

Research Abstracts and Comments

 Alvarez OM; Mertz PM; Smerbeck RV; Eagistein WH. (1983).


'The Healing of Superficial Skin Wounds is stimulated by External Electrical Current'
Journal of Investigative Dermatology. Vol 81: 144-48


Summary

Alvarez noted a significant increase in collagen synthesis on days 5, 6, and 7 in wounds treated with direct current (50-300 μ A). In addition, the rate of wound epithelialization was also significantly accelerated. Thus suggesting that an electrical field can affect the proliferative and migratory capacity of epithelial cells and fibroblasts.

Comment


This team did not find any correlation between electrical current and wound tensile strength i.e. collagen cross-linking, albeit that DC affected the collagen production.

 Assimacopoulos D. (1968). 'Low Intensity Negative Electric Current in the Treatment of Ulcers of the Leg due to Chronic Venous Insufficiency.' *American Journal of Surgery. Vol. 115: 683-687, AND*

 Assimacopoulos D. (1968). 'Wound Healing Promotion by the Use of Negative Electric Current.' *The American Surgeon. Vol. 34(6): 423-431.*

Summary

Induced full thickness skin defects in rabbit ears were treated with direct current through the -ve electrode until complete healing. A twenty five percent (25%) acceleration was noted in Electrical Stimulation (ES) group than in controls with histology revealing a thicker, denser scar & increased tensile strength. It has been hypothesised that a local re-establishment of lost -ve charge due to injury is important in scar development.

 Bailey S (2001). 'How Micro-Current Stimulation Produces ATP - One Mechanism'
www.chiroweb.com/archives


Summary

The author suggests that micro-current (MC) (200-800 μ A) is a way of supercharging the tissue with ATP, which is then available when required. He hypothesised that it is the cleaving of the phosphate bond in ATP that results in ADP and subsequent energy


released. Virtually every cytological, histological & physiological process is ATP mediated and the body should be able to produce all the ATP that is required; unfortunately this doesn't always happen.

Comment

The author's argument is that the healing process requires an enormous amount of energy and if this energy is available in abundance, the repair will take place in an accelerated fashion, up to fifty percent more quickly. He states that MC stimulation increases ATP in the tissue by up to 400%. Conversely, other electric stimulation devices decrease ATP levels & stimulation over 1 milli-amp (mA) causes a plateau and then reduction in ATP. The turnover rate for ATP is very high and capacity to store ATP is vast.


 Becker RO (1985). 'The Body Electric'.

Becker RO and Murray DO. (1967). 'A Method for Producing Cellular Dedifferentiation by Means of very Small Electrical Currents.' *Transactions New York Academy of Sciences* 29: 606-615.

 Becker RO. (1974). 'The Significance of Bioelectric Potentials.' *Biochemistry and Bioenergetics* 1. 187-199.

Comment

Becker was the first to conceptualise the existence of a direct current electrical system controlling tissue healing. When tissue is injured the electrical balance of the body is disturbed resulting in a current of injury, which triggers a cascade of wound healing events. Once repair is complete this current of injury disappears. Thus if low intensity direct current (LIDC) is externally applied in indolent wounds homeostasis could be re-established.

 Bourguignon GI and Bourguignon LYW. (1987). 'Electric Stimulation of Protein and DNA Synthesis in Human Fibroblasts' *FASAB J.* 1(5): 398-402.


Summary

Bourguignon and Bourguignon looked at the effects of HVPGS - high voltage pulsed galvanic stimulation - on human fibroblast protein & DNA synthesis in culture & found

that they could be significantly increased by specific combinations of HVPGS voltage & pulse rate but that intensities greater than 250V had an inhibitory effect.

Comment

These authors used micro-current in the range of 40-100 μ A and may have inadvertently highlighted an effect of the micro-current as much as the voltage.

 Carley PT and Wainapel SF. (1985). 'Electrotherapy for Acceleration of Wound Healing: Low Intensity Direct Current.' *Archives Physical Therapy Rehabilitation* 66: 443-446.

Summary


30 patients with indolent ulcers - 15 controls & 15 receiving LIDC between 300-700 μ A. All ulcers were debrided prior to the start of the study. Those with the current healed 1.5-2.5 times faster which was statistically significant, in addition they required less debridement, there was no wound infection, the scarring was more resilient & less discomfort at the wound site.

LIDC stimulation for 2hrs twice daily for 5 days. -ve current used for first 3 days then +ve current from day 4. Current output was set between 300 μ A & 500 μ A for patients with normally innervated tissues & 500-700 μ A for denervated skin. Wound healing progression was recorded weekly and area measurements for length, width & depth to the nearest mm & weekly photos documented. Data collection was for five weeks or until the ulcer was noted as healed. The Wilcoxon' 5 rank sum test was used to compare the LIDC & Control groups at outset & at each week. No statistical difference was noted at beginning or for the first two weeks of treatment but a difference was noted from week three to five. In addition, scar tissue was stronger on palpation of closed wound & original margins in LIDC group, & the control group typically showed the lines of contraction with healed tissue appearing thin & fragile, some also need repeated debridement with lots of pain.

Comments

The mean age of the patients in both groups was over 70 years old. Would this be a systemic factor in both groups & what are the implications? The author's mentioned that area measurements were taken of length, width & depth but did not state how this was

done particularly the depth measurement. Table 2 in the paper stated the wound measurements in cm^3 - how was this calculated?

 Chapman-Jones D and Hill D. (2002). 'Novel Micro-Current Treatment is More Effective than Conventional Therapy for Chronic Achilles Tendinopathy.' *Physiotherapy. Volume 88 :471-480.*

Summary

Chapman-Jones evaluated the effect of micro-current on chronic Achilles tendinopathy. Forty eight (48) subjects, twenty four (24) controls & twenty four (24) receiving MC treatment for thirty minutes per day for fourteen days @ 40 μA and 10Hz. Baseline assessment at the start & then assessed at 3 month intervals for one year. Statistical tests used were chi-squared test, the unpaired t-test & the Mann-Whitney U test. Pain, flexibility & ultrasound scoring systems were put place as well. The author's concluded that MC treatment can make a significant contribution to improvement of patients with chronic Achilles tendon pathology.

It demonstrated that micro-current based treatment has the potential to augment the healing by promoting fibroblast & tenocyte proliferation allowing an increase in collagen production. Mechanism of action is not clear.

Comment

A clear study that used low intensity direct current. The author is still not sure that optimal parameters have necessarily been reached however, can this ever be truly established since it could well be that every patient will have a different optimal range.

 Chapman-Jones D (2002). 'Micro-Current Therapy' *Synergy. March. pp: 12-13.*

And Chapman-Jones (1997) The Effect of Micro-Current Electrical Stimulation on Intrinsic Healing in the Achilles Tendon In-vitro: An Ultrastructural Study of Tenocyte Activity' *University of Nottingham. Unpublished MSc Thesis Sport and Exercise Medicine*

Summary


The purpose of the study was to examine tenocyte activity in the Achilles tendon. Micro-current electrical stimulation was applied to whole Achilles tendon sections at two

different intensities, 40uA and 1uA. Cell activity was evaluated using electron microscopy and the results of the experimental groups were compared with a non-stimulated control group. The appearance of the tendon sections that received electrical stimulation at intensity of 40uA was remarkably different from the non-stimulated tendon in the control group.

There was disruption of the mature formed compact collagen with increased numbers of active tenocytes that appeared to have acquired the cytoplasmic organelles to synthesise new protein. The tendons in the group that received 1 uA of electrical stimulation showed inactive and degenerating fibroblasts. The tendon sections were taken from cadaver specimens and remained viable for the duration of the experiment. However, infection contamination with two of the tendon sections reduced the sample size.

Comment

Interesting findings and the fact that the analysis was undertaken in a blind and independent manner gives greater credence to the results.

 Cheng N; Van Hoof H; Bockx E; Hoogmartens MJ; Mulier JC; Dijcker FJ; Sansen WM; De Loecker W. (1982). 'The Effects of Electric Current on ATP generation, Protein Synthesis and Membrane Transport in Rat Skin.' *Clinical Orthopaedics and Related Research No.171*


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 analysing them, they determined that skin treated at currents below 1000 uA showed up to 75% higher amino acids and up to 400% more available ATP than controls, and that skin treated at levels above 1000 μ A showed depressed levels of these substances; often less than non-treated controls.

Comment

This is a difficult paper to read but confirms the fact that there is a three to five fold increase in synthesis of ATP after electric current is applied (50 μ A -1000 μ A). At 1 mA

the ATP concentration levelled & at 5mA it reduced slightly. The current also seems to increase protein synthesis primarily & independently, however DNA metabolism is not affected by electrical stimulation suggesting that the effect on protein synthesis occurs independently of an effect on transcriptional processes. Results also support the chemiosmotic theory of Mitchell (via proton movements). The increase in ATP will also be partially responsible for the increase in protein synthesis alongside the increased availability of amino acid & their transport

 Feedar TA; Kloth LC and Gentzkow GD (1991). 'Chronic Dermal Ulcer Healing enhanced with Monophasic Pulsed Electrical Stimulation' *Physical Therapy* 71(9): 639-649.

Summary

Feedar et al. evaluated the healing of chronic dermal ulcer enhanced with monophasic pulsed electrical stimulation using a RCT. Forty seven (47) patients using ES & placebo (sham). Statistical analysis used was the 2 sample t-test to evaluate the null hypothesis of no treatment differences. Paired t-test for the patients in the control group who crossed over to active stimulation after the four weeks. Five of the control group's ulcers increased in size, none of the treatment did. Only adverse effect reported were minor tingling in the wound that occurred in 15% of the patients - 10% of control & 20% in treatment group.


The results are in accordance with previous studies showing that ES enhances rate & extent of healing in chronic wounds & promotes healing of acute wounds induced in animals. After four weeks wounds in the treatment group healed to a mean of forty four percent (44%) of their initial size at a mean healing rate of fourteen percent (14%) & control group healed to a mean of sixty seven percent (67%) of their initial size at a mean healing rate of eight and one quarter percent (8.25%) a week. (comment - this is high but not unduly surprising when you consider the intensive amount of additional care they received including the maintenance of a moist wound microenvironment).

Comment

Feedar et al stated that they believe that ES of dermal ulcers works by mimicking the body's own bioelectrical signals. They delivered monophasic pulsed current at a frequency of 128pps to the wound tissue until it healed to stage II, thereafter the frequency was dropped to 64 since they believed it might be harmful to the newly healed


tissue. This would actually go with our own school of thought at Synapse that a set period of treatment appears to be the way forward and that one can cause regression in the wound if the ES is prolonged. However this group were unable to discern what effect the two pulse frequencies had on the rates of healing.

The mechanism involved in the promotion of wound healing with ES was not identified nor the optimal parameters in this paper.

 Foulds I S and Barker AT. (1983) 'Human Skin Battery Potentials and their Possible Role in Wound Healing'. *British Journal of Dermatology*. Vol 109: 515-522..


Summary

These authors reported an average voltage difference of 23mV between the dermis and the skin surface over multiple sites on the human body

 Fujita M; Hukuda S; Doida Y. (1992). 'The Effect of constant Direct Electrical Current on Intrinsic healing in the Flexor tendon *in-vitro*'. *Journal of Hand Surgery*. 17b. 94-98.

Summary

Fujita et al. evaluated the effect of constant direct electrical current on intrinsic healing in the flexor tendon in vitro. They concluded that ES under 1 μ A appeared to suppress the proliferation of synovial cells but activates tenocyte proliferation & promotes collagen production. They suggest that this may be of value in preventing adhesions after the repair of flexor tendons.

 Gardner SE; Frantz RA; Schmidt FL. (1999). 'Effect of Electrical Stimulation on Chronic Wound Healing: A Meta-analysis.' *Wound Repair and Regeneration*. 7: 495-503.

Summary


Gardner et al evaluated the effect of ES on chronic wound healing using a meta-analysis. Fifteen studies which included twenty-four ES samples & fifteen controls were analysed, the average healing rate per week was calculated. Samples were grouped by type of ES device (LIDC, HVPC, AC & TENS) & wound. The LIDC used was continuous, monophasic waveform 20-200 μ A at low voltage (<8V), the parameters for the three others were also given. Among ES studies undertaken to date, percentage healing per week is the most

common measure of rate of healing reported which was deformed as the percentage reduction in wound size from baseline measurements. PWH was calculated for each ES & control sample, all but three PHW estimates were based on surface area measurements i.e. length x width as opposed to volume measurements which included depth. +ve PHW results indicate healing or decrease in ulcer size.

Results revealed twenty two percent (22%) healing rate per week for ES & nine percent (9%) for controls. Net effect was thirteen percent (13%) per week for ES group, an increase of one hundred and forty four percent (144%) over the controls. The mean follow up period was six point two (6.2) weeks for the ES group and six point four (6.4) weeks for the controls. ES was most effective on pressure ulcers & the different ES devices findings were inconclusive. Concluded that further research needed to discover which ES devices are best & which wounds respond best to this treatment.

Comments

The limitations discussed in this paper indicate lack of information within the studies included, regarding other variables that influence WH for example nutritional status, tissue perfusion, & bacterial burden, from which to make comparisons between ES & controls. Many of the ES trials didn't give parameter information to allow examination of the influence of dose on PHW & it would be useful to further research on the relative effectiveness of different ES devices.

 Gault WR and Gatens PF. (1976). 'Use of Low Intensity Direct current in Management of Ischaemic Skin Ulcers.' *Physical Therapy*. Vol 56(3): 265-269.

Summary

Gault & Gatens, applied same parameters as Wolcott et al, on 106 chronic ischaemic ulcers on 76 patients. 200-1000 μ A, 6hrs per day applying cathode over wound for 3 days & then switching to the anode. Mean treatment time was four point seven (4.7) weeks.

Hundred patients with skin ulcers were treated with micro current stimulation; six of them had bacterial ulcers with one side used as controls. Stimulation of 200-800 μ A was applied, with negative polarity used until infection cleared, and then polarity reversed. Patients had diagnosis ranging from quadriplegia, CVA, brain tumour, peripheral vascular

disease, burns, diabetes, fracture, and amputation. The lesions with patients treated with currents showed approximately twice as fast a healing rate.

🔴 Gentzkow GD and Miller KI (1991). 'Electrical Stimulation for Dermal Wound healing' *Clinics in Podiatric Medicine and Surgery*. 8(4):827-841.

Summary

Author's reported that ES increased DNA synthesis & fibroblast proliferation, increased calcium uptake and neural growth & extension. It also changed the expression of cellular receptors for growth factors.

🔴 Gentzkow GD. (1992). 'Electrical stimulation for Dermal wound healing' *Wounds: A Compendium of Clinical Research and Practice*. Vol 4(6): 227-235.

Summary

Gentzkow produced a review of ES for dermal wound healing.

Comment

This is a useful paper that acts as a good summary of historical work to 1992. However, it is ten years out of date.

🔴 Illingworth CM and Barker T. (1980). 'Measurement of an Electric Current Emerging During the Regeneration of Amputated Finger Tips of Children' *Clinical Physiology and Physiological Measurement*. 1: 87-89.

Illingworth & Barker found currents of $10\mu\text{A}$ to $30\mu\text{A}/\text{cm}^2$ emerging during the healing of stumps of children's fingers that were accidentally amputated. The currents were measured with the fingertip immersed in a saline solution.

🔴 Katelaris PM; Fletcher JP; Little JM; McEntyre RJ; Jeffcoate. (1987). 'Electrical Stimulation in the Treatment of Chronic Venous Ulceration'. *Australian New Zealand Journal of Surgery*. 57: 605-607.

🔴 Kirsch DL (2001). 'A Practical Protocol for Electromedical Treatment of Pain.' [.http://alphastim.com/Technology/Protocol/Introduction A/MET/met.html](http://alphastim.com/Technology/Protocol/Introduction%20A/MET/met.html)

Summary

This paper gives a concise history of micro-current applications and state that the majority of the studies report significant accelerated healing. They also highlight the potential of bacterial inhibition.

Comments

This paper is particularly useful since it gave an understanding of the actual bioelectrical concept within injured tissue & why/how MC can augment endogenous current flow. Well referenced.

🔴 Kirsch DL and Lerner FN (2002). Electromedicine *The Other Side of Physiology*'.

Comment

There is not much to this paper as it gives a little information on the biophysics side. The authors propose that cells within a tissue communicate through specific frequencies and current intensity in the μA range. They believe that the right frequency activates the COI causing the system to head towards homeostasis. Ohmmeter measures pathological tissue because it has a reduction in conductivity that sets up a electrical potential on either side of the injury that controls pain & signals the healing process. Once a low conductive area is found an ES device with an effective waveform can augment the COI to control pain & initiate/increase healing rate.

🔴 Lee RC, Canaday DJ, Doong H. (1993). 'A Review of the Biophysical Basis for the Clinical Application of Electric Fields in Soft-Tissue Repair.'
Journal of Burn Care and Rehabilitation. 14: 319-335.

Summary


The purpose of this review was to examine and summarize the data regarding the effects of electric and magnetic fields on soft-tissue cells, placing special emphasis on cells that play a role in wound repair. Scientific interest in bioelectrical and bio-magnetic phenomena is quite well established. As early as 150 years ago, the significance of electric signals in nerve and striated muscle function was recognized. Several of the

most important advances in biological science in this century relate to the transmission of electric signals through excitable membranes. The interest in the possibility of electric field regulation of bone and connective tissue growth, remodelling, and repair began within the last 40 years. After the discovery of mechanical-to-electric transductive coupling compelling evidence that suggests that electrical currents modulate cellular function has occurred.

Although electric or magnetic fields have not been widely used clinically to treat skin or soft-tissue wounds, increasing evidence exists that electric and magnetic fields are able to alter the process of mammalian soft-tissue repair.

Comment

This is a complicated paper, which is difficult to read. It has the potential to be useful when analysing the membrane structure/signalling, calcium fluxes etc. The paper covers selected reports of electric or magnetic field alteration of wound healing in vivo and examines reports of natural "wound currents" to determine possible interaction with externally applied fields. Cell-specific effects of electric field exposure on the cells involved in wound repair as observed in tissue and individual cell-model experiments will be covered. We discuss the putative mechanisms of field interactions with cells in the context of the alteration of signal transduction mechanisms of normal cell membranes.

 Lee-Evans RD; Foltz D and Foltz K. (2001). 'Electrical Stimulation with Bone and Wound Healing.' *Clinics in Podiatric Medicine and Surgery. Volume 18(1): 79-95.*


Summary

Lee-Evans et al reported on ES with bone & wound healing. They state that ES on tissues is multifaceted with increased blood flow, increased oxygen tension, collagen production, increased diapedesis of neutrophils & macrophages & bacterial inhibition is influenced by ES.

Comment

This is another paper which confirms that ES can be used in chronic wound as a catalyst to reboot the fibroblastic phase & aid in contraction. They look at four different types of ES, none of which give great insight into use on chronic wounds. Contraindications

acknowledged - cardiac pacemakers, underlying osteomyelitis, pregnancy, schematic pain syndromes, and concomitant use of metal containing solutions.

 McKenzie et.al. (1994) 'Pulsed Microampere Stimulation: A Controlled Study of Healing of Surgically Induced Wounds in Yucatan Pigs' *Physical Therapy*, Vol. 74: 3

Summary

This study failed to confirm the superiority of stimulated-stimulated wounds in test pigs over controls. 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 stimulated to be efficacious for wound healing.


 **Moth & Feedar. (1988)**

Summary

The study used pulsed, high voltage current (100v to 175v) instead of LIDC. Sixteen (16) patients were exposed for forty five (45) minutes daily, five (5) days per week with a +ve electrode initially & once healing plateaued it was reversed. They author's reported that treated ulcers healed completely in seven point three (7.3) weeks & that control ulcers increased in size by twenty nine (29%) in the same time. They also found what a lot of other authors found & that was the electrode polarity needed to be changed during treatment to obtain optimal results particularly if there was a standstill in wound healing.

Comment


There are some good references & historical facts contained within this paper that highlights the effectiveness of ES and WH. This healing potential is expressed not only in decreasing wound size over time but also in complete healing in chronic ulcerations when measured against controls. It gives the different types of ES but isn't clear about which one is most efficacious.

 Nessler JP and Mass DP. (1985). 'Direct current Electrical Stimulation of Tendon Healing in Vitro'. *Clinical Orthopaedics*. 217:303-311.

Summary

Nessler & Mass used direct current ES to augment tendon healing in vitro. The author's debated the intrinsic capacity of tendons to heal after injury as it was originally thought that they were relatively inert but now found to have a healing capacity therefore a means of enhancing this would be desirable. Martell et al. & Manske et al had found that rabbit tendons remained viable in culture so this was the model used. The response of the tendon was determined by measuring uptake of radioactive proline and its conversion to radioactive hydroxyproline. Histological changes were also noted.

ES level used were at 7 μ A (seven) incubating the tendons for 7,14,21,42 days (20 (twenty) per group, 10 (ten) ES). The average total DPM/mg of labelled tendons for both control & ES groups was calculated & t-test used to determine the stat significance of the differences between the 2 groups. The incorporation of isotope labelled proline measured cellular activity & its conversion to hydroxyproline, a measure of collagen synthesis. There was an increase in both cellular activity (255% at seven (7) days) & collagen synthesis (sixty per cent (60%) at forty two (42) days) in the stimulated groups. Concluded that a continuous DC accelerates early synthetic tendon activity that may persist for up to 6weeks, this was also indicated histological. Clearly caution must prevail when considering in-vivo research since pH, temp etc were not taken into account. This demonstrates the intrinsic capacity of tendons to heal.

 Nessler JP and Mass DP (1987) 'Direct-Current Electrical Stimulation of Tendon Healing in Vitro' *Clinical Orthopaedics and Related Research*;303-12

Summary

Eighty (80) tendons from white rabbits were surgically transected and removed from the animals after being surgically repaired. They were divided into four (4) groups of twenty (20), and cultured with ten (10) of each group being electrically stimulated, and half not.

A 1.4-volt direct current connected through a 150 kOhm resistor was used for stimulation, at a current of about 7 μ A. 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, the author's

stated "a continuous direct current causes increased tendon cell activity within seven days and the increased activity may persist as long as forty two (42) days."

🔴 Oweye I, Spielholz N and Nelson AJ (1987) 'Low-intensity Pulsed Galvanic Current and the Healing of Tenotomized Rat Achilles Tendons: Preliminary Report Using Load-to-Breaking Measurements' *Archives Physical Med Rehab. Vol. 68*

Summary

Sixty (60) rats were divided into three groups of 20. One was un-stimulated, one group had their Achilles tendons stimulated with positive (anodal) current, and the third group's tendons were stimulated with negative (cathode) 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 cathode currents".

🔴 Peters EJ; Lavery LA; Armstrong DO; Fleischli Jo. (2001). 'Electric Stimulation as an Adjunct to Heal Diabetic Foot Ulcers: A Randomised Clinical Trial.' *Archives of Physical Medical Rehabilitation. Volume 82.721-725*

🔴 Sinitsyn, Razvozva (1986) 'Effects of Electrical Micro currents on Regeneration Processes in Skin Wounds' *Orthop Travmatol Protez, Feb.*

Summary


Sixty eight (68) patients with post burn and post-traumatic wounds underwent treatment constant and modulated micro current of negative polarity of 1-10 uA/cm² over a period of 2-20 (two – twenty) 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.

🔴 Spadaro JA, Chase SE, and Webster DA (1986) 'Bacterial Inhibition by Electrical Activation of Percutaneous Silver Implants' *Journal of Biomedical Materials Research. Vol. 20: 565-77*

Summary

Silver wire implants were placed percutaneously 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 - cathode 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 20 μ A (twenty) current level. The author's comment that "metallic silver can be effectively and efficiently activated to elicit its anti-microbial activity by the application of microampere electrical current."

 Stanish WD and Gunlaughson B (1988) 'Electrical Energy and Soft-Tissue Injury Healing' *Sportcare and Fitness*, Sept/Oct

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".

 Stromberg BV. (1988). 'Effects of Electrical Currents on Wound Contraction.' *Annals of Plastic Surgery*. Vol 21(2): 121-123.

Summary

Thirteen (13) wounds on seven (7) pigs. Seven (7) wounds - controls. Three (3) wounds - -ve current. Three (3) wounds - received +ve alternating with -ve currents on 3 day cycles. Treatment protocols were 35 μ A & 128 pps. Thirty minutes (30) minutes twice a day. -ve current actually retarded wound contraction but alternative +ve and -ve currents increased rate of closure & this appeared to happen earlier on.

Comment

Pig skin is very similar to humans therefore it's a good animal model, & clearly identical wounds can be created. The problem with this study is numbers. To only have three wounds for both -ve currents & alternating ones is simply too few to be clinical valid.

🔴 Weiss DS; Eaglstein WH; Falanga V. (1989). 'Exogenous Electric current can Reduce the Formation of Hypertrophic Scars.' *Journal of Dermatological Surgical Oncology*. 15: 1272-1275.

🔴 Weiss DS, Kirsner R, Eaglstein WH. (1990) 'Electrical Stimulation and Wound Healing.' *Archives of Dermatology*. Vol 126: 222-225.

Summary

Weiss et al. (1990) produced quite a good paper that examined the biological electric properties of living Systems & review existing literature on ES & WH. The paper summarises that DC surface electro potentials are present in living tissue and, following tissue injury a current of injury (COI) is generated that is thought to trigger biological repair, & there is a lot evidence that exogenous ES can accelerate the healing process.

🔴 Windsor RE; Lester JP; Herring SA. (1993). 'Electrical Stimulation in Clinical Practice.' *The Physician and Sports Medicine*. Vol. 21(2): 85-93.

Summary

This study relates to sports medicine principally. It describes four forms of ES. Micro-current is based on an increase in cellular capacitance & normalization of membrane potentials; it appears to address many of the biophysical changes that occur with injured tissues.

🔴 Wolcott LE; Wheeler PC; Hardwicke HM; Rowley BA. (1969). 'Accelerated Healing of Skin Ulcers by Electrotherapy: Preliminary Clinical Results.' *Southern Medical Journal* Vol. 62:795-801.

Summary: These researchers applied micro current stimulation ranging from 200-800 μ A given in three hour segments each day, seven days a week 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 control, with stronger tensile strength of scar tissue and anti-bacterial effects in infected



wounds in the treated group. Forty percent (40%) of treated ulcers healed completely, none of the controls did.

Comment

A competent study and paper, although a little dated.