Minor Sports Injuries: Molecular Considerations and Treatment With an Electro-magnetic Device

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Abstract

Application of a new patented electromagnetic device (TheraMag™) to acute and sub-acute musculo-skeletal sports injuries has proven to be successful in reducing the pain, increasing mobility and dramatically decreasing the prolonged time for recovery of a variety of muscular, tendon and periosteal injuries sustained during American football practice and games. The net result is that the injured player is able to rejoin the team and the injury has had a markedly reduced impact upon performance. It would appear from this study that virtually any form of minor mechanical trauma would respond to therapy with the TheraMag™ electro-magnetic device within one hour of treatment.

Introduction

Despite the significant success of western medicine into the 21st century, there are a number of conditions associated with acute or chronic injuries and pain for which successful treatments have not been established. While acute pain and trauma are related mainly to injuries or swelling/inflammation and can generally be controlled, the chronic conditions, in contrast, represent a serious problem for society. The National Institutes of Health estimate that chronic pain affects more than 48 million Americans, and results in a $65 billion annual loss of productivity. In addition, over $100 billion is spent on pain care each year. Western medicine is based mainly on the achievements of chemistry which have been utilized and expanded by the pharmaceutical industry. Unfortunately, nearly all pharmaceuticals affect not only the target tissues but also the entire organism and in many cases initiate adverse effects. In contrast, physical medicine in general, and magneto-biology in particular, provides non-invasive, safe and easily applied methods to directly treat the site of injury, the source of pain, and the inflammation. Recent advances in bio-magnetic technology make magnetic and electromagnetic fields a useful modality for treatment of various pathologies and diseases. It has been shown that electromagnetic field does provide a practical and exogenous method for inducing cell and tissue modifications which correct selected injuries and pathological conditions. Within the world community, various types of magnetic devices have been shown to be effective not only for therapy of diseases and injuries, but also for the relaxation and well-being of subjects. This becomes even more important with respect to increasing physical and emotional stress in the everyday life of millions and millions of people on a global perspective.[1-4]

Minor sports injuries are relatively frequent in contact sports and have been treated with a variety of therapies with varying degrees of success. This report categorizes the acute and sub-acute injuries that occur during professional football. Early treatment of the acute and sub-acute injuries will forestall and reduce chronic conditions for which there is little effective therapy[5,6]*. Furthermore, we describe a new form of electro-magnetic therapy; called TheraMag™ device. It would appear from this study that virtually any form of minor mechanical trauma would respond to therapy with the TheraMag™ electro-magnetic device within one hour of treatment.*

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[1]Vallbonna, C. and Richards, T. (1999) Evolution of Magnetic Therapy From Alternative to Traditional Medicine. Physical Med. Rehab. Clinics Of North America. 10 (3): 729-754. [2]Becker, R.O. (1990) Cross currents. New York: The Putnam Publishing Group. [3]Becker, R, O. and Marino, A. A. (1982) Electromagnetism and Life. State University of New York Press. Albany, NY. [4]Becker, R.O., Selden, G. (1985) The body electric: Electromagnetism and the foundation of life. New York: William Morrow and Company. [5]Bassett, C. A. L., (1987) Low-energy pulsing electromagnetic fields modify biomedical processes. Bioassays 6: 36-42. [6]Vallbona, C., Hazlewood, C. F., and Gabor, J. (1997) Response of pain to static magnetic fields in post-polio patients: a double blind pilot study. Archives of Physical Medicine and Rehabilitation. 78: 1200-1203.

Traditional Concepts of Sports Injuries

Muscle soreness and pain that results from trauma and overexertion has been classified into two types based upon onset and localized character: Pain during and immediately after exercise has been traditionally considered due to diffusion of metabolites into the extra-cellular spaces while localized delayed soreness that occurs within twenty-four hours to forty-eight hours is considered to be due to ultra-structural changes, and this is called delayed onset muscle soreness. Common football injuries result from the physical size of the players, speed of the play, helmets and masks and the playing surface. The most common less serious injuries are bruises, sprains and strains, tendonitis, concussions, burners or stingers (compression of the brachial plexus), injury to the toes (turf toe), ligament and meniscus tears or fractures, contusions, hip pointer (bone bruise of the pelvis), and spinal trauma. Most therapy is directed at reducing further injury, lessening of edema and prevention of additional tissue bleeding. This is accomplished by **R**est-**I**ce-**C**ompression-**E**levation. Several traditional theories have been postulated for the mechanism of injury. These are:

The first is the mechanical trauma theory. This theory proposes a model in which original causal factor is the disruption of tissue due to the high mechanical forces that may be required during muscle contraction. This structural damage results in a net calcium influx into the muscle cells that alters and activates the calcium-dependent enzyme that degrades troponin and tropmyosin. This in turn sets up the inflammatory phase that invariably accompanies delayed onset of inflammation.

The second is the ischemia theory. This theory postulates that the trauma causes increased tissue pressure which leads to compression of capillaries and local ischemia supervenes. This localized ischemia then causes cellular structural damage that will result in an inflammatory process that further increases the ischemia and inflammation. Thus a vicious cycle is created. This theory is considered pivotal in that it is consistent with findings of increased electrical activity muscle pain syndromes. Further it is consistent with prevention or relief of pain and spasm by static massage or stretching.

Obviously, therapy for acute sports injuries is directed at the gross morphological changes that inevitably occur: petechial and gross hemorrhages from localized disruption of blood supply, swelling from cellular and extra-cellular fluid displacement and protection of further tissue destruction. Interruption and disruption of normal blood flow and hemorrhage as well as gross disruption and dislocation of normal tissue portends specific and directed therapies, which has been amply discussed in the medical sports literature.[7-9] **Our focus in this article will be to explore new concepts of cell organization and function and to consider the impact of electromagnetic therapy for sports injuries**. In addition, this study has utilized a patented unique form of electromagnetic energy that has an immediate therapeutic value in hastening recovery and reducing chronic disabilities and, therefore, a hypothesis as to electromagnetic effect on sports injury action is mandated.[5]

Unfortunately, there is not a cellular mechanism that adequately explains the altered cellular metabolic changes that accompany minor-to-moderate muscular-skeletal trauma. Therefore, consideration of basic intra-cellular metabolic functions is imperative in order to understand the pain, swelling, stiffness and disability arising from acute and sub-acute sports injuries. Trauma does not respect tissue types but is linearly related to velocity, locality of tissue damaged, responders of primary and secondary tissue damage as well as the relative response of the injured player. Alteration as viewed with magnetic resonance imaging reveals early changes in cellular water distribution. Trauma, therefore, at the cellular level will require a new understanding of the cellular morphology and biochemistry of structure as well as knowledge of tissue injury and repair.

Electro-magnetic device (TheraMag™)

Design

TheraMag™ is a patented device designed to be utilized for electromagnetic therapy. Electromagnetic therapy is a non-invasive and pain free therapy that does not involve needles, pills, drugs or surgery.[10-12] Much like the MRI units that employ the use of an electromagnetic system as the source of the magnetic field (which have already received approval by The Food and Drug Administration [FDA]), the TheraMag™ device is comprised of an electromagnet, although much smaller than in an MRI unit, that may produce a magnetic field of up to 4000 gauss. The number of windings of wire around the coil determines the exact gauss reading. Currently the windings of the TheraMag™ device produce a magnetic field strength of approximately 1,500 gauss (some two to ten times smaller than most MRI units). Again, as is the case for MRI units operating with an electromagnet, the magnet for the TheraMag™ device is made by winding wire around a spool or mounting member. The spool with the wire coiled around it may be referred to as the magnetic field generator (or the electromagnet).

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[7]Bassett, C.A.L., Mitchell, S.N., and Gaston, S.R. (1982) Pulsing electromagnetic field treatment in ununited fractures and failed arthrodeses. J. Am. Med. Assoc. 247:623-628. [8]Blank, M., Findl, E. editors (1987) Mechanistic approaches to interactions of electric and electromagnetic fields with living systems. New York: Plenum Press. [9]Carpenter, D. O., Ayrapetyan, S. editors (1994). Biological effects of electric and magnetic fields. San Diego: Academic Press. Two Volumes. [5]Bassett, C. A. L., (1987) Low-energy pulsing electromagnetic fields modify biomedical processes. Bioassays 6: 36-42. [10]Bassett, C.A.L., Mitchell, S.N., and Gaston, S.R. (1981) Treatment of un-united tibial diaphyseal fractures with pulsing electromagnetic fields. J. Bone Joint Surg. 63A: 511-523. [11]Bassett, A. (1994) Therapeutic uses of electric and magnetic fields in orthopedics. In: Carpenter DO, Ayrapetvan S, editors. Biological effects of electric and magnetic fields. Vol 2: beneficial and harmful effects. San Diego: Academic Press p. 13-48. [12]Glassman, L. S., McGrath, M. and Bassett, C. A. L. (1986) Effect of External Pulsing Electromagnetic Fields on the healing of Soft Tissue. Ann. Plast. Surg, 16: 287-295.

USAGE

In the case of the MRI unit, the entire body is typically placed in the opening of the coil; whereas, for the TheraMag™ device, exposure of the magnetic field is limited to the hand and forearm or the feet of the subject.[13] The subject is exposed to the magnetic field through a cylindrical opening which is approximately 5 inches in diameter for hand and forearm exposure and 8 inches for the feet. The TheraMag™ device is powered by 120 VAC and may be mounted on wheels. The electrical power line furnishes current to the coil. Flow of current in the coil produces a magnetic field in the opening of the magnet. Therefore, the generated magnetic field penetrates all the tissues of the hand and forearm or feet: skin, muscles, bones, blood vessels, lymphatics, and peripheral nerves, etc.[14-18] Typically, magnetic field exposure is initiated by placing the hand and forearm in the cylindrical opening of this machine for a given period of time (usually 30 minutes to one hour which is roughly the same exposure time as in MRI units). The TheraMag™ device is enclosed in a housing that has the access passage for insertion of a subject's hand and forearm or the feet. The TheraMag™ device includes a control circuit that regulates the amount of current flowing in the coil. The control circuit permits adjustable regulation or control of the electromagnetic field (EMF) strength by the field-generating coil to establish the field strength. Within this range of exposure time, numerous therapeutic effects have been observed for conditions such as reflex sympathetic dystrophy (RSD), chronic regional pain syndrome (CRPS), Parkinson's disease (PD), and seizures. In the conditions of RSD and PD, various muscle groups tend to relax which allows increased mobility. In addition, there is reason to believe that the magnetic fields generated by the TheraMag™ device will impact wound healing in an efficacious manner (including decubitus and diabetic ulcers, peripheral neuropathy, as well as multiple pain disorders). The TheraMag™ device has been designed to minimize or eliminate any potential hazards. For example, an oil circulating system has been installed for cooling the coil. Also, should temperatures reach above 140 F, the unit will shut down automatically. The cylindrical opening produces a homogenous electromagnetic field, which will bathe the hand or forearm of the patient when inserted into the unit. The magnetic field produced from a parallel coil placed across the body part and, for the purpose of this study, the exposure time was one hour.

The FDA has related that it is permissible to use magnets in specific studies since there have not been any published reports of ill effects resulting from the external application of magnets over any part of the body, therefore, safety is not an issue. Furthermore, the World Health Organization has reported that "the available evidence indicates the absence of any adverse effects on human health due to exposure to static magnetic fields up to 2T": WHO (1987) and (1989) (2T = 20,000 Gauss).[19-20] The IDE classifies this type of medical device as low risk, and does not require formal IDE application.[21-22] Magnetic radiation has been monitored in this device.

Study Pilot Results

1. There was a marked redness of the opposite extremity than that placed in the TheraMag™ Device after about 15-20 minutes.
2. Each patient experienced for a slight euphoria followed by drowsiness during the course of therapy for 1 hour.
3. There was a detectable slight drop in postural (standing) blood pressure following conclusion of therapy that lasted from 30 second to 60 seconds.
4. After 45-60 minutes a profound decrease in cellular edema and an increase in urine production invariably results associated with the therapy.

Pain Relief – Muscle and Tendon Spasm and Relief – Table

The study population consisted of over 60 NAFL professional football players aged 19-34 with muscular-skeletal acute and sub-acute injuries. Each session with the TheraMag™ device lasted 60 minutes. During the process of a 60 minute session on the TheraMag™ device, observable reduction of edema occurred, up to 3-4 cm, pain and spasm are immediately reduced, and muscle and tendon function improved, although many players had several injuries, simultaneously. Each player was asked to rate the pain/stiffness and agility on a 0-10 point analog scale. Overall the pain relief index decreased from 8.5 to 1.5 within 60 minutes of therapy. Players were often able to return to the game within days after serious hamstring or other injuries. Some more chronic conditions, such as tendonitis, required several treatments before the player was able to resume his sports activity. Overall, over 90% of the injuries were dramatically improved with one 60 minute treatment, thus allowing the injured player to resume normal contact sports participation. The 10% poor responders were all chronic joint and tendon problems.

[13]Markov, M and Colbert, A. (2001) Magnetic and Electromagnetic Field Therapy. J of Back and Muscloskel. Rehab. 15: 17-29 [14]Trock, D.H., Bollet, A.J., Markoll, R. (1994) The effect of pulsed electromagnetic fields in the treatment of osteoarthritis of the knee and cervical spine. Report of randomized, double blind, placebo controlled trials. J Rheumatol 21:1903-1 1. [15]Bassett, A. (1994) Therapeutic uses of electric and magnetic fields in orthopediecs. In: Carpenter, D. O., Ayrapetvan, S., Eds. Biolgical Effects of Electric and Magnetic Fields. Vol 2, San Diego, Academic press. P. 13-48. [16]Glassman, L. S., McGrath, M. H., and Bassett, C. A. L. (1986) Effect of External Pulsing Electromagnetic Fields on the Healing of Soft Tissue. Ann. Plast. Surg. 16: 287-295. [17]Itoh, M., Montemayor, J. S., Matsumoto, E., Eason, A., Lee, M. H., and Folk, F. S. (1991) Accelerated wound healing of pressure ulcers by pulsed high peak power electromagnetic energy (Diapulse). Decubitus 4:29-34. [18]Stiller, M.J., Pak, G.H., Shupack, J.L., et al. (1992) A Portable Pulsed Electromagnetic Field (PEMF) Device to Enhance Healing of Recalcitrant Venous Ulcers: A Double-blind, Placebo-controlled Clinical Trial. British J. Dermatol. 127: 147-154. [19]Miner, W.K., Markoll, R. (1993) A double blind trial of the clinical effects of pulsed electromagnetic fields in osteoarthritis. J Rheumatol 1993, 20:456-60. [20]World Health Organization (1987). Magnetic fields. United Nations Environment Program, The International Labor Organization. Geneva: WHO. [21]Health and Safety Guide No. 27: (1989) Magnetic Fields Health and Safety Guide. World Health Organization, p 24. [22]Inhofe, P.D., and Garcia-Moral, C.A.: (1994) Reflex Sympathetic Dystrophy: Orthopedic Review: 655-661.

TheraMag™ Sports Table (Total Cases 87)				
Type of Injury	**Number of Cases**	**60 Minutes Immediate Results**	**Number Treatments % Improvement**	**Return to Competitive Sports**
Achilles Sprain	10	95%	1-100%	5 days
Med/Lat. Knee Sprains	15	93%	2-3-94%	4 days
Hamstring Sprain	21	92%	2-100%	6 days
Quad. Sprain	8	94%	2-95%	5 days
Contusions Upper Ext.	9	96%	1-100%	4 days
Contusions Lower Ext.	9	95%	1-100%	5 days
Tendonitis	7	68%	3-4-95%	7 days
Burners/Stingers	4	92%	1-100%	4 days
Hip Pointer	4	87%	2-97%	5 days
Low Back Contusion	5	94%	1-99%	4 days
Cervical Strain	7	99%	1-100%	2 days

Discussion of Mechanism of Action Acute Pain and Inflammation

Chemoattractant-mediated recruitment of lymphocytes is a key step in the progress of acute pain and inflammation of tissues following injury.[23-31] Pain, like inflammation, must be viewed as a process that has several components. Cytokines and chemokines play a central role in both acute and chronic inflammation and pain syndromes. It is these cytokines that influence the functional differentiation of T lymphocytes. This step is one in which naïve CD4 T lymphocytes are altered to become either a TH1 cell or a TH2 cell. These TH1 and TH2 cells have very different structure and function. In addition to the chemical structure of the cytokine, the amount released and the sequence of the released chemical factors are important in deterring the amount and type of biological response. Very large amounts of peptides that achieve a high density on the surface of antigen-producing cells tend to stimulate TH1 cell responses, whereas low-density presentation tends to elicit TH2 cell responses. Most protein antigens that elicit CD4 T-cell responses stimulate the production of both TH1 and TH2 cells, but to a differing degree.[32] Production of TH1 cells tend to inhibit the production of TH2 cells.

The Biochemical and Physiological Mechanism of Pain

Pain is produced by the local release of specific prostaglandins.[33-35] There are many types of prostaglandins, but prostacyclin (PGI2) is the main prostaglandin that is produced by vascular epithelial cells at the site of injury. This bioactive substance is a potent vasodilatator, prevents platelet aggregation, interferes with platelet adherence to the vascular endothelial membrane, induces the production of hydrochloric acid in the stomach and causes sodium and water retention. This process leads to further localized tissue damage, inflammation and edema. The physical consequences of which are pain, swelling, spasm, tenderness and loss of function. The prostaglandin F2, by contrast, causes vasoconstriction and contraction of smooth muscle. Closely related to the prostaglandins are the leukotrienes that accentuate smooth muscle contraction, vasoconstriction, vascular permeability and the release of lysosymal enzymes.[36]

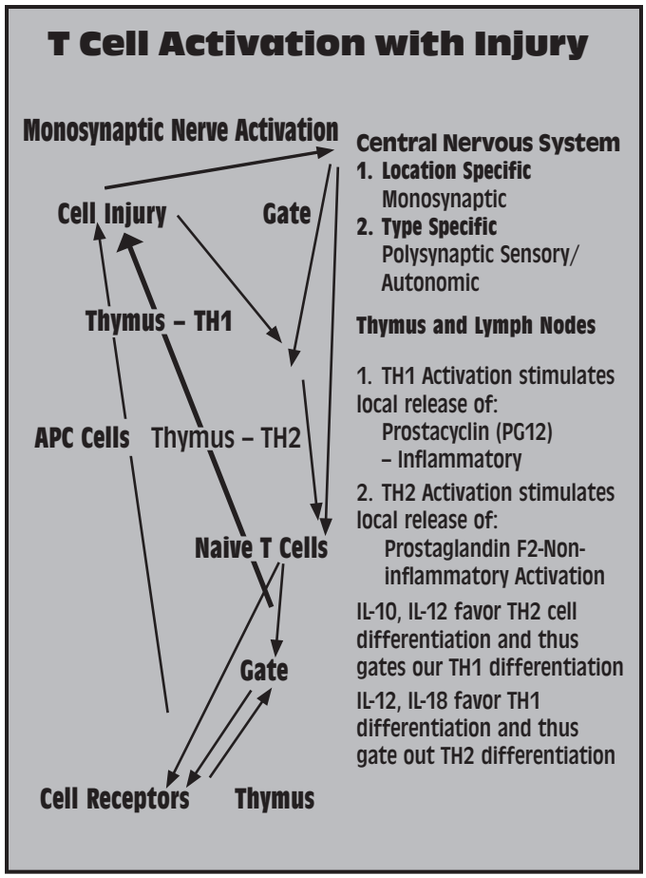
Although we cannot offer an exact mechanism(s) for the immediate pain relief observed in our study patients, the effect could result from a local or direct change in pain receptors and several authors have made speculations regarding

[23]Adey, W.R. (1981) Tissue interactions with non-ionizing electromagnetic fields. Physiol. Rev 61: 435-514. [24]Beall, P.T., Hazlewood, C.F., Rao, P.N. (1976) Nuclear magnetic resonance patterns of intracellular water as a function of HeLa cell cycle. Science 192:904-7. [25]Hazlewood, C. F. (1979) A View of the Significance and Physical Properties of Cell Associated Water. In: Cell Associated Water. Ed. By Walter Drost-Hansen and James Clegg, Academic press, New York, pp 293-325. [26]Hazlewood, C.F. and Van Zandt, R.L. (1995) A hypothesis defining an objective end point for the relief of chronic pain. Medical Hypotheses 44:63-65. [27]Ayrapetvun, S., Avanesian A., Avetisian, T., Majinian S. (1994) Physiological effects of magnetic fields may be mediated through actions of the state of calcium ions in solution. In: Carpenter DO, Ayrapetvzin S, editors. Biological effects of electric and magnetic fields. sources and mechanisms. San Diego: Academic Press p. 181-92.9. [28]Hazlewood, C.F., Nichols, B.L., and Chamberlain, N.F. (1969) Evidence for the Existence of a Minimum of Two Phases of Ordered Water in Skeletal Muscle. Nature 222:747-750. [29]Hazlewood, C.F., Rorschach, H.E., and Lin, C. (1991) Diffusion of Water in Tissues and MRI. Magnetic Resonance in Medicine 19:214-216. [30]Rorschach, H.E., Lin, C., Hazlewood, C.F. (1991) Diffusion of Water in Biological Tissues. Scanning Microscopy Supplement 5:S1-S10. [31]Hazlewood, C.F. (1995) Water Movement in Diffusion in Tissues. In: Diffusion and Perfusion: Magnetic Resonance Imaging. Edited by Dennis Li Bihan and Bruce Rosen, Rana Press, New York., 1995. [32]Chen, Q., Gholardi, N., Wang, H., et. Al. (2000) Development of Th 1-type immune responses requires the type 1cytokine receptor TCCR. Nature 407: 916-920. [33]Andrian, U. and Mackay, C. (2000) T-Cell function and migration. NEJM, 343, 14: 1020-1034. [34]Van der Merwe, P. and Davis, S. (2002) The Immunological Synapse-a Multitasking System. Science, 295: 1479-1481. [35]MacKay, I. and Rosen, F. (2000) T-Cell Function and Migration. NEJM, 343: 14, 1020-1034. [36]Sasaki. T., Irie-Sasaki, J., Jones, R., et. Al. (2000) Function of P13Kg in Thymocyte Development, T Cell Activation and Neutrophil Migration. Science, 287: 1040-1046.

the possible mechanism of action.[1] These cytokines all appear to mediate a response by NF-kB activation in the receptor cells, which, in turn causes the typical inflammatory response.[37] It appears that specific activation of types of T cells by antigen and the subsequent release of Type-1 (TH1) or Type-2 (TH2) T cell cytokines as well as perhaps other effector molecules (peptides) will result from initial injury.

Cellular Mechanisms of Pain Syndromes

It is conceivable that with acute pain syndromes thymocytes are altered so that cells develop with large stores of lipid kinases for adhesion and infiltration during the pain syndrome. The consequences of the production of TH1 lymphocytes versus TH2 lymphocytes are profound. This gate mechanism is the selection of THI versus TH2 T cells which tend to gate out the other type of T cells. TH1 cells are specialized for the activation of macrophages; they secrete interferon gamma as well as other effector molecules, and express membrane bound CD40 members of the tumor necrosis family and/or the Fas ligand. TH2 cells are specialized for B cell activation; they secrete the B cell growth factors, IL-4 and IL-5. Membrane bound effector molecule expressed by TH2 cells is CD40 ligand, which binds to CD40 on the B cell and induces B cell proliferation.[38-41] Activated macrophages increase their expression of CD40 and of TNF receptors, and secrete TNF-a. This secretion induces the production of nitric oxide (ferritin dependent) and oxygen radicals and further activates resting CD4 T lymphocytes. It is therefore clear that the two subsets of CD4 T cells, TH1 and TH2 cells can down-regulate each other and once one subset becomes dominant it is often hard to shift the response to the other subset. It is believed that one reason for this is that cytokines from one type of CD4 T cell inhibit the activation of the other; a cytokine gate mechanism. IL-10, a product of TH2 cells can inhibit the development of TH1 cells by acting on the antigen-presenting cell, whereas IFN-g, a product of the TH1 cells, can prevent the activation of TH2 cells. Peptides that interact strongly with the T cell receptor tend to stimulate TH1-like responses, while peptides that bind weakly tend to stimulate TH2-like responses. Glucocorticoid hormones (increased during physical or emotional stress) tend to drive the development towards TH2 T cells. Recently, Ericsson[42] and Ericsson and Hazlewood and Marko[43], Hazlewood and Ericsson[44] have shown that as a consequence of production of TH 2 T cells, following TheraMag™ usage, increased serine, glycine, and fructose turnover rates may herald enhanced energy production while insulin receptor activity was unchanged. The simultaneous formation of increased cysteine may represent a tendency toward greater adhesive molecule production. The following diagram illustrates the role of the central nervous system for localizing and activating the thymus gland in this complex process:



Summary of Injury and Pain

Following injury a mono-synaptic neuronal stimulus localized the post capillary in juxtaposition to the injury. Neuro-activated release of selectins and integrins occurs, slowing down the antigen presenting cells (APC's) so that they tumult and pick up the signal on their surface. Signals are also sent to the Thymus gland and nodes for activation of naïve T cells. When these APC's reach the thymus gland they impart their information and either TH1 or Th2 T cells are manufactured and released. Once release the THI T cells incite the local tissue at the site of injury to release prostacyclin PG12 thus activating further inflammation. On the other hand if TH2 T lymphocytes are produced and released they activate the release of prostaglandin F2, which is non-inflammatory.

[1]Vallbonna, C. and Richards, T. (1999) Evolution of Magnetic Therapy From Alternative to Traditional Medicine. Physical Med. Rehab. Clinics Of North America. 10 (3): 729-754. 37Albelda, S., Smith, C. and Ward, P. (1994) Adhesion molecules and inflammatory injury. FASEB, 8: 504-512. 38O'Garra, A. and Arai, N. (2000) The molecular basis of T helper 1 and T helper 2 cell differentiation. Cell Biology, 10: 542-550. 39Delves, P. and Roitt, I. (2000) The Immune System, First of Two Part. Science, 343: 37-49. 40Delves, P. and Roitt, I. (2002 The Immune System, Second of Two Parts. Science, 343: 108-1525. 41. Lee, K., Holdorf, A., Dustin, M. et. Al. (2002) T Cell Receptor Signaling Precedes Immunological Synapse Formation. Science, 295: 1539-1542. 42Ericsson, A. D. (2001) Thymus and T Cell Development, Differentiation, Conformation, Cytokine Production and the Pilot Study Evaluation of a New Form of Therapy-Cefal-eX™. Explore, 10; 2: 45-50. 43Ericsson, A. D., Hazlewood, C. F., Marko, M and Crawford, F. (20040) Specific Biochemical Changes in Circulating Lymphocytes Following Acute Ablation of Symptoms in Reflex Sym[pathetic Dystrophy. Biological Effects of EMF's, October 2004, Kos, Greece. 44Marko, M, Hazlewood, C. and Ericsson, A. (2004) Systemic Effect-A Plausible Explanation of the Benefit of Magnetic Field Therapy: A Hypothesis. Biological Effects of EMF's, October 2004, Kos, Greece.

Summary of Therapy With the Electro-magnetic Device

The TheraMag™ device performs the following in acute and sub-acute sports injury:

1. Increase in arterial and capillary blood flow. This removes toxic and metabolic waste products that are responsible for delayed injury.
2. Alters the neuronal synaptic membranes and thus reduces pain.
3. Alters CD4 T lymphocyte inflammatory responses by reducing the release of inflammatory prostaglandins at the site of the injury (favors the production and release of TH2 T lymphocytes).
4. May act at the cellular level to increase ATP production and release which result in normal cellular water polarization.
5. Clinically allows for markedly accelerated regeneration and recovery of the injured tissue.

These physiological-biochemical effects help sports injured person by:

A. Immediate reduction of pain.
B. Increased function of the affected part.
C. Enhanced healing of the sports injury wound; including fractures, tendon tears, tendonitis, muscular and skeletal sprain-strain syndromes, bruises and contusions and joint injuries.

Use of the TheraMag™ device demonstrates a total bodily effect as evidenced by increased arterial and capillary blood flow in the opposite (contra-lateral) extremity, influences central and peripheral nervous system directly and alters CD4 T lymphocytes as shown in a previous study of Parkinson's Disease[45] and Reflex Sympathetic Dystrophy[43]. At the cellular level electromagnetic frequencies may have an effect upon iron molecules. These iron molecules are distributed as Ferritin in hemaglobulin (bound) and in Iron Response Elements (unbound) as regulatory elements and repressor proteins in Ribose Nucleic Acid (mRNA). In all cells of the body, excluding red blood cells, mRNA is distributed in the nucleus and mitochondria. In the nucleus it appears to regulate or gate cell division or peptide production, while in the mitochondria it regulates ATP production and release. Any small reduction of ATP will invariably lead to water molecule displacement but on the other hand, marked reduction of ATP appears to be accompanied by cell death, a process known as apoptosis. The net result is an athlete that heals more effectively, is in less pain and returns to sports arena more rapidly. Obviously more studies as to the mechanisms involved are necessary, however, the use of electromagnetic devices, particularly TheraMag™ device appears to be very successful in treating acute and sub-acute muscular and skeletal sports injuries.

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[45]Ericsson, A. D., Hazlewood, C. F. and Hrna, D. (2002) Pilot Study-TheraMag™: A Treatment of Parkinson's Disease. Explore, 11; 6: 40-41. [43]Ericsson, A. D., Hazlewood, C. F., Marko, M and Crawford, F. (20040) Specific Biochemical Changes in Circulating Lymphocytes Following Acute Ablation of Symptoms in Reflex Sym[pathetic Dystrophy. Biological Effects of EMF's, October 2004, Kos, Greece.