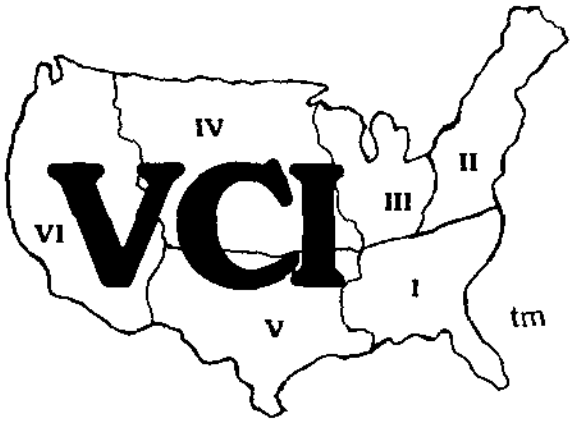

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AN INTRODUCTION TO VETERINARY ELECTRO-THERAPY

The following is an article presented by Joel Rossen DVM. Dr. Rossen is President of the California Veterinary Holistic Medical Association and Vice-president of the American Veterinary Holistic Medical Association. He has been involved with the study of non-pharmaceutical veterinary pain control methods for 11 years. In 1972, Dr. Rossen participated in an extensive veterinary pain control research project with the UCLA pain control unit in Los Angeles, CA. He has successfully used the techniques of Electro-therapy and acupuncture in private practice since then. At this time, Dr. Rossen is primarily involved as a consultant in the field of pain management for the medical and veterinary medical professions.

This article reflects the clinical experience of Dr. Rossen and does not imply endorsement of the technique, equipment or theory by VCI[tm].

This is an introduction, for the veterinary profession, to an exciting new development for the management of pain, feline leukemia, and ideopathic seizure disorders (epilepsy). The techniques described below have proven effective for veterinarians across the country during the past five years, and now, for the first time, I am presenting a synopsis of veterinary uses of electrotherapy.

I feel that your understanding of the techniques I am using will be enhanced by an introduction to the theory behind the device which is being used to administer the therapy. It is only the existence of this instrument that makes it possible to achieve the results described below.

The instrument employed for administration of electro-therapy is the ELECTRO-ACUSCOPE 80. It is a highly sophisticated transcutaneous electrical nerve stimulator which is currently being used in about 40 veterinary and nearly 2000 human medical practices nationwide. It requires no prior acupuncture knowledge and is so easy to use that most veterinarians can develop proficiency in about four hours. In practice, the ELECTRO-ACUSCOPE 80 has proven to be significantly more effective and versatile than laser devices, faster and easier than needles and, in addition, it has been approved for marketing by the FDA. It is manufactured in California by Biomedical Design Instruments, Inc. and has been in production since 1978.

The instrument has both diagnostic and therapeutic functions and a great deal of its effectiveness is linked directly to its unique diagnostic abilities. The ACUSCOPE actually gives feedback which indicates the locations of areas of pain or pathology; and it tells the therapist when an area has been successfully treated.

The theory of operation is based upon research done in the mid-seventies by Robert Becker M.D. at the V.A. Hospital in Syracuse, New York. His work proved that the electrical resistence of tissue is higher in areas of pathology than in areas where the tissue is normal. The reasons for the condition of high resistence are multi-fold and include the following:

1) Intracellular Adenosine Tri-Phosphate (ATP) deficiency is a result of metabolic exhaustion; ATP stores energy for the cell in the form of electrons. When stored energy is needed by the cell, the ATP is degraded to Adenosine Diphosphate (ADP) and a phosphate radical, and electrons are released to take part in the cell's metabolic functions. Insufficient ATP means a deficient supply of intracellular electrons (low charge), thus electrical resistence is elevated.

2) Deficiency of usable electrons at the cell membrane means that the Sodium Pump will have inadequate fuel and the cell membrane potential will be low. Nerve cell membrane potential, normally balanced at -85 millivolts, is an essential element of tissue conductivity, and low membrane potential creates a state of resistence.

3) Resistence also comes from intracellular lactic acid build-up and a deficiency of cellular metabolites. This condition is resolved by the re-establishment of the sodium pump and equilibration of the cellular membrane potential.

Additionally, Dr. Becker demonstrated that regeneration is a series of endothermic, electro-chemical reactions. What this means is that sufficient energy in the form of electrons is necessary in the area of pathology in order for the biochemical reactions of healing to occur.

Combined, these two revelations from Becker mean this; an area of pathology (whether of a traumatic or infectious origin) needs electrical energy in order to recover. Since energy will travel only via the path of least resistence, the high electrical resistence in the area of pathology effectively walls off the pathologic area from the body's own normal electrical flow. In this abnormal state, energy will circumvent rather than enter the damaged tissue.

Diagnostically, the Acuscope will show exactly where the electrical

Continued on page eight

Continued from page seven

blockage is and, using computer designed integrated circuitry, it can put a usable electrical charge on the tissue exactly where it is needed. It can eliminate the electronic blockades and will re-establish normal electrical flow. (A detailed explanation of these phenomena is available from me on request.)

For this article, I have chosen to concentrate on the above introduction to the theory behind the workings of the ELECTRO-ACUSCOPE 80 and case studies must therefore be kept to a minimum. An article promised for future publication will present detailed case studies. The cases presented below, and the positive results, are typical of those I have seen in my practice.

CASE 1: A young female mixed breed cat was presented with lethargy, depression and anorexia. Standard bloodwork revealed that the cat was FeLV positive. At my request the two other cats in the same household were tested for Feline Leukemia and they too were positive. The second and third cats appeared to be asymptomatic when therapy was initiated. By the second treatment the initial cat's symptoms had all disappeared; she was active, happy, and eating well. The big surprise was the greatly increased energy levels and appetites of the two 'asymptomatic' cats. The owner commented that she had not been aware that the other two were sick until, for the first time in their lives, they had become healthy and normal. A series of ten, ten-minute treatments was given to each of the three cats over a two month period. All three cats have remained asymptomatic now for over three years.

CASE 2: A mature (greater than six-year old) cat was presented with a two year history of stress related epilepsy. Seizures were daily and were poorly controlled by phenobarbitol. The seizures began when the original owner died. The seizures diminished somewhat over time, but became more severe when the new owner went on vacation, leaving the pet with a sitter. Two 15 minute treatments and complete withdrawal of medication produced an asymptomatic cat. During the following three years no recurrance has been reported despite intermittent occurences of stressful events.

CASE 3: A four month old golden retriever was presented with a front leg lameness. The radiographic diagnosis was osteochondritis dessicans with a large lytic area on the head of the left humerus. The dog was given a series of ACUSCOPE treatments over a four month time span. Radiographic re-examination showed that the lytic area in the head of the humerus had filled in completely. All lameness disappeared and now, three years later, the dog remains sound.

Similar results are typical for hip dysplasia, acceleration of delayed wound healing, old age syndrome, spondylolysthesis, intervertebral disc syndrome and wobbling produced by subluxated cervical vertebrae. Equally impressive results are produced in the equine and will be presented at another time.

the Mason metasplint was removed four weeks later, the dog could use the leg normally.

Case history No. 4

An 8-month-old female coyote was presented by an animal control officer one week after it was hit by a car. Radial nerve paralysis was present in the left front leg. After daily treatments with the acuscope, partial extension of the paw was evident on Day 5. Treatment from Days 6 to 10 consisted of therapy with the machine at the normal setting, then the upgraded setting, followed by eight minutes of manipulation with the roller electrode.

A Mason metasplint put on the leg after treatment on Day 11 was removed by the coyote during the night. The next day, the coyote was able to run normally and was released into its natural desert habitat on Day 13.

Comments

The principles of acupuncture have been used for 3,000 years. As the cases in this report seem to indicate, these principles can be applied with modern technology to formulate individual treatment plans to help reverse conditions such as radial nerve paralysis.

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INTRODUCTION TO ELECTRO-THERAPY

PULSE DURATION (PULSE WIDTH). The time the current is on to produce an individual pulse is typically less that one millisecond, and usually is in the 20 to 400 microsecond (millionth of a second) range. The significance of the short pulse duration will become apparent below.

INTENSITY. Shown as the height (or amplitude) in Figures 1 to 3, this is the amount of volts or amperage (the amount of current flowing, or the EMF, the force driving the current through the conductor). Depending on the instrument, either the level of volts or amps may be referred to by this Intensity parameter.

TOTAL CHARGE. This represents the total amount of current that flows during one pulse (or phase) of a pulsatile current. Total charge is the most critical factor determining the physiological effect. The total charge is shown as the shaded area under the curve in figure 3 (a and b).

RATE. Pulses generated per second, measured in pulses per second (pps), also called Hertz (Hz). Typically these range from less that one, to several hundred pulses per second. Certain specialized TENS and electro-acupuncture devices will have higher pulse rates.

MODULATION. Called alternately, surged, or interrupted, this refers to rhythmic changes in any of the pulse characteristics mentioned above - Wave Form, Duration, Intensity, or Rate. This regular variation in electrical output is said to prevent accommodation - the tendency of the sensory nerves to cease registering a steady stimulus that continues for more than a short time. Modulation mode is thus designed to minimize the need to make intensity adjustments during use. A common form of modulation is Burst, when 5 to 10 pulses are produced in quick succession (a "burst") followed by a much longer rest. Usually 2 bursts are produced per second.

E. PHYSIOLOGICAL EFFECTS

The most common application of electrotherapy in western medicine and in acupuncture is for pain relief, the second most common is for muscle stimulation. Electro-stimulation in acupuncture is also widely applied to specific acupuncture points or meridian pathways for the treatment of meridian imbalances or disease processes.

With modern electro-medical devices we can selectively stimulate different nerve fibers. Three types of nerve fibers are central to this discussion: A alpha and A beta fibers (conduct non-painful sensation), motor neurons (stimulate muscle contractions), and C fibers (conduct chronic deep pain signals). Comparing these three types of nerve fiber, resistance to current flow is lowest in the sensory nerves, greater in the motor nerves, and greatest in the C fibers. Therefore, greater total current per pulse is needed to produce the action potential in a pain conducting nerve. A motor nerve or sensory nerve is more easily stimulated.

We can stimulate the sensory nerve, to produce a tingling feeling (paresthesia), without producing any muscle contractions, or any pain. If we increase the total current, we will begin to see muscle contractions, but still without pain. If we continue to increase the total current we begin to stimulate the pain fibers, and cause pain. Selective engagement of specific nerve fibers is one key to understanding the modern medical application of electricity. It was only with the introduction of modern, very brief pulsatile currents (one millisecond or less), that this remarkable differential stimulation became possible.

F. TENS AND ELECTRO-ACUPUNCTURE

Three primary modes of treatment are common.

1) Stimulation below the level of action potential of even the highly conductive sensory nerves. The patient feels nothing at all. New research is being done in this area, including bio-stimulation lasers, ion pumping cords and more. There is as yet no widely accepted physiological explanation for the effectiveness of these therapies. Most of electro-acupuncture machines can produce outputs in this "micro-current" range.

2) Stimulation to excite the sensory nerves only - so called conventional TENS or electro-acupuncture. This is by far the most common mode in both western medicine and acupuncture. Usually a tingling, pleasant feeling is reported. Most commonly, Pulse Duration of between 40 and 200 microseconds, and Intensity in the 5 to 20 milliamp range are used. All conventional TENS and electro-acupuncture devices fit here. Ryodo-raku or other DC stimulators are not intended for this purpose.

3) Muscle stimulation - important in Physical Therapy, used for muscle reeducation. Special wave forms and electro-stimulation modes have been developed for this Physical Therapy application. In TENS or electro-acupuncture strong rhythmic contractions are usually desired. Most TENS and electro-acupuncture devices displayed in this catalog will produce moderately strong muscle contractions. This more intense stimulation at low pulse rates (via TENS or stronger electro-acupuncture) is thought to increase the production of endorphins. Some electro-acupuncture units may not be strong enough to produce strong contractions in large muscle groups. In selecting a machine for this application, either a TENS device, or an electro-acupuncture machine with maximum output over 50 milliamps is required.

By adjusting either the amplitude or the duration of a pulse to produce a greater total current (the area under the curves in Figures 1 to 3), each of the three modes above can be set. Each has its own physiological effect, and therapeutic uses. As mentioned previously, the narrow pulse widths of modern stimulators allows for this differential engagement of sensory, motor, or pain nerve fibers.

G. THEORY OF PAIN RELIEF

In the west two theories of pain and pain relief dominate discussion of the use of TENS. The gate theory and theories of the production and function of endogenous opiates - endorphins.

The Gate theory suggests that an increased volume of nerve signals from the sensory nerves to the brain will block transmission, or recognition by the brain, of the slower traveling painful nerve impulses. This blocking "fools" the brain into thinking the pain is gone.

Endorphins are our own internally produced pain killers, one type of a class of substances called endogenous opiates. They are generated in response to painful stimuli in nature, and apparently also produced by certain forms of more intense electro-stimulation. Such intense stimulation usually produces muscle contractions (see muscle stimulation above).

H. CONCLUSION

Electrotherapy has been used over the centuries because it works. The development of modern electronics allowing the selective stimulation of different nerve fibers has broadened the application of electro-stimulation. Treatment has also become more comfortable for the patient! As the mode of action of various new forms of electro-stimulation are made clear, we can expect ever widening applications of these modality.

I. REFERENCES ON ELECTRO-THERAPY

Several excellent books on electrotherapy and TENS are now available from Redwing Book Company, including: "Clinical Transcutaneous Electrical Nerve Stimulation" by Mannheimer and Lampe (636 pages), "New Frontiers in TENS" by Hymes and Tapio (250 pages), "Principles and Practice of Electrotherapy" by Kahn (295 pages), "Clinical Electrotherapy" by Nelson and Currier (200 pages), "Pain" by Michel (283 pages), and "Electro-Medical Therapeutics" by Newland.

Acknowledgements: Thanks to Jim Oschman and Eric Blomberg for technical assistance.

INTRODUCTION TO ELECTRO-THERAPY

A. INTRODUCTION

The application of electrical currents to the human body, both transcutaneously (non-invasive) and as electro-acupuncture (percutaneously), is both old and new. Electric eels were used in antiquity in Europe. Some of the ancient acupuncture needle manipulation techniques can be understood as ways of introducing a mild static charge into the body via the needle.

The best known form of electro-stimulation for needles is based on work done in modern China. Pulsed electrical current applied to the needles replaced vigorous hand manipulation for acupuncture anesthesia - pain relief in a dramatic form. Electro-stimulation of needles at a lower power (that feels comfortable) is also effective for pain relief, and is widely used today.

As mentioned above, electro-stimulation for pain relief in the west has a long history. TENS (Transcutaneous Electrical Nerve Stimulation) came into widespread use in the US in the early 1970's. It was originally developed as a non-invasive method to locate proper sites for implanted electrodes for relief of intractable chronic pain (dorsal column stimulation). When many patients noticed excellent pain relief from this non-invasive method, TENS was born.

The use of batteries or alternating current as a source for electrical stimulation, and the inclusion of modern electronic circuitry in electro-stimulation devices have led to new applications of electrotherapy. We should note that, although there are anecdotal and clinical evidence for the value of many different healing modes, from magnets to lasers to the laying on of hands, there are not yet clear scientific explanations for the effectiveness of these therapies. What follows is a brief survey of the physiological effects of electro-stimulation, and an outline of the electrical features of modern TENS and Electro-acupuncture devices.

B. PHYSIOLOGY

The action potential: Nerve and muscle cells have excitable membranes. In the resting state, there is a concentration of positive ions (+) inside the cell, and negative ions (−) outside the cell. If the concentration of − ions outside the cell is increased past a threshold level there will begin a rapid shift of − ions into the cell, and of + ions out of the cell. This is the action potential, and represents the firing of the nerve, "triggering action", whether a muscle contraction, or a sensation of pain, pleasure etc.

All physiological processes take place in the presence of these − and + ions. It follow, therefore, that even sub-threshold levels of current in the body will affect the ion concentrations, and that these sub-threshold currents - even though they are unable to be felt at all - must have effects on the body. Exciting work remains to be done to elucidate the many possible effects of these very tiny current flows. Could the production of such micro-currents account for the reported effectiveness of magnets and bio-stimulation lasers?

C. ELECTRICITY

CURRENT. Matter is composed of atoms, which in turn contain protons with a positive (+) charge, and electrons with a negative (−) charge. Some atoms can lose one or more electrons and be left with a positive charge, and are called positive ions (+). Other atoms gain electron(s) and become negative ions (−). Also, electrons can become free of a particular atom, and be free electrons. Current in a wire is free electrons, moving from a place of greater concentration to a placed of lesser concentration of electrons. The quantity of electrons passing a given point in a given time is called current, and is measured in Amperes.

VOLTAGE. There is resistance to the flow of electrons or charged ions in matter, and that resistance must be overcome to have a flow of electricity. The greater the difference in concentrations of + and − ions or of electrons on the two sides of the substance, the more "push" there is for the current to flow. This difference in charge is referred to as Electromotive Force (EMF) or Voltage.

RESISTANCE. This refers to the tendency of a substance, be it copper wire or muscle tissue, to prevent or resist the flow of current through it. Resistance is commonly measured in ohms. The relationship between volts (V), current (I), and resistance (R) is shown by Ohm's Law Equation: $V = I \times R$. Thus if the resistance is increased, and we wish to keep the same amount of current flowing, that is to say, keep the amperage the same, we must increase the voltage, and visa versa.

IMPEDANCE. The human body has a complex set of substances for electricity to move through. The word impedance describes this set of factors, the sum of which represents the ease or difficulty of flow of electricity through the body. Impedance is also measured in ohms.

EXAMPLE. Lets take an example from this catalog. Look at the specifications for the Pointer F-3 on page 20. 500 ohm test load refers to the resistance used in a test circuit. 500 ohms is used because it is an average impedance for invasive or non-invasive electro-stimulation to the human body. 0.7 to 42 Hz means we have a choice of pulses produced per second, from about 2 pulses in 3 seconds, up to 42 pulses in one second. Voltage output can be as high as 50 volts. Using the formula above $V = I \times R$, we see that at our 500 ohm test load ($R = 500$), if voltage is 20 ($V = 20$), then solving for I, we get ($I = 0.04$), commonly written as 40 milliamps.

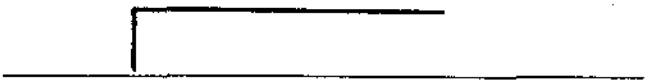

Figure 1

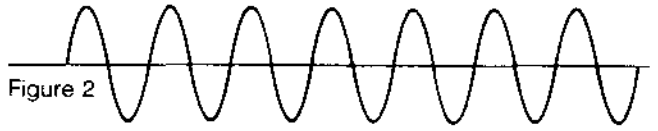

Figure 2

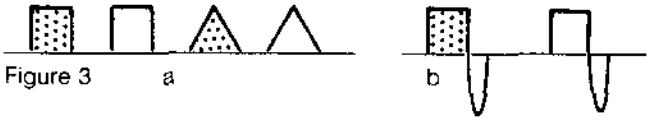

Figure 3 a b

D. ELECTRO-STIMULATOR PARAMETERS

DIRECT CURRENT. Figure 1. Direct current (DC) means the steady flow of electrons and charged ions in one direction only through the conductive medium. The earliest electro-stimulation devices in both the west and the orient were DC devices. The Ryodo-raku instruments are examples of this application.

ALTERNATING CURRENT. Figure 2. Alternating current (AC) means that the direction of flow of the electrons and charged particles changes rapidly (house current is an example). The change in polarity (direction of current flow) is measured in milliseconds (thousandths of a second) or in microseconds, (millionths of a second).

PULSATILE CURRENT. Figure 3. Pulsatile current flows in pulses of short duration, followed by a long off time when no current flows. Virtually all modern TENS and electro-acupuncture instruments generate pulsatile current of this type. Typically, this off time is 98% or more of each second.

WAVE FORM. There are three basic types of wave form for pulsatile currents: 1) mono-phasic (Fig 3a) which can be thought of as a very brief flow of direct current, 2) bi-phasic (Fig 3b) when current flows one way and then reverses direction before stopping, or 3) polyphasic pulses (not illustrated). Any of these waveforms is appropriate for TENS and other noninvasive application. For acupuncture or other invasive uses, bi-phasic pulses (Fig 3b) should be used (symmetrical if possible), to prevent excessive charge building up in the tissue and damaging the nerve, or pitting and weakening the needles.

ELECTRO-ACUSCOPE

The Electro-Acuscope is an electrotherapeutic instrument which acts upon subcutaneous tissues to reduce pain and inflammation. It will also improve blood flow in circulatory-impaired tissues.

Many types of tissue cells have membranes with ion channels that are voltage-sensitive. Electrotherapeutic currents can increase the entrance of substances such as calcium ions which turn on repair mechanisms within those cells. Sensory nerve endings, for instance, release vasoactive peptides in response to the entrance of calcium. The Electro-Acuscope monitors the electrical conductivity and impedance of the tissue, and also can compute important electrical characteristics of the tissue from the current and voltage pulses themselves. Using this information, it adjusts the shape of those current and voltage pulses in order to optimize treatment effectiveness. The output pulses of the Electro-Acuscope are neither constant-current nor constant-voltage during their duration, but are between the two modality limits.

MYOPULSE

The Myopulse instrument is designed to treat connective tissue associated primarily with muscle. The amplitudes of the current and voltage pulses continuously vary within a "sinusoidal modulation envelope." It is well established that the membrane of each muscle fiber contains voltage-controlled calcium ion channels.

Much of the effectiveness of the Myopulse instrument appears to be due to modest increases in internal calcium which, though inadequate to cause muscle contraction, could still result in increased ATP and protein synthesis in order to prevent atrophy, accelerate tissue repair and alleviate pain. (It would not be desirable to induce muscle contraction in the manner of conventional muscle stimulators, because this would use up ATP which could be put to better use as an energy source for synthesizing new cellular repair molecules.) Since the current and voltage pulses have constantly varying amplitudes over the four-second period of each modulation envelope cycle, some impulses will be optimal for each portion of the three-dimensional current field (even to considerable depth into the tissue). Some of the current pulses will have an initial current overshoot portion that can open higher threshold ion channels especially in regions of the current field that are closer to the electrodes. In addition to monitoring the current waveform of each pulse, the Myopulse instrument also has special current and voltage monitoring impulses to provide tissue impedance information.

UNIQUE FEATURES WHICH INCREASE THE EFFECTIVENESS OF THE ELECTRO-ACUSCOPE

The waveform of the current pulse of the Electro-Acuscope has both a short duration current overshoot (100-200 microsec.) and a longer duration current plateau (2-200 millisec.).

Short duration pulses have been shown to be quite effective in healing ulcers (Feedar, Kloth, Gentzkow, 1991), burns (Cruz et al, 1989), reduction of edema-producing capillary leakage (Bettany et al, 1990), and in stimulating protein and DNA synthesis in cultured fibroblast cells (Bourguignon and Bourguignon, 1987). This short duration overshoot pulse portion of the Electro-Acuscope waveform will also be more effective in opening the N-type calcium channels that predominate in sensory nerve endings that release neuroactive and powerfull vasoactive peptides such as CGRP (calcitonin gene-related peptide) (Maggi et al, 1989; Fox, Nowycky, Tsien, 1987).

On the other hand, the longer duration plateau portion of the Electro-Acuscope waveform is a more efficient way to open, and keep open, the non-inactivating L-type of voltage sensitive calcium channels which predominate on human fibroblast cells, so important for tissue repair (Chen and Hess, 1987; Fox, Nowycky, Tsien, 1987).

The Electro-Acuscope monitors the electrical impedance of the tissue and adjusts the output waveform to optimize its efficacy. When the D.C. tissue resistance is lower than normal (as would be expected when the insulted tissue is characterized by a disruption of its extracellular matrix) the width of the current overshoot portion of the pulse increases (to 200 millisec. or more on the highest current setting). This will open more N-type calcium channels on the sensory neurons that release the neuroactive and vasoactive peptides (CGRP and substance-P).

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A Semi-Technical Explanation of the Bio-Electronic Effects of the Electro-Acuscope 80

The Electro-Acuscope 80 is a rather new concept in medicine. Its high degree of effectiveness is based upon a series of electronic and electromagnetic manipulations of the patient's tissues.

During the treatment, the operator works in tandem with the acuscope. The instrument acts as an auxiliary intelligence in treatment regime. That is to say, it is pre-programmed to respond to changes in the patient's electrovibratory rate, capacitance, and resistance with changes in its own output within a set of parameters set bythe operator. DON'T QUIT NOW!! READ ON!! This will all make sense later on.

If all this sounds complex, that's because it is. The true beauty of the instrument is that it will work whether you understand any part of this paper or not. Below is part of what's happening at a cellular and molecular level. The following will allow you to picture what is going on but it will not make a lot of difference in your Electro Acuscope technique.

It takes about 4 hours to learn competence with the Acuscope. The parameters are preset and 99 percent of the instrument function is automatic. Using settings that can be learned in less than one hour, the application of the electrodes to the pathology will put the patient on the road to recovery.

The following is a capsulized explanation of some of the electronic phenomena involved with acceleration of the healing process and reduction of pain levels.

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 pro vide 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 4 picoamps). The patient's body contains more than a sufficient quantity of energy to produce the desired effect. Unfortunately, the resistance in the area of involvement is so high that the energy flow will not enter 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 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 at the area of involvement. This is done by treating 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 electrical flow. Additionally, as cell charge increases, the molecular kinetic energy 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 electroconductivity (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.

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 (adenosine triphosphate) 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 deficient in ATP. It follows, therefore, that the electrical energy of these areas must be below standard. 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 trans-membrane movement of sodium, potassium, calcium, metabolic waste and metabolites, requires large amounts of energy to

move ions in and out of the cell. Metabolic wastes build up in toxic concentrations when a cell is not respirating properly. Simultaneously, the intracellular, oxidizable metabolite concentration is reduced. The energy from the ATP fuels the reactions which establish balanced membrane potential gradients and which 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, starving cell. Not a pretty sight.

Re-establishment of the Sodium Pump function occurs when the application of the Electrovibratory Current to the cell increases mitochondrial function. The increased EVR of the mitochondrial inclusions is translated into kinetic energy. This translation manifests as an increased concentration 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 bioelectric ionic concentration gradient. What this means is that cell membrane potential 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.

You have now laid the foundation for the recovery process. In most cases, the patient will improve after one treatment, then plateau. It generally requires a series of treatments over a two week period to give the long-lasting effects which are the signature of Electro-Acuscope. Because the benefits of the Acuscope are cumulative, each subsequent treatment will require a shorter application and will provide greater relief. Ultimately, the effect of each treatment will be to provide 6 weeks to 6 months or, as in many cases, permanent relief from the pain.

By necessity, this is just a brief introduction to the effects of bio-electronic electrovibratory tissue manipulation. If certain questions remain unanswered, ask. More papers will be forthcoming so that we may delve deeper and deeper into the many ways that the professions of healing can harness the laws of physics as we enter the next dimension in the field of medicine.

The following is **a partial explanation of the Electro-Acuscope**; what it is and what it does. I hope this may clarify some concepts for you.

The Electro-Acuscope is a relatively new concept in the health care delivery system, being available since 1979. Its high degree of effectiveness is based on a series of electronic manipulations of tissue cells with low voltage, low amperage current. The Electro-Acuscope considers the cells of the body as tiny electrolytic batteries, each with a potential current flow of approximately four pico amps or four trillionths of an ampere. The Electro-Acuscope measures where the cellular battery has been discharged and then produces the ideal voltage to painlessly maximize the charge on the cells, normalizing the electrical impedence of the tissue.

The following three points are a brief explanation of some of the electronic phenomena involved with acceleration of the healing process and the reduction of pain at the cellular and molecular level:

1. All molecules, above the temperature of absolute zero, vibrate with characteristic rates, amplitudes and intensities.
2. Body cells that have degenerated to the point of pathology have higher resistance than normal cells. Electrical energy flow is much like water; i.e., it follows the path of least resistance, which tends to impede the healing process, since current flows around rather than through the resistant tissue.
3. Regeneration involves a series of endothermic and electro-chemical reactions. In simple language, this means that electrical current in extremely small quantities is needed to provide energy to help fuel the regeneration process of the involved cells.

The Electro-Acuscope is made up of three very unique components. The first is the monitoring or measuring aspect. It may be thought of as a very sophisticated **biofeedback instrument**, but instead of the information being fed into an ocilloscope or a dial with a needle, it is fed into the second component which is computerized. The **computer circuitry** has been **pre-programmed** with a vast range of cellular frequencies which are used as reference data. These references are then compared with the frequencies picked up during the monitoring phase so that the degree of cellular imbalance can be ascertained, i.e., whether the cellular resonance is excessive or subnormal.

Once this has been determined, the computed formulated treatment is then given to the third component, which is a very sophisticated **electronic oscillator**. All the current delivered by the Electro-Acuscope is

created from a vibratory source. This is very important because, as was stated earlier, this is the same type of electricity created normally by the body cells each having their own characteristic EVR (Electro-Vibratory Rate). Therefore, the Electro-Acuscope is not forcing an abnormal current into the cells or one that will overpower the body cells. The amperage employed by the Electro-Acuscope is between 25/millionths to 500/millionths of an ampere; this is the same micro-electrical low energy potential that the body actually uses.

The processes previously described, the monitoring and treating, take place many times per millionths of a second. It monitors for $2^1/_2$ milliseconds, formulates a treatment, then treats for $2^1/_2$ milliseconds attempting with each cycle to normalize any monitored imbalance.

To illustrate how this works in the body, let's pretend for a few moments that we have the world's finest, most accurate and most sophisticated electronic piano tuner. Let's also pretend that each body cell is a string on a piano, each with a known normal vibratory response (EVR). Now let's suppose the tuning instrument sends out a stimulus that causes each string to vibrate. If any of these strings vibrate at an abnormal rate, the electronic piano tuner's computerized circuitry picks this up and will attempt to tune these strings automatically so that they will be in harmony and resonate at the proper rate.

Treatments with the Electro-Acuscope are designed to help bring about homeostasis or normal balance like that of healthy tissue from an electro-chemical and electro-magnetic standpoint. When this balance can be recreated even for a moment, cellular function can begin to operate in a regenerative and ultimately more normal way.

As was mentioned in the beginning, this is only a partial explanation to help you understand how the Electro-Acuscope works to reduce pain and accelerate the body's healing processes. The Electro-Acuscope is *not a diagnostic instrument*, nor is it intended to be used to prevent, treat or cure any disease process. It is designed to accurately provide the electronic signals which most effectively activate the body's mechanisms of self-repair.

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 are already aware of the remarkable effectiveness of treating 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, the first section of this paper will outline a comparison between milliamperage and microcurrent devices. (By the way, 1 microamp (μA) is one millionth of an ampere or 1/1000th of a milliamp [Ma]).

As recently as fourteen 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 more 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 20 Ma 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 to many hundreds of years before the accomplishment of the commercial production, storage, 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, the use of electrical stimulation has become increasingly 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 dangerous. High doses proved to be 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 much less than 1% of the strength 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. Electrical current levels in the neighborhood of 20 to 110 milliamps were once and to a certain extent still are commonplace. 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.

SPORTS HISTORY

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 stimulation 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 1988 Forty-niners to win yet another Super Bowl. Carl Lewis' remarkable 1988 Olympic victories were a victory for microcurrent as well.

SCIENTIFIC HISTORY ..... *Research into tissue healing*

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 tran-

sected simultaneous with the induction of a tibial fracture. The healing rates of this group were compared with those of a control group. The control group had the fracture induced and the nerve left 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 amount of 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 encoded messages from the DNA 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 (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. The electronic frequencies used also seem to be quite important. In addition to sophistication of current levels, the frequencies of stimulation and the electrical wave forms of treatment are becoming increasingly sophisticated and well defined as the science of micro-electrotherapy approaches maturity.

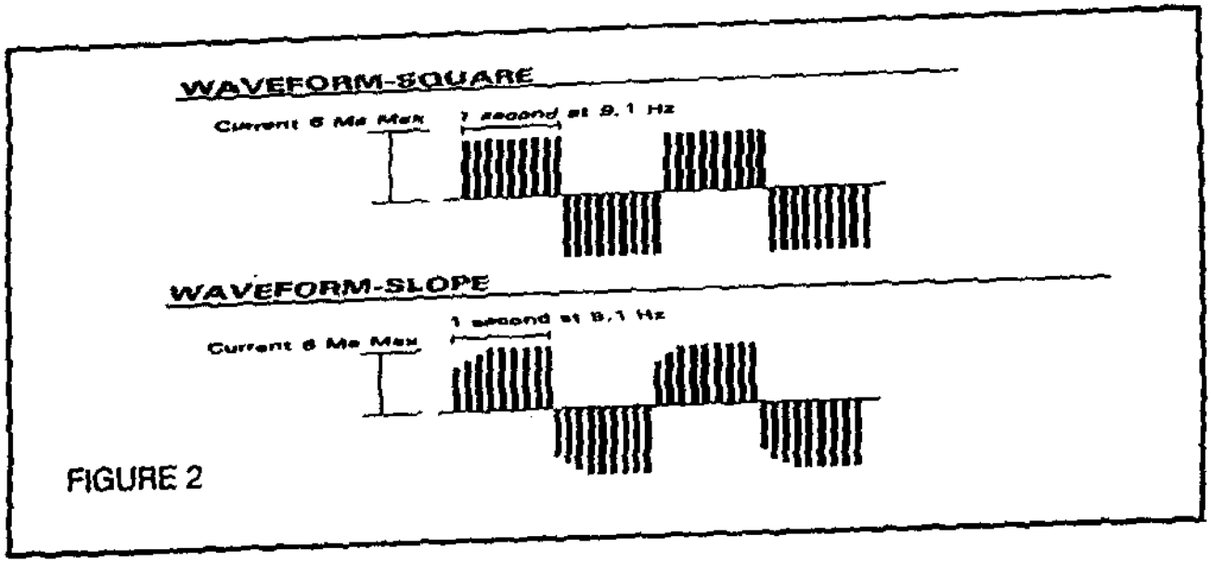
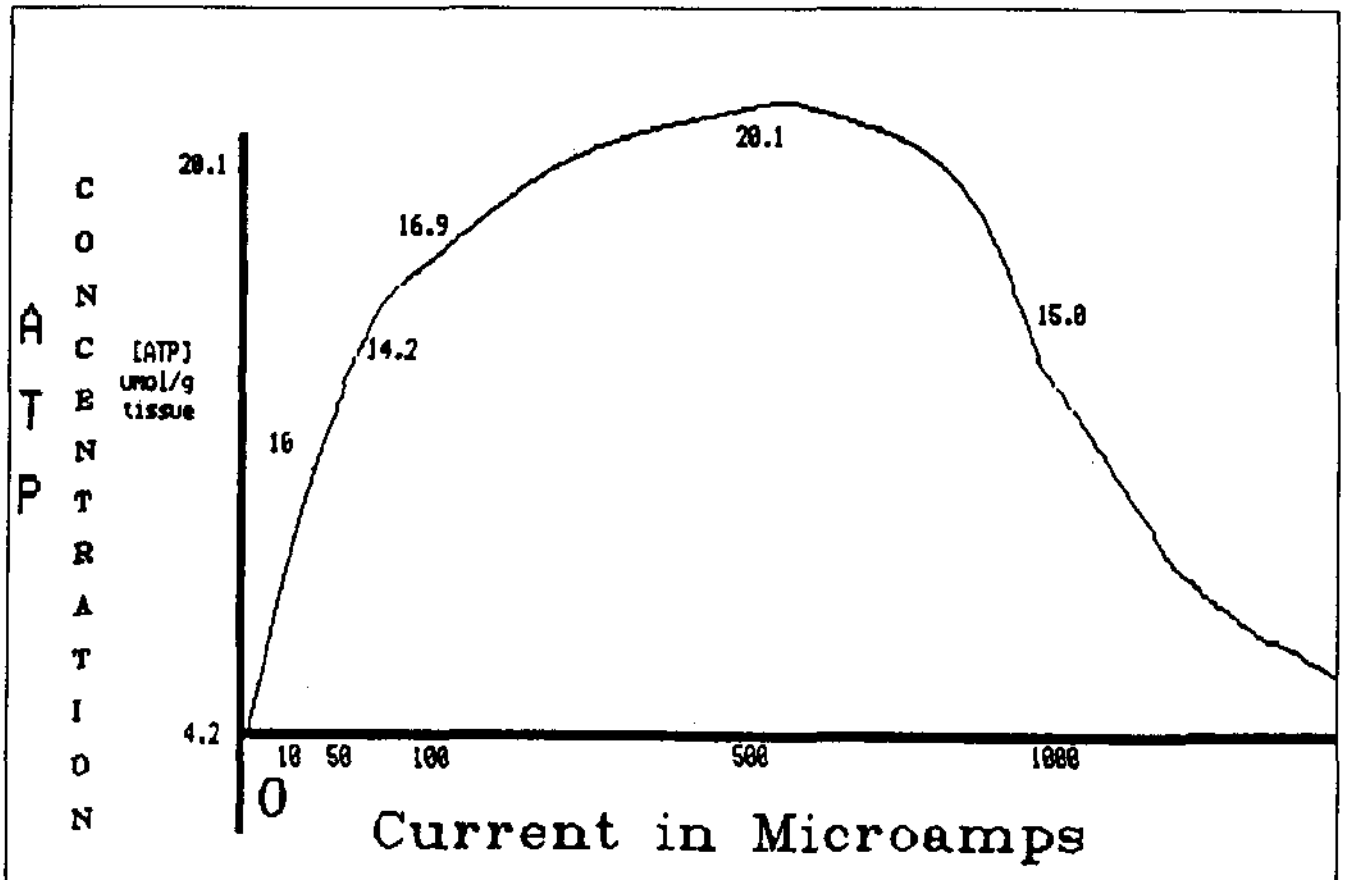


FIGURE 2

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, # 1 71, Nov.-Dec. 1982) on the effects of microcurrents on Adenosine TriPhosphate (ATP) concentrations and protein synthesis in rat skin. ATP deficiencies are common in areas of chronic pain. Sufficient ATP concentrations are essential to power the processes of cell respiration and metabolism. 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.

Dr. Cheng's study demonstrated that glycine incorporation into rat skin proteins was significantly stimulated by a constant current varying from 10 microamps to 1000 uA. The maximum stimulatory effects were obtained at 500 μA 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 25μA and 1000 μA (1 Milliamp). Marked increases in protein synthesis were also observed from stimulation in the microamp range. Insofar as protein synthesis depends on adequate ATP levels, the increased ATP levels must be at least partially responsible for the increased protein synthesis. Overall, the greatest stimulatory effects were obtained around 500 microamps. (See graph on page 4).

Higher current intensities, exceeding 5000 μA (5 milliamps), inhibited protein synthesis with currents as low as 1.5 Ma. In the 10 to 30 Ma range, the cellular glycine



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 500 uA with a 500% increase in the concentration of 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.

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 μA to 1000 μA increased transport of amino acid analog by 30% to 40% over untreated 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-inflamed abnormal tissue is higher than that of the immediately surrounding normal or less pathological tissue;

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

If there is inflammation in the area the problem is compounded. Inflamed tissue has very high electrical conductance. It literally attracts any electricity flowing near it like a lightning rod attracts lightning. The elevated 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. The excess current through the area of inflammation further heats up the inflamed areas because of the increased current flow through already overly electrified tissue. The body's energy, which was electrical in nature, has been transformed to heat. The heat energy is useless to the cells and is essentially wasted. Huge amounts of energy can be wasted by the inflammatory process.

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.

In a chronic case the body's energy will simply circumvent the area of involvement and in an acute case the energy will both circumvent and be transformed into heat and be wasted as it is radiated away from the body.

Since the laws of physics seem to be immutable we must enable the energy to charge the deficient pathological tissue while continuing to obey the laws. 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 rechargeable 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 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 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. Biological*ly, the capacitance of the cell is directly proportional to the concentration of ATP in the* cell and ranges from about 1 to 3 micro farads. 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 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, metbolic 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 does not have proper respiration. Simultaneously, the intracellular, oxidizable metabolc substrate concentrations are reduced.

Energy 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, hypoxic, starving cell. Not a pretty sight!

Re-establishment of the sodium pump occurs when the increased available intracellular energy results in enhanced mitochondrial function which in turn increases intracellular ATP concentrations. The work of Dr. Ngok Cheng, et. al., has shown that ATP concentrations are only affected positively when the applied electrical flow is in the range of from 25μA to less than 5 milliamps, the normal working range of the Acuscope. 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 and energy available to the mitochondria enhance 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 synthesis. 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 noticeably reduced and tissue regenerative functions are re-established.

PART II
Treating Using Microcurrent Therapy

The 80's saw the rise of a new generation of electrical stimulation, the microcurrent generation. Although it has been used in the field now for over fourteen years, microcurrent stimulation is only now beginning to be understood, even by those who have been doing it successfully for a decade.

Part I of this treatise was designed to provide an overall understanding to the physiological 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 microcurrent.

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

This explanation is a combination of Eastern and Western medicine and metaphor. 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. Keep an open mind and just let the pictures happen. If any part of this explanation is in conflict with your training or beliefs, fine. I only ask that for the next fifteen to twenty pages, try to entertain two separate levels of consciousness at the same time. Later, the one which feels the most true will remain for you.

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), deficiency, and mixed. The vast majority of cases you treat will be of the mixed variety.

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 resistance) and are usually chronic. Tissue energy deficiency also occurs as a sequellae to congestion, so you may assume almost all cases you will ever be involved with will have some degree of deficiency. Most will have a congestive component. In other word, almost all cases, other than those of a very chronic nature, will be mixed, deficiency and congestion.

Thermographic examination will show cold spots (tissue temperature is decreased) when examining deficient tissue. Deficiency is a common sequela of chronicity.

A deficiency syndrome is similar to 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 (that is, the battery is good and charged), 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. Fortunately, unless the battery is ol d and dying, this does not usually kill the battery. If left to rest, that battery may even restore itself enough to get another start out of it.

Hence, even after the primary pathology, the solenoid, is repaired, a secondary (energy deficiency) pathology remains. Re-establishment of the battery's electrical charge level is still necessary for the vehicle to function again. A trickle charge on the battery is what is necessary to restore function.

CONGESTION:

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

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.

I believe that congestion is actually the biological equivalent of an electrical short circuit. The toaster metaphor still works, but the true analogy is to a toaster which has a short and will eventually burn out.

TONIFICATION/SEDATION:

TONIFICATION is the process which is used to energize deficient tissues and SEDATION is the process used to treat (cool off) congested tissue. Please note, this is not to imply that microcurrent stimulation is actually acupuncture; it is just that the acupuncture metaphors may be successfully applied to enhance your understanding of the microcurrent therapeutic process.

THE TISSUE'S PROPERTY OF ELECTRICAL CONDUCTION:

Electrical conduction is the ability of a medium to carry (conduct) electricity. Electrical resistance is the ability of a medium to block or reduce the flow of current.

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 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 device's measuring output to be rapidly calibrated to conductance readings in the range 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.

In the context of conductance, you will 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 decreases. 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 include neurological, osteological, and myological pathways 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 and energetic systems. It is used for establishment and maintenance of the cell's membrane potential, which is a particularly critical parameter for nerve cell firing/re-polarization. The active transport system provides the energy for transporting metabolic substrate into the cell for cellular energy needs and for the removal of metabolic waste .

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 maintenance 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 effect.

5.) Deficient tissue will exhibit low conductance readings.

Deficient tissue is often cold to the touch and will show decreased temperature when tested with thermography. Deficiency is a common sequela of chronicity. It is like what happens when you try to start yourcar over and over again. As stated above, 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 battery's electrical charge would be necessary for the vehicle to function again. The metaphor is repeated because it is the key to your understanding of the deficiency process.

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 electrical conductivity in the tissue causing excess electrical flow in the area which produces tissue overheating.

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 destined for the nearby deficient tissues will be redirected through the congested cells and will not arrive at the target tissue.

7.) Congested tissue is that which has inflammation. It is generally hot to the 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 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.) Even though there will be tissue of a deficient nature immediately surrounding the inflammation, the inflammation will create the appearance of high conductance, In order to treat (charge) the deficient tissue in a generally congested area, it is always necessary to first eliminate or decrease the congestion (clear the short circuit) by the process of dispersion (sedation).

THE ELECTRO-PHYSIOLOGICAL METAPHOR.

Before resuming the electronic theory 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 your understanding and in the application of the therapy. Clear

intent is one of the keys to masterful energy therapy. No matter what your therapeutic approach, a clear picture of your desired outcome will enhance the likelihood of arriving at that outcome.

GARDEN METAPHOR: I often visualize 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 soil is dry. 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 can 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 you may imagine that there are some watering holes or canals (points of high conductance like acupuncture points), deep holes which go down to the roots. If water is poured into the 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 stems and it will be dispersed throughout the plants as needed.

As stated above, for adequate watering, the soil must be saturated at the surface. The gardener may 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 analogous to the electrically highly resistant tissues. Additionally, if there are canals or furrows which divert the water away from the garden, these defects must be corrected before rehydration of the garden begins.

Restated for clarity, the dry areas are equivalent to the low conductive tissue 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 the furrows in the soil which gather water and shunt it away from the area where it is needed. A deep channel (very high conductivity) can move massive quantities of water through and around the affected area without leaving any water in the garden to do work. Treatment of these areas is accomplished 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 the area were being watered by shower massager which, by its pulsing, helps to overcome the resistance or dryness and breaks up and soaks the clumps of dirt which are dried and hard.

A BAD EXAMPLE: You may choose to water the area with a fire hose. That is the equivalent of using a very high voltage and current setting. Although it will soak the entire area and it will do so quickly, the result will not be what is desired. Once the current is applied, there will be so much disruption in the area that replanting the garden (healing) will certainly be necessary.

Fire Metaphor: When you are treating an area of inflammation, the tissue is hot. Imagine that it is on fire. We will be treating the inflammation with the high frequency. Imagine that the high frequency floods the area.

What happens when you put water on a big fire, and then stop flooding the area before the fire is completely out? The fire flares up again. That is what happens when you treat an area of inflammation with low frequency.

On the other hand, if you continue dousing the fire continuously until it is out, it will not flare up again. That is what happens when you stimulate (sedate) with a high frequency. Conversely, tonification is attained with a low (generally 20hz or lower) frequency.

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 two 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 and the effect of these frequencies depends upon the length of time of stimulation.

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 osteo-arthritis, use the low frequencies. Chronic pain of any type should be stimulated with low frequency. The purpose is to bring energy to the area and charge the tissue. The exception is where there is inflammation in the area in which case you must sedate the area first. The ideal frequency for tonification is 0.5 hz. Stimulation for the purpose of tonification is often very short. Generally less that one minute is sufficient to tonify a small area or a meridian.

SEDATION:

The HIGH frequencies (above 30 hz) 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:

Most situations or conditions dictate the need for a combination of both high and low frequency stimulation. A classic example would be the treatment of tennis elbow (lateral or medial epicondylitis of the elbow). The muscles which insert and/or originate on the affected epicondyle of the elbow generally are hypertonic or shortened in their muscle bellies and have inflammation of the tissues of the tendons where they meet the bone. The treatment here is a two step process. First the epicondyle and associated muscles and tendons are treated for inflammation using high frequencies, generally 40-80hz.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 area 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 conducts the body's current as well as the instrument's measuring current through the fascial planes rather than through the muscles themselves. Because the inflamed tissue offers a specific pathway with resistance which is significantly lower than that of the surrounding tissue, the measuring current, and hence the treatment current as well, travel only via the inflamed tissues. As the treatment at the high frequency sedates the area of involvement, the hyper-conductive nature of the inflamed area decreases.

After sufficient stimulation (often 1 to 3 minutes at high frequency)

the practitioner will generally observe a measureable decrease in the conductivity of the treatment area. This is related to the inter-consuming- supporting and the inter-transforming relationship of the YIN and the YANG. As stated in the text, Essentials of Chinese Acupuncture, "Once a certain limit is reached, a change to the opposite direction is inevitable and the quantitative changes lead to qualitative change". The cycle of YIN/YANG and CONGESTION/DEFICIENCY is pushed beyond the threshold and the one transforms to the other. Continued stimulation will eventually push the tissue again through threshold and the cycle of congestion/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 80-95% of scale.

Although the long term goal of the treatment is to raise the conductance of the deficient tissue, beginning the therapeutic session with sedation is correct. You are on the right track. The short term goal of a treatment in an area of congestion or inflammation is to lower the conductance. This is done by stimulating the area at a high frequency current for as long as it takes to "take the conductance over the top". Your goal is to take the conductance as high as you can until it reverses direction and starts to fall. Continue treatment of the area or point until the conductance bottoms out and reverses direction. This marks the beginning of the tonification process. You may also use palpable heat to evaluate the treatment's progress. When the heat in the treated area subsides, you may move on the phase 2 (tonification).

When you enter the tonification stage, it is time to shift gears. Change the frequency to low Continue tonifying for as long as the conductivity 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 conduct ance any further. 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 increase in conductance.

A common scenario in areas of inflammation is that, at first, the conductance increases, then it decreases and then it increases again. Let me explain a bit about the process of sedation and the need for it.

Congestion is not exactly an overcharge of the tissue. What is present in an area of congestion is tissue which is highly conductive.

TOASTER METAPHOR: Earlier I mentioned a toaster, now I return to complete that comparison. When a toaster is turned on and you look down into it, you will observe wires (elements) which glow bright orange. These wires are very hot and have electricity passing through them exciting the electrons and causing photon release. When an area is inflamed, it will have an elevated temperature and often it will appear red.

The conductivity of the elements is higher than the conductivity of the air and other materials that is between the elements. This means that all electricity that enters the area will be conducted through the elements.

Examination of inflamed tissue, particularly contused muscle, during a surgical intervention will yield the following observation: 1.) The area of involvement is red and hy-

peremic. It is generally quite well defined. The temperature of the entire area is elevated. This is the primary inflamed tissue. 2.) Immediately surrounding the well defined tissue of involvement, is a zone of hot, yet pale tissue. This tissue is actually poorly electrically conductive and is inadequately supplied with blood. The energy which has been sent to the area by the body to supply all the tissue is intercepted and diverted by the highly conductive inflamed tissue. This highly conductive tissue then heats up from the over abundance of electrical supply and radiates heat into the surrounding tissue. (The inflamed tissue is like the toaster's heating element.)

This is very similar to the situation inside the toaster. The wires glow hot and the surrounding lower conductive space (air) gets hot enough to make toast from the irradiated heat. How hot the wire can get without melting is limited by the type of filament. Beyond a certain limit the wire will break and current flow through the area will cease. What happens when the wire is broken anywhere along its pathway? *The entire element, toaster and all, cools down to ambient temperature.*

In the body, there is also a limitation to how much current can pass through a specific area. When the current flow goes beyond the limits of the tissue, it is as if a circuit breaker blows and the excessive current flow stops. At some point, the tissue's hyper conductive circuitry (congested tissue) will have had all the stimulation it can take and it will suddenly discharge, leaving the area sedated.

Back to our treatment of the epicondylitis: After the treatment of the areas of inflammation, move the site of therapy to the bellies of the muscles involved. This is important. Notice, the tendonitis did not just occur on its own. It is secondary to some type of single or accumulative traumatic event to the tendon or, more likely, to the muscle(s) involved. The classic condition know as Tennis Elbow is of the latter type.

After a period of time doing virtually any repetitive physical activity such as hitting or serving a tennis ball or turning a screw ten thousand times or shoveling snow for several hours or days, the result may be a repetitive motion injury. In this type of injury/pathology, there will always be two phases to manage. The first is the inflammatory phase described above. The second phase is intended to manage the muscular spasm, tightness, and ischemia as well as the 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 after brief sedation at 80 - 160 - 320 hz. settings. Use the 0.5 or 2.5 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 (by scarring or hypertonicity), there will be major tendon stress every time the opposing musculature contracts and the joint tries to reach 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 than muscle, they are prone to damage from excess tension and will develop the inflammatory condition known as tendonitis. Because of poor blood and electrical supply to these areas, it is common for this condition to become chronic.

Tendonitis is generally a symptom which is secondary to physical stress. It occurs when a muscle which has been shortened by spasm or scarring is stretched beyond its maximum (in the pathological state) capability. The power of the opposing muscle group plus centrifugal force can extend or flex the joint further than the limiting muscle group will allow. In particular, if the muscle is in spasm (shortened) the stretch will reach into the 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 tendons. The inflammation occurs anywhere along the tendon and often where the tendon attaches to the periostium. There may also be an associated periostitis.

USING THE CORRECT AMOUNT OF CURRENT:

As you must know, using a very low current is one of the keys to the effectiveness of microcurrent. But how do you know precisely where to set the current. If you are treating humans, verbal/tactile feedback is your best gauge. The treatment current should be low enough that the patient cannot feel it and high enough that, if it is turned up just slightly, it can be felt. Your patient will tell you the proper current setting if in structed properly. If the current is set too high, an animal patient will attempt to move away.

Imagine that the purpose of this treatment is to fill your patient's empty tissue with electricity.

Let's make a new metaphor for the purpose of visualization. Imagine the area of the patient's body you are charging is like a large drinking glass. You are filling the glass up with water. If you turn the water pressure on high, the glass will fill quite quickly and completely until it reaches the top. At the top, if the pressure remains high, water will rapidly spill over the top. As a matter of fact, it will spill so forcefully that if you suddenly turn the water off, the top of the water level will settle somewhat below the top of the glass, maybe as low as halfway down, depending on the water pressure used.

The point where the water starts splashing over the top is equivalent to the point at which the patient can feel the stimulation. If you then decrease the water pressure, you can actually put a larger amount of water in. There will come a time when you will need to slow the water again, until it is dripping quite slowly.

The metaphor takes on more reality if you use a glass with a very slow leak in it. In an actual patient, as you stimulate the area, it is truly as if you are filling that area with electricity. But this is not a closed system. As the tissue fills up to its maximum capacity, there is leakage into the surrounding tissues. As the tissue fills, the rate of loss of charge decreases. At some point, the rate of input is only slightly greater than the rate of loss. That is the ideal treatment level. At another point, the tissue is essentially saturated and it is time to discontinue the treatment session, at least for the one specific location. When the glass is nearly full, making the water drip more and more slowly, actually allowsyou to overfill the glass because of the surface tension of the water. You may be able to do the same thing to the body using very very low currents.

Treatment to reduce radial nerve paralysis

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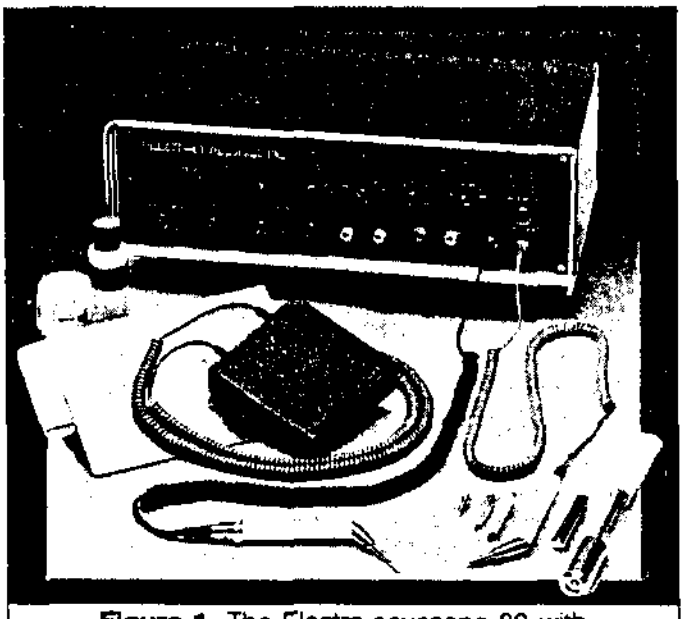


Figure 1. The Electro-acuscope 80 with its accessories and treatment electrodes.

RADIAL NERVE PARALYSIS occurs commonly in dogs after trauma to the forelimbs or avulsion of the nerve roots. Conservative treatments such as use of corticosteroids, muscle relaxants, and splinting of the leg seldom re-establish function to the damaged nerve.

This paper presents four cases in which damage to the radial nerve was reversed to the extent that full function and normal appearance of the limb were restored. The treatment technique is similar to acupuncture principles; relying on low-intensity electrical current rather than placement of needles. Treatment is painless and more efficient than acupuncture.

Technique

Pathologic changes alter the electrical activity of tissues, resulting in high-resistance areas of low conductivity. Stimulation of acupuncture points reduces this resistance, restoring normal electrical activity at the altered sites, and thus normal function of the affected region.

Enhancing the electrical activity of damaged tissue has been shown to increase the rate of healing.[1] One investigator determined, after experimental sectioning of peripheral nerves and the spinal cord, that application of an electrical current across the injured nerve tissue stimulates regrowth of axons.[2]

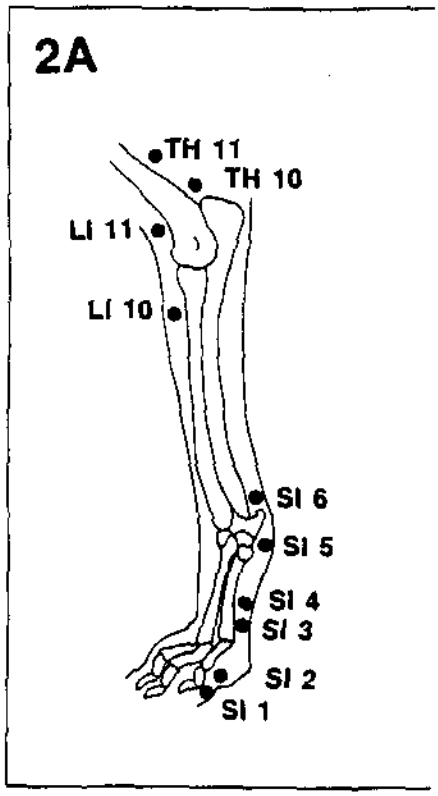
The Electro-acuscope 80 (Current Medical Instruments) (*Figure 1*) is the transcutaneous electroneural stimulator used in these four cases to promote healing. This device has the ability to re-establish the proper electromagnetic field of the body by balancing each part and creating a more efficient flow of energy in the entire system.

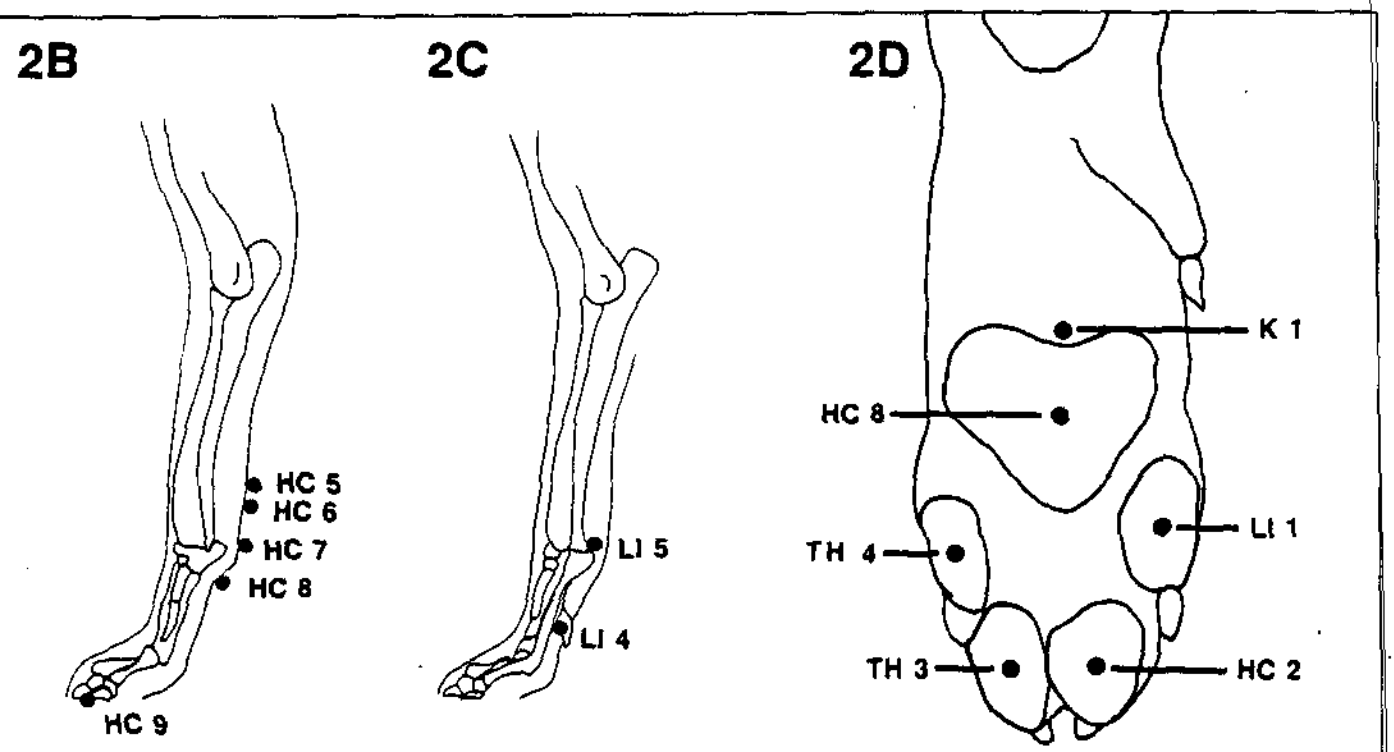
Procedure

Treatments with the Electro-acuscope 80 are cumulative. In general, two treatments are given the first

Figure 2 *(right).* Location and *numerical designation of the acu*puncture points used in treatment.
A. Left foreleg (lateral view): small intestine (SI), triple heater (TH), and large intestine (LI).
B. Right foreleg (medial view): heart constrictor (HC).
C. Right foreleg (medial view): large intestine (LI).
D. Forepaw (ventral view): kidney (K).

Figure 3 *(below).* Relative distribution of the radial nerve.
A. Medial view of the foreleg. (Redrawn from Hoerlein.[4])
B. Cutaneous distribution in the foreleg.
C. Medial and lateral distribution *(cutaneous).*
D. Cutaneous distribution in the paw (dorsal view).





day of therapy, with at least a one-hour interval between them. Standard treatment settings on the machine include a frequency of 0.5 cps, for 6 sec., with an intensity of 500 microamperes. The gain spectrum setting should be adjusted to correlate with the patient.

Acupuncture points on the traumatized limb that may be treated daily with electric stimulation include: large intestine (LI) 4,5,10,11; small intestine (SI)1-6; heart constrictor (HC) 5-9; triple heater (TH) 10 and 11; and those points at the center of each front foot pad (*Figures 2A — D*).[3] The only point the author treats bilaterally is LI 4.

When dipped in electrolyte solution produced by the manufacturer, brass tips or cotton-swab tips can serve as electrodes with equally good results. Shaving the skin at the treatment site is not necessary, although electrolyte solution is applied to these points to enhance conductivity.

Case history No. 1

A 6-month-old female German Shepherd was presented for treatment three hours after it was involved in

ANATOMY OF RADIAL NERVE PARALYSIS

The radial nerve arises from the ventral branches of the last two cervical nerves and the first two thoracic nerves of the brachial plexus (C 7-8 to T 1-2). The radial nerve serves as the motor to all extensors of the elbow, carpus, and digits and as the sensory mechanism to skin on the dorsal and lateral sides of the antebrachium and dorsal aspect of the paw *(Figures 3A - D)*.[4]

Most cases of radial nerve paralysis affect the nerve at the elbow or the nerve just distal to the elbow. Although the joints remain flexed, the extensor thrust reflex and supporting and placing reflexes are absent; the leg cannot bear weight. Knuckling over on the dorsum of the paw occurs when the animal walks *(Figure 4)*.

an automobile accident. Routine treatment was given for shock. Signs of radial nerve paralysis were apparent. No extensor thrust or supporting or placing reflexes were evident during a neurologic examination. Skin over the dorsum of the paw was not sensitive to pin pricks.

The first Electro-acuscope treatment was given within an hour after the dog was admitted. A second treatment was given two hours later. By the next day, some cutaneous sensation was evident over the toes. Periodically, the dog would extend the paw when walking. A third treatment was given the next day. By the third day the dog could extend its leg well at each joint and was discharged from the hospital. When re-examined one week later, it was walking normally.

Case history No. 2

A 2-year-old male Chow Chow suffered radial nerve paralysis of the right front leg when it fell out of a truck. After two months of unsuccessful treatment, the dog was referrred to this clinic. Severe atrophy of the muscles was evident along the entire leg; cutaneous sensation was not present from the shoulder to the carpus. An ulcerated, necrotic lesion was present on the dorsum of the paw.

Figure 4. The coyote knuckles over onto the dorsal side of the paw when walking.

Before treatment the hair surrounding the lesion was shaved and the foot was soaked in Betadine® Solution (Purdue Frederick). Two acuscope treatments were given, three hours apart. The treatment area included the ulcerated site on the foot. The lesion was then covered with gauze soaked in aloe vera gel and Granulex®-V (Beecham).

The dog received one treatment on each of the next two days. The bandage was changed daily. After the standard treatment on Day 4, the acupuncture points were stimulated with the acuscope settings upgraded to 20 cps for 12 sec. at 500 microamperes. This was repeated on Day 5. Because the dog was becoming more aggressive, the foot was wrapped with gauze impregnated with aloe vera gel and vitamin E in an oil suspension (28,000 IU), then placed in a Mason metasplint.

When the splint was removed two weeks later, the ulcerated area was healed and the dog could extend its leg when walking. Because atrophy of the muscles was still evident, treatment with the acuscope at both settings was repeated. In addition, the muscles were manipulated for eight minutes with the roller electrode attachment lubricated with electrolyte cream and with the machine set for continuous frequency at 500 microamps. One month later, the muscles were no longer impaired and the dog was walking normally.

Case history No. 3

A 1-year-old male Golden Labrador Retriever was presented for treatment one day after it was hit by a car. Edema was evident in the right front leg; radiographs showed dislocation of the elbow.

With the dog under anesthesia, the dislocation was reduced. Treatment with Lasix® (American Hoechst) resolved the edema by the next morning. A neurologic examination at that time revealed radial nerve paralysis at the level of the elbow.

Two normal treatments with the acuscope were given two hours apart. Little improvement was seen by the next day, but the owner had to return home, 150 miles away. The dog was given an additional treatment and *aquapuncture* was implemented. A 30-ga needle was used to inject 0.2 ml of vitamin B_{12} (1,000 mcg/cc) into acupuncture points LI 4 and K 1, bilaterally. When

Treatment of GANGRENE With The Electro-Acuscope

Patient: Sharon Johns: Her physician recommended amputation, but patient did not have insurance and couldn't afford it. Her therapist, Janice Simmons, recommended Electro-Acuscope therapy daily but patient could only afford treatment two times a week. Treatment was one hour per week with brass plates at 160 Hz. Probes were also used on the leg to help lymph drainage. No other treatment was given once the Electro-Acuscope treatments were started.

22 x 14 cm Before 1st Electro-Acuscope Treatment 5-16-95

5.75 x 17.5 cm 6-30-95

Completely Healed 10-30-95

ACCELERATED TISSUE REPAIR WITH ELECTRO-ACUSCOPE THERAPY[1]

The following sequence of photographs illustrate the effectiveness of Electro-Acuscope/Myopulse therapy for wound-healing applications.[2]

Diagnosis: Venous Stasis Ulcer

History: One year old ulcer with no improvement. Two skin graphs, hydrotherapy, and medications were all unsuccessful.

Therapy: Electro-Acuscope treatments three (3) times a day from 8/12/87 through 8/31/87. Treated as an outpatient two (2) times a day from 9/1/87 through 10/16/87. Treatment time was 10 minutes with two probes and 20 minutes with brass alloy plates. Instrument settings were 10 minutes at 160 Hz and 20 minutes at 80 Hz. No other therapy or medications were used.

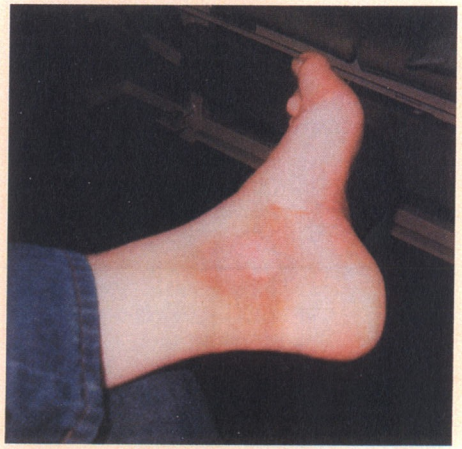
8/12/87 4.0 cm

8/14/87 3.5 x 3.0 cm

9/2/87 1.9 x 1.4 cm

9/16/87 1.1 x 0.5 cm

10/12/87 0.1 x 0.1 cm



10/16/87 HEALED

[1] *Presented at the Annual Meeting of the American Academy of Neurological and Orthopedic Surgeons, October 24, 1987, Las Vegas, Nevada, by Mark C. Biedebach, Ph.D., Associate Professor, Department of Anatomy and Physiology, California State University at Long Beach.*

[2] *Photos courtesy of Linda Richter, R.P.T., Memorial Hospital of Gardena, 1145 West Redondo Beach Blvd., Gardena, California, 90247*