Results of Search for Micro-current Research Studies

From 1969 to 1999

KEYWORDS: patch clamp, currents, membranes, diabetes, ion channel

(1) **Lawrence Altman:** **Cell Channel Finding Earns Noble Prize** New York Times Medical Science section, October 9,1991

Summary: Two Germen scientists, Dr. Erwin Neher and Dr. Bert Sakmann, will share the $1 million dollar Nobel Prize for their development of the patch-clamp technique that allows the detection of minute electrical currents in cell membranes. This discovery, which "revolutionized modern biology" may shed light on the causes of several diseases, like diabetes and cystic fibrosis. This method allowed the detection of 20 to 40 types of ion channels that allow positive or negatively charged ions into and out of the cells. This study confirmed that electrical activity is not limited to nerve and muscle tissue, as previously thought, but is intrinsic to "all kinds of other cells".

KEYWORDS: wound healing, scar, ulcers, direct current

(2) **Carly and Wainapel:** **Electrotherapy for Acceleration of Wound Healing: Low Intensity Direct Current** Archives of Physical Medicine and Rehabilitation, Vol. 66, July 1995.

Summary: 30 hospital patients with non-healing ulcers were divided into two groups, one treated with conventional wound dressings and one with micro-current stimulation at 300-700 uA. The latter group was given two hour stimulation periods per day. After six weeks of such treatments, the group treated with micro-current showed a 150%-250% faster healing rate, with stronger scar formation, less pain, and lessened infection of the treated area.

KEYWORDS: accelerated, wound healing, current, ATP, amino acids, biochemical

(3) **Cheng, et Al:** **The Effects of Electric Current on ATP Generation, Protein Synthesis, and Membrane Transport in Rat Skin** Clinical Orthopedics and Related Research, #171, Nov/Dec. 1982.

Summary: These researchers used in-vitro slices of rat skin to determine some of the biochemical explanations for accelerated wound healing demonstrated in the above studies. By applying various levels of current to the samples, and then chemically analyzing them, they determined that skin treated at currents below 1000 uA showed up to 75% higher free amino acids and up to 400% more available ATP than controls, and that skin treated at levels above 1000 uA showed depressed levels of these substances, often less than non-treated controls.

KEYWORDS: ulcers, polarity, stimulation, quadriplegia, healing

(4) **Gault and Gatens:** **Use of Low Intensity Direct Current in Management of Ischemic Skin Ulcers** Physical Therapy, Vol. 56, #3, March 1976.

Summary: 100 patients with skin ulcers were treated with micro current stimulation; six of them had bilateral ulcers with one side used as controls. Stimulation of 200-800 uA was applied, with negative E polarity used until infection cleared, and then polarity reversed. Patients had diagnosis ranging through quadriplegia, CVA, brain tumor, peripheral vascular disease, burn, diabetes, TB, fracture, and amputation. The lesions in patients treated with current showed approximately twice as fast healing rate.

KEYWORDS: micro current, polarity, healing, scar, antibacterial

(5) **Wolcott, Wheeler, Hardwicke, and Rowley:** **Accelerated Healing of Skin Ulcers by Electrotherapy** Southern Medical Journal, July 1969.

Summary: These researchers applied micro-current stimulation ranging from 200-800uA to a wide variety of wounds, using negative polarity over the lesions in the initial phase, and then alternating positive and negative electrodes every three days. The treated group showed 200%-350% faster healing rates than controls, with stronger tensile strength of scar tissue and antibacterial effects in infected wounds in the treated group.

(6) **Sherrod, D.C.:** **The Modulation of Musculoskeletal Injuries With Micro current**

and Macrocurrent Electrotherapy: A review Chiropractic Products Feb, 1989.

Summary: In this article, the author reviews his treatment protocols combining micro current stimulation and "Russian" stimulation.

KEYWORDS: tendon, Achilles

(7) **Stanish and Gunnlaughson:** **Electrical Energy and Soft-Tissue Injury Healing** Sportcare and Fitness, Sept/Oct. 1988.

Summary: This article is a summary of research into tendon healing acceleration, including human injuries of the anterior cruciate ligament and the Achilles tendons: "While the results are subjective, the individuals in both groups appear to have returned to usual activities more quickly, and have greater mobility, than people treated more conventionally".

KEYWORDS: tendons, stimulated, stimulation, praline

(8) **Nessler and Mass:** **Direct-Current Electrical Stimulation of Tendon Healing in Vitro** Clinical Orthopedics and Related Research, April 1987.

Summary: 80 tendons from white rabbits were surgically transected and removed from the animals after being surgically repaired. They were divided into 4 groups of 20, and cultured, with 10 of each group being electrically stimulated, and half not. A 1.4-volt direct current connected through a 150-kOhm resistor was used from stimulation, at a current of about 7 uA. It was found that currents any higher than this caused discoloration of the tendons. Healing was measured by proline uptake and bridging of the repair site by the epitenon. Results: "a continuous direct current causes increased tendon cell activity within seven days and that the increased activity may persist as long as 42 days". The researchers suggested that externally applied micro-currents might be preferable in future studies.

KEYWORDS: Achilles, tendon, anodal, cathodal, micro amps, load

(9) **Oweye, Spielholz and Nelson:** **Low –intensity Pulsed Galvanic Current and the**

Healing of Tenotomized Rat Achilles Tendons: Preliminary Report Using Load-to- Breaking Measurements Archives Phys Med. Rehab, Vol. 68, July 1987.

Summary: 60 rats were divided into three groups of 20. One was unstimulated, one group had their Achilles tendons stimulated with positive (anodal) current, and the third group's tendons were stimulated with negative (cathodal) currents. A current of 75 micro amps, at 10 Hz was used. Results: "The group treated with anodal current withstood significantly greater loads ($p<0.001$) than did

either the group which healed normally (i.e., without stimulation) or the group treated with cathodal current".

KEYWORDS: post traumatic, micro current, modulated

(10) **Sinitsyn, Razvozova (Russian):** **Effects of Electrical Micro-currents on Regeneration Process in Skin Wounds** Ortop Travmatol Protez, Feb. 1986.

Summary: 68 patients with post burn and posttraumatic wounds underwent treatment with constant and modulated micro current of negative E polarity of 1-10 uA/cm2 over a period of 2-20 days. Although both groups showed accelerated regeneration, the modulated electric current group showed more prolonged and marked effect. Better survival of skin grafts was demonstrated compared with untreated patients.

(11) **Sinitsyn, Razvozova (Russian):** **Stimulation of the Regeneration of Skin Wounds by Micro-currents** Vopr Kuroortol fizioter Lech Fiz Kult, Nov.-Dec. 1985.

(12) **Vanable, Joseph:** **The Role of Endogenous Electrical Fields in Limb Regeneration Limb Development and Regeneration**, Part A, pgs. 587-596, Alan Liss Publishing, N.Y., 1983

KEYWORDS: micro currents, bone healing, remodeling

(13) **Tomoya Ohno (Japanese):** **Experimental Studies of Influences on Healing Process of Mandibular Defect Stimulated by Micro current** Shikwa Gakuho, #82, 1982.

Summary: 50 uA micro currents were applied to one side of the jaws of a group of dogs with lesions in their jaws. The other side was untreated. The dogs were examined at periods of 3, 7, 14, 21, 28, 42, and 56 days. Results: "it seems likely that direct micro current promotes normal bone formation within the defective area and accelerates the osseous healing process. Prolonged application of electrical stimulus promotes a remarkable bone remodeling mechanism."

KEYWORDS: wheatstone, conductance, acupuncture, points, conductance

(14) **Reichmanis, Marino, and Becker:** **Electrical Correlates of Acupuncture Points** IEEE Transaction on Biomedical Engineering, November 1975.

Abstract: "Employing a Wheatstone bridge, skin conductance was measured over those putative acupuncture points on the large intestine and pericardium meridians lying between the metacarpophalangeal joints and the elbow. Results were compared to those from anatomically similar locations devoid of acupuncture points. At most acupuncture points on most subjects, there were greater electrical conductance maxima than at control sites".

(15) **Rowley, McKenna, and Wolcott:** **Proceedings: Use of Low-Level Electrical Current for Enhancement of Tissue Healing** Biomedical Scientific Instruments #10, 1974.

Summary: This article is an overview of theory and research into the title field.

KEYWORDS: osteogenesis, humerus, burst, cathode, anode, necrosis, capacitance

(16) **Richez, Chamay and Bieler, U. of Geneva:** **Bone Changes Due to Pulses of Direct Electric Micro current,** Virchows Arch. Abt. A Path Anat. 357, 11-18 (1972)

Summary: 26 rabbits had platinum electrodes surgically implanted into the medullary cavities of their humerus bones. Micro current stimulation was applied at 50 and 250 uA, allowing pause periods of one second between one second treatment bursts. The scientist found that osteogenesis (bone growth) happened more around the cathode (negative polarity), and that slight tissue necrosis occurred around the anode. The tissues stimulated acted as capacitors, discharging 75% of the current absorbed during the rest periods. They concluded that pulsed current is superior to direct current for bone healing acceleration.

KEYWORDS: silver, staphylococcus, infection, anodal

(17) **J.A. Spadaro, S.E. Chase, and D.A. Webster: Bacterial Inhibition by Electrical Activation of Percutaneous Silver Implants**, Journal of Biomedical Materials Research, Vol. 20, 565-577 (1986)

Summary: Percutaneous silver wire implants were placed in rats, and the wounds inoculated with Staphylococcus aureus to test how much infection would spread. Micro current stimulation was passed through the wires, with + anodal current placed into implanted silver wire, and the – cathodal electrode placed on the rat's belly as a ground. It was found that significant inhibition of infection occurred, with the most marked results at 20uA current level. "Metallic silver can be effectively and efficiently activated to elicit its anti-microbial activity by the application of microampere electrical current."

KEYWORDS: pulsed, Yucatan pigs

(18) **Byl, McKenzie et. al.: Pulsed Microampereage Stimulation: A Controlled Study of Healing of Surgically Induced Wounds in Yucatan Pigs**, Physical Therapy, Volume 74, Number 3/March 1994

Summary: this study failed to confirm the superiority of micro current-stimulated wounds in test pigs over control/ A good review of previous studies is given as well as a discussion of which research variables could account for the inconclusive results, which vary from other studies that found micro current to be efficacious for wound healing.

KEYWORDS: micro current, TMJ, laser, placebo

(19) **Bertolucci and Grey: Clinical Comparative Study of Micro current Electrical Stimulation to Mid-Laser and Placebo Treatment in Degenerative Joint Disease of the Temporomandibular Joint**, Journal of Craniomandibular Practice, 1995

Summary: 48 patients were divided into three groups, some receiving placebo, some micro current and some laser to treat pain of TMJ syndrome. Both micro current and laser were found to be significantly more effective than placebo. The author acknowledges that lasers are not legally sold in the United States for this purpose, and that micro current's easy accessibility makes it more practical for practitioners here.

KEYWORDS: EEG, FFT, chaos analysis, neurofeedback, micro current

(20) **M. Heffernan: Comparative Effects of Micro current Stimulation on EEG Spectrum and Correlation Dimension,** Integrative and Behavioral Science, July-September, 1996, Vol. 31, #3

Summary: 30 subjects were selected for a study comparing the effects of micro current on smoothing of EEG measurements of the brain. Subjects were randomly assigned to three groups – micro current (100uA) applied to earlobe, trapezius area of the shoulder, and no stimulation. Electrodes were arranged so subjects could not tell which group they were in. Fast Fourier Transform (FFT) and correlation dimension from chaos analysis were used to measure results. The researcher found that micro current applied to the shoulders was markedly more effective in smoothing EEG patterns than earlobe or placebo. "This would represent a possible cost-effective alternative to neurofeedback in treating (anxiety and attention deficit disorders), by raising low regions in the FFT."

KEYWORDS: **Trigger points, TP, temporomandibular, conductivity, GSR**

(21) **DuPont:** **Trigger Point Identification and Treatment with Micro current**, The Journal of Craniomandibular Practice, October 1999, Vol. 17, #4

Summary: This article gives the author's techniques for locating and stimulating trigger points (TP's) using a micro current stimulator, specifically for the treatment of temporomandibular disorders. He states that electrical conductivity is highest over trigger points, and galvanic skin response (GSR) testing can be used to locate such points. He utilizes probe electrodes to treat small TP's, and pad electrodes to treat larger ones. Probe treatment is delivered @ 0.3 HZ, 20 – 40 uA, with treatment time of 10 – 30 seconds per site. He suggests administering treatment in 24-48 intervals, and states that results should be seen within 2 – 3 treatments. He acknowledges that these protocols are not necessarily the best ones, but work well for his practice. 2) Vanable, Joseph: The Role of Endogenous Electrical Fields in Limb Regeneration Limb Development and Regeneration, Part A, pgs. 587-596, Alan Liss Publishing, N.Y., 1983