of the area with a high frequency (greater than 30 Hz) will break down the canals and the resistence in the area to the energy flow through the area will actually increase at first. Once you increase the resistence by high frequency stimulation, the current flowing through the area will impeded. This means that more of the current will stay in the area being treated until saturation is complete. Using another easy metaphor, if you wish to fill that bathtub, close the drain.

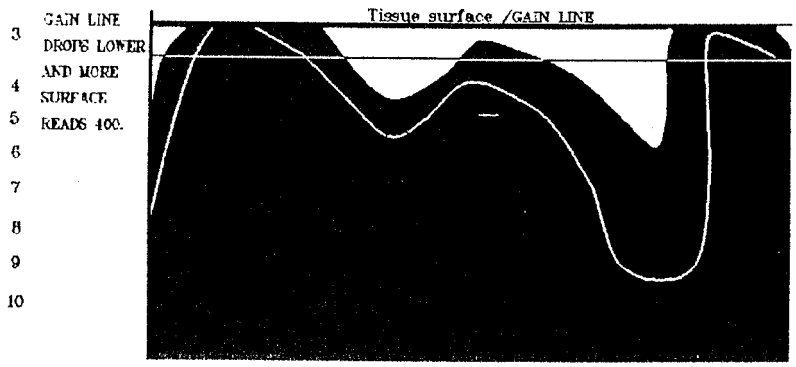
Another metaphor I use when picturing the ideal outcome for a microcurrent treatment is that of a frozen river. I picture some water flowing deep but the surface is frozen solid. There are some areas where the ice is quite broken and some water reaches the surface. These areas are like acupuncture points. The places where the water is frozen clear through are equivalent to the LCS (low conductive sites). The goal is to re-establish the river's flow. There are 2 ways to unfreeze the river. One is to pour large quantities of very hot water into the holes in the ice. In this way energy goes deep and melts the ice from below where the hot water comes in contact with the ice above. A second way is to chip away at the thick parts of the ice and pour hot water on the thick areas until there is a breakthrough into the deep, still running waters. Both methods work.

Now, if you would please make the jump from water to electricity. What we are actually doing when we treat the tissue with microcurrent stimulation is to charge tissue which

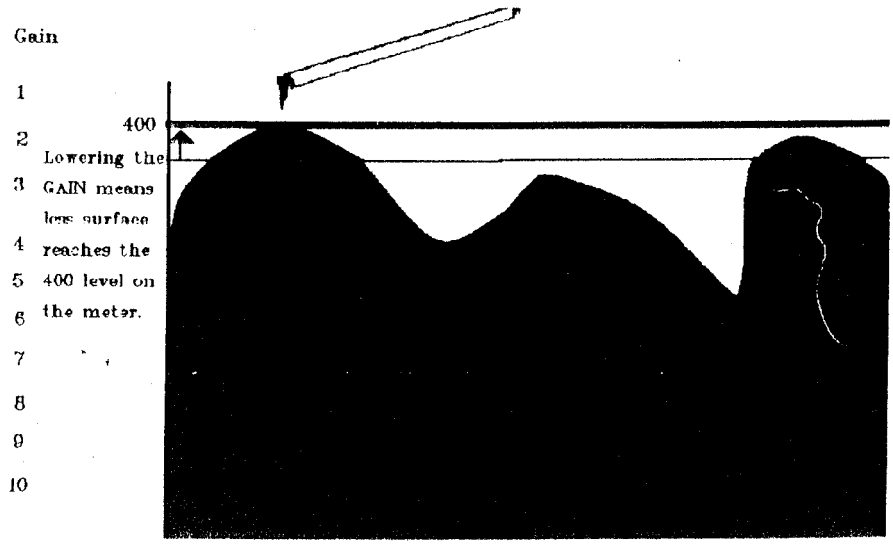
has lost its electronic resiliency, the ability for electricity to flow through and be stored in the tissue. That is, when the tissue has its optimum health, the body's electricity passes through the area with a minimum of difficulty and the body's biological batteries hold the charge vital to optimal cellular performance.



Finally the entire area is charged and it is time to seek another area of non-homogenous conductivity. That is, it is time to look for an area of low conductance in the midst of an area or areas of high conductance. Using the river metaphor, it is time to locate more chunks of ice floating in the otherwise thawing river.



When looking for a high conductive point, you are likely to find areas, such as that between the *s on the figure to the left. This means that the gain is too high this particular point. Remember, 400 is saturation of the measuring device and all 400 readings are not equal. The 400 at the periphery of the area of the probe is lower than at the cen-



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