D A T A B A S E

Selected Representative Overview of Scientific and Clinical Papers

INTRODUCTORY LETTER

Dear Reader:

We would like to present you with the enclosed selection of Selected Representative Overview of Scientific and Clinical Papers, which is the basic science supporting the PST™ Technology. For ease in reviewing the documentation, we have placed the information into three categories:

I: Intracellular Processes (24 papers)

II: Cell Response to PEMF (PST Stimulation - (45 papers)

III: Medical Applications (51 papers)

These scientific and clinical papers were extracted from our database, a pool of more than 2,500 scientific and clinical publications produced over the past thirty years. All of these papers stem from pure review medical and scientific journals. We would be happy to provide any additional information you should require.

On page 39, "Key Words" have been provided to assist you in any future requests. Additionally, may we suggest you use the key number (for example: T#:00524) should you wish to request the complete unabridged article.

If you are interested in additional data or scientific papers for any particular topic, please

provide us with the Key Word and we will then provide you with all applicable papers.

TABLE OF CONTENTS

PEMF – Pulsed Electromagnetic Fields (PST – Pulsed Signal Therapy)

SELECTED REPRESENTATIVE OVERVIEW OF SCIENTIFIC AND CLINICAL PAPERS

INTRACELLULAR PROCESSES

T#:01007

Adey WR (1993). **Whispering between cells: electromagnetic fields and regulatory mechanisms in tissue.** *Frontier Prospectives*, 3(2):21-25.

SUM: "At the core of observed sensitivities to low-level EM fields are a series of cooperative processes. One such series involves calcium ion building and release. Available evidence points to their occurrence at cell membranes and on cell surfaces in the essential first steps of detecting EM fields. Also, attention is now directed to newly defined roles for free radicals, that may also participate in highly cooperative detection of weak magnetic fields, even at levels below thermal (kT) noise." (p. 21) "It is at the atomic level that physical processes, rather than chemical reactions in the fabric of molecules, appear to shape the transfer of energy and the flow of signals in living systems. (p. 24)

KEYWORD(s): calcium, membrane, EMF

T#:00141

Adey WR (1988). **Physiological signaling across cell membranes and cooperative influences of extremely low frequency electromagnetic fields.** In: *Frohlich H, ed. Biological Coherence and Response to External Stimuli.* Springer-Verlag, 148-170.

SUM: Discussion of required field intensities as they affect degrees of cooperativity.

KEYWORD(s): calcium, human tissue, PG, chemical, ELF

T#:00752

Akizuki S, Mow VC, Muller F, Pita JC, Howell DS, Manicourt DH (1986). **Tensile properties of human knee cartilage: I. Influence of ionic conditions, weight bearing, and fibrillation on the tensile modulus**. *J Orthop Res*, 4(4):397-392.

SUM: "The flow-independent (intrinsic) tensile modulus of the extracellular matrix [ECM] of human knee joint cartilage has been measured for normal, fibrillated, and osteoarthritic (removed from knee joint replacements) cartilage. ...The tensile modulus of the ECM correlates strongly with the collagen/proteoglycan ratio." (p.379)

KEYWORD(s): collagen, arthritis, human tissue, cartilage

T#:00660

Anderson JC, Eriksson C (1968). **Electrical properties of wet collagen**. *Nature*, 218:166-168.

SUM: "The electrical properties of dried collagen and bone have been studied by Fukada and Yasuda. Both were shown to be piezoelectric, producing a measurable potential between opposite faces when stressed and also deforming on application of a voltage.... The mechanism of streaming potential at its simplest depends on the absorption of one type of ion on the surface of the molecule, with an associated diffuse layer of ions of the opposite type extending out from the molecular surface. When the liquid streams past the molecule there is a net transport of one type of ion with a resulting potential gradient, which may be measured by means of electrodes placed in the stream. The magnitude of the streaming potential is dependent on the type of molecule and the pH of the solution." (p. 166) "These results with wet collagen imply that, because it exhibits no piezoelectric effect, it belongs to a group of higher symmetry than does the dry material." (p. 167)

KEYWORD(s): collagen, bone, streaming potentials

T#:00636

Bassett CAL, Pawluk RJ (1972). **Electrical behavior of cartilage during loading**. *Science*, 178:982-983.

SUM: "When cartilage is deformed, it becomes electrically polarized. At least two mechanisms seem to underlie this phenomenon, namely, a short-duration, high-amplitude, piezoelectric-like response and a longer-duration, lower-amplitude response secondary to streaming potentials. The polarity of articular cartilage during loading could hypothetically facilitate joint lubrication."(p. 982) "...regions of growth are characteristically electro-negative.... Joint lubrication during loading occurs largely as a result of the adherence of sodium hyaluronate to the articular surface. This biopolymer is a strong polyanion and would be expected to adhere more effectively to a positively charged surface than to one which was negatively charged. Since cartilage itself is fabricated to a large degree of protein-polysaccharides, which are negatively charged, it would seem appropriate to assume that Nature developed an electrostatically based method to facilitate cartilage lubrication at the moment of loading."(p. 983)

KEYWORD(s): bone healing, ossification, animal tissue, cartilage, streaming potentials

T#:01008

Benveniste J (1993). **Transfer of biological activity by electromagnetic fields**. *Frontier Prospectives*, 3(2):13-15.

SUM: "The essential molecular functions appear in fact to be determined by electromagnetic mechanisms. A possible role of molecular structures would be the carrying of electric charges which generate, in the aqueous environment, a field specific to each molecule. Those exhibiting such coresonating or opposed fields ("electroconformational coupling") could thus communicate, even at a distance. Therefore a minute variation in the structure of molecules (plus or minus an atom, or a rearrangement of an amino acid, for example), which even

slightly modifies their radiating field, would allow their message to be received or not by a receptor, as in the FM waveband." (p. 15)

KEYWORD(s): receptors, EMF

T#:00408

Bjelle A (1977). **Glycosaminoglycans in human articular cartilage of the lower femoral epiphysis in osteoarthritis**. *Scand J Rheumatology*, 6:37-44.

KEYWORD(s): OA, human tissue, PG, cartilage

T#:00213

Blakeslee S (1992). **Magnetic crystals, guides for animals, found in humans**. *New York Times*, C1,C12 (May 12).

KEYWORD(s): earth's geomagnetic field

T#:1189

Blank M, Goodman R (1997). **Do electromagnetic fields interact directly with DNA?** Bioelectromagnetics, 18(2): 111-115.

SUM: "The mechanisms whereby electromagnetic (EM) fields stimulate changes in biosynthesis in cells are known. It has generally been assumed that EM fields first interact with cell membranes, but this pathway may not be the only one. Interactions with membranes are well documented, but recent studies of EM signal transduction in the membrane NA, K-ATPase are best explained by direct interaction of electric magnetic fields with mobile charges within the enzyme. Interaction with moving charges may be a mechanism that is operative in other biopolymers. Recent studies on DNA have shown that large electron flows are possible within the stacked base pairs of the double helix. Therefore, gene activation by magnetic fields could be due to direct interaction with moving electrons within DNA. The mechanism of EM field-transcription may be related to the process in striated muscles, where endogenous electrical activity induces the synthesis of new proteins." (p. 111)

KEYWORD(s): receptors, membrane, RNA/DNA

T#:00014

Brandt KD, Radin E (1987). **The physiology of articular stress: Osteoarthritis**. *Hosp Pract*, 103-126.

SUM: Describes some of the mechanisms of OA.

KEYWORD(s): OA, *in vitro*, PG, cartilage, review

T#:00967

Breger L, Blumenthal NC (1993). **Electromagnetic field enhancement of membrane ion transport**. Proceedings of the Thirteenth Annual Meeting of the Bioelectrical Repair and Growth Society; October 10-13, 1993; Dana Point, CA. *BRAGS*, 38.

SUM: Experiments to test Liboff's hypothesis concerning magnetic fields and calcium diffusion were performed using artificial and biological membranes with no results.

KEYWORD(s): calcium, membrane, nerve regeneration, ELF-PEMF

T#:00197

Buckwalter JA, Mow VC (1992). **Cartilage repair in osteoarthritis.** In: Moskowitz RW, Howell DS, Goldberg VM, Mankin HJ, eds. *Osteoarthritis: Diagnosis and Medical/ Surgical Management*. 2nd ed. Philadelphia: W. B. Saunders Company, chap 4.

KEYWORD(s): OA, cartilage, PEMF

T#:00452

Calvino B, Villanueva L, Le Bars D (1987). **Dorsal horn (convergent) neurones in the intact anaesthetized arthritic rat. I. Segmental excitatory influences**. *Pain*, 28:81-98.

SUM: "In healthy rats, the convergent and non-noxious neurones of laminae 3-6 are generally almost silent in the absence of an any stimuli within the receptive field. This was also true in the present study for the ‘typical’ neurons; however about half (58%) of the ‘atypical’ neurons exhibited a high level, background discharge which sometimes showed dramatic increases...."(p. 93)

KEYWORD(s): OA, pain

T#:00453

Calvino B, Villanueva L, Le Bars D (1987). **Dorsal horn (convergent) neurones in the intact anaesthetized arthritic rat. II. Heterotopic inhibitory influences**. *Pain*, 31:359-379.

SUM: "It is concluded that the input for triggering heterotopic inhibitory influences by mechanical stimuli is altered in the arthritic rat, a model of chronic pain. This is consistent with the known lowering in threshold of nociceptive afferents innervating the joint capsule, induced by arthritis."(p. 360)

KEYWORD(s): OA, pain

T#:00728

Caterson B, Lowther DA (1978). **Changes in the metabolism of the proteoglycans from sheep articular cartilage in response to mechanical stress**. *Biochim Biophys Acta*, 540:412-422.

SUM: "Cartilage integrity can be controlled by many factors which influence the balance between synthesis and breakdown of its components. The results presented here suggest that articular cartilage has the capacity to respond to the mechanical stresses to which it is exposed and that mechanical stress and motion are required for the maintenance of the cartilage constituents at normal physiological levels." (p. 421)

KEYWORD(s): OA, animal tissue, PG, cartilage, streaming potentials

T#:00942

Cochran GVB, Otter MW, Bieber W, Wu D (1993). **Streaming potentials associated with gap healing in canine tibia**. Proceedings of the Thirteenth Annual Meeting of the Bioelectrical Repair and Growth Society; October 10-13, 1993; Dana Point, CA. *BRAGS*, 9.

SUM: "This experiment measures the first in vivo measurements of SPs from bone callus; it identified two factors which affect the electrical output. First, the magnitude of SPs correlated roughly with the magnitude of total strain on the callus; this was the dominant effect. As healing progressed, and the enchondral layer became thinner and eventually disappeared, the signals decreased as strain tended to be reduced and to become equalized between callus and adjacent bone. Second, the signal strength...tended to increase as the new bone became more dense, thus supporting the prior observation that new and remodeling bone generates lower amplitude SPs/strain (1) than does normal cortical bone..." (p. 9)

KEYWORD(s): canine tissue, bone repair, streaming potentials

T#:00212

Davey CL, Kell DB (1990). **The dielectric properties of cells and tissues: What can they tell us about the mechanisms of field/cell interactions?** In: O'Connor ME, Bentall RHC, Monahan JC, eds. *Emerging Electromagnetic Medicine*. New York, NY: Springer-Verlag, 19-43.

SUM: In cell suspension, as the frequency is increased, permitivity falls and conductivity rises. [Implication: at low Hz, permitivity highest, but conductance low.] At low frequencies, the cell membrane behaves as non-conductors suspended in a conducting medium; most of the current is flowing in the suspension around the cells. As it takes time for ion movements to occur, low frequencies allow time for it to occur. Oscillations caused by rapid alternating frequencies can generate heat; low frequencies are isothermal. "If fields can affect enzymes and cells, [one should expect] to be able to tailor a waveform as a therapeutic agent in much the same way as one now modulates chemical structures to obtain pharmacological

selectivity and perhaps withhold many of the side-effects common to pharmaceutical substances." [ref 58-Kell in a Wales local journal.]

KEYWORD(s): membrane, EMF

T#:00778

DeWitt MT, Handley CJ, Oakes BW, Lowther DA (1984). **In vitro response of chondrocytes to mechanical loading, the effect of short-term mechanical tension.** *Conn Tissue Res*, 12:97-109.

SUM: "The results presented in this paper demonstrate that it was possible to elicit a direct response in vitro by chondrocytes to mechanical stimuli over a 24 h period. There was an increase in the rate of proteoglycan synthesis by the chondrocyte cultures..." (p. 107) "However, high impact loads or abnormal loading of synovial joints results in loss of proteoglycan from articular cartilage, fibrillation of this tissue and cell death reflected in a loss of cellularity, changes which resemble those seen in osteoarthritis." (p. 109)

KEYWORD(s): OA, cAMP, chick, PG, cartilage, streaming potentials

T#:00643

Dunham J, Shackleton DR, Nahir AM, Billingham MEJ, Bitensky L, Chayen J, *et al.* (1985). **Altered orientation of glycosaminoglycans and cellular changes in the tibial cartilage in the first two weeks of experimental canine osteoarthritis**. *J Orthop Res*, 3:258-268.

SUM: "Changes in the cellularity and in the nature of the matrix were studied in the cartilage of the tibial plateau in experimentally induced arthritis in the dog,.... The orientation of the glycosaminoglycans was assessed by the new 'induced birefringence' method. The results indicated that only the region of the medial tibial cartilage that was unprotected by the meniscus was affected, showing increased water content, loss of superficial cells, and a crease in orientation of the glycosaminoglycans. Whereas the birefringence [orientation] of the collagen was unaffected, the superficial area that lacked oriented glycosaminoglycans was markedly increased; this may be a useful indicator of early osteoarthritic changes." (p. 258)

KEYWORD(s): OA, canine tissue, GAG-PG, cartilage

T#:1190

Eichwald C, Walleczek J (1996). **Activation-dependent and biphasic electromagnetic field effects: model based on cooperative enzyme kinetics in cellular signaling.** *Bioelectromagnetics*, 17(6):427-435.

SUM: Experiments on filed exposure effects of extremely-low-frequency electric and magnetic fields (EMFs) biological systems have shown that, in many cases, the biological-functional status is of fundamental importance for an effective interaction. For example, studies of calcium uptake regulation in cells of the immune system, particularly in T

lymphocytes, have revealed that, depending on the degree of cellular activation, either stimulatory, inhibitory, or no field exposure effects are observed for identical field parameters.

KEYWORD(s): calcium, immune system, mech action, EMF, DNA, human tissue

T#:00676

Eyre DR (1991). **Cartilage expression of a type II collagen mutation in an inherited form of osteoarthritis associated with a mild chondrodysplasia.** *J Clin Invest*, 87:357-361.

SUM: "We postulate that the presence of the mutant protein molecules in the extracellular collagen reduces the durability of the articular cartilage and manifests as the disorder, severe primary OA. The fibrils may be less able in the long term to cope with the mechanical stresses that articular cartilage endures, perhaps through defects in material properties. In addition the collagen may be more susceptible to extracellular proteases that are active in matrix remodeling but which do not normally degrade the collagen triple-helix. ...Because failure of the underlying collagen fabric of cartilage appears to be a key, irreversible event in the process of joint destruction in OA in all its subsets, defining how this single amino acid substitution is etiologically associated with severe but otherwise typical disease manifestations may prove instructive in understanding osteoarthritic joint failure." (p. 360)

KEYWORD(s): OA, human tissue, cartilage

T#:00283

Ficat C, Maroudas A (1975). **Cartilage of the patella. Topographical variation of glycosaminoglycan content in normal and fibrillated tissue**. *Ann Rheum Dis*, 34:515-519.

SUM: "The glycosaminoglycan content of normal cartilage is lower in the knee than in the hip. This fact, together with the existence of high pressures during load bearing, may be responsible for the greater frequency of destructive lesions affecting the cartilage of the patella compared with that of the hip." (p. 515)

KEYWORD(s): human tissue, surface glycoprotein, cartilage

T#:1141

Fromherz P (1995). **Self-focusing of ion channels in cell adhesion.** *Physical Review E*, 52(20):R1303-1305.

SUM: "Accumulation of ion channels in a cell membrane may be triggered by the flow of current through the channels if the membrane is closely attached to a surface and if the channels are electrophoretically mobile. Using the Smoluchowski-Kelvin equations to describe the channel density and the voltage in the cleft between membrane and surface, it is shown that this process may occur for parameters which well be realized in a tissue or in cell

culture." (p. R1303)

KEYWORD(s): membrane

T#:01180

Liu H, Abbott J, Bee JA (1996). **Pulsed electromagnetic fields influence hyaline cartilage extracellular matrix composition without affecting molecular structure**. *Osteoarthritis Cartilage*; 4(1):63-76 (March)

SUM: This study focuses upon the effect of PEMF on the composition and molecular structure of cartilage proteoglycans. Sixteen-day-old embryonic chick sterna were explanted to culture and exposed to PEMF for a 3h/day for 48 h. PEMF treatment did not affect the DNA content of explants but stimulated elevation of glycosaminoglycan content in the explant and conserved the tissue's histological integrity. These results demonstrate that exposure of embryonic chick cartilage explants to PEMF for 3h/day maintains a balanced proteoglycan composition by down-regulating its turnover without affecting either molecular structure or function.

KEYWORD(s): chick, cartilage, (PG) proteoglycan, PEMF

CELL RESPONSE TO PEMF

T#:1418

Akai M, Hayashi K, (2002). **Effect of electrical stimulation on musculoskeletal systems: a meta-analysis of controlled clinical trials.** *Bioelectromagnetics,* 23:132-143.

SUM: "The studies in this review had some methodological limitations, and the selected pooled trials do not constitute acceptable proof that electrical stimulation has specific effects on health. However, one cannot ignore the statistically significant positive findings reported in the trials, from which extracted data were able to be combined." (p.132)

KEYWORD(s): EMF, bone, osteoporosis

T#:00935

Aaron RK, Ciombor DM (1993). **Increase in proteoglycan synthesis in cartilage explant cultures exposed to pulsed fields.** Proceedings of the Thirteenth Annual Meeting of the Bioelectrical Repair and Growth Society; October 10-13, 1993; Dana Point, CA. *BRAGS,* 2.

DEV: EBI 15 Hz pulse-burst

SUM: "This study examines the effects of one PEMF upon proteoglycan synthesis and accumulation within the extracellular matrix in adult bovine cartilage explants. ...Control explants behaved as previously reported, reaching a steady state of PG synthesis by day 5 of culture. Explants exposed to PEMF demonstrated significantly enhanced PG synthesis by day 2 of culture reaching 150% of control by day 12. 95% of the PG synthesized were retained

within the matrix and GAG content was increased by greater than 60% compared to controls. No evidence of proliferation, measured by thymidine incorporation, or DNA content was observed. Chromatographic analysis revealed the PG and GAG synthesized to be of normal size distribution and composition. This study indicates that exposure to the PEMF studied increases the synthesis of cartilage proteoglycans of normal size, composition, and function, and suggests that this PEMF may be of use in stimulating cartilage repair." (p. 2)

KEYWORD(s): *in vitro*, bovine, PG, cartilage, PEMF

T#:00329

Aaron RK, Ciombor DM (1992). **Stimulation with pulsing electromagnetic fields act synergistically with growth factors to increase cartilage matrix synthesis**. *Proceedings of The First World Congress for Electricity and Magnetism in Biology and Medicine*, June 14-19, 1992. Lake Buena Vista, FL, (N-1) 41-42.

DEV: Inductively coupled PEMF. 22 pulses/burst and a 5-millisecond duration. 15 Hz

SUM: "Increased PG synthesis has been observed in early cartilage injury and arthritis and may be associated with a limited repair process. Increased PG synthesis is of interest both as a measurement of chondrocyte activity and as a component of healing of cartilage injury." (p. 41) "This study confirms that either growth factors or PEMF alone can increase the synthesis of PG molecules of typical size and composition and that these two stimuli may have a synergistic effect to increase PG synthesis above the level achieved by either modality alone."(p.42)

KEYWORD(s): OA, RA, bovine, PG, cartilage, PEMF

T#:00027

Aaron RK, Ciombor DM (1992). **Synergistic effects of growth factors and pulsed fields on proteoglycan synthesis in articular cartilage**. *Proceedings of the 38th Annual Meeting. Orthopaedic Research Society*, Feb 17-20, 1992. Washington, DC, 17(2):527.

SUM: Results demonstrate a synergistic activity of growth factors and electrical stimulation in modulating proteoglycan (PG) synthesis by adult articular cartilage explant cultures maintained in a steady state.

KEYWORD(s): *in vivo* (A), animal tissue, GAG-PG, cartilage, PEMF

T#:00524

Aaron RK, Ciombor DM, Jolly G (1989). **Stimulation of experimental endochondral ossification by low-energy pulsing electromagnetic fields**. *J Bone Min Res*, 4(2):227-233.

DEV: coils w/radius 9 cm; 4,5 ms pulse bursts; 12-19 mV; 0-20 G, 15 Hz

SUM: "Pulsed magnetic fields (PEMFs) of certain configuration have been shown to be equally effective clinically in promoting the healing of fracture nonunions and are believed to enhance calcification of extracellular matrix.... The synthesis of cartilage molecules is enhanced by PEMF, and subsequent endochondral calcification is stimulated.... These results

indicate that a specific PEMF can change the composition of cartilage extracellular matrix in vivo and raises the possibility that the effects on other processes of endochondral ossification (e.g., fracture healing and growth plates) may occur through a similar mechanism." (p. 227)

KEYWORD(s): collagen, ossification, animal tissue, GAG-PG, fractures, PEMF

T#:00480

Aaron RK, Plass AHK (1987). **Stimulation of proteoglycan synthesis in articular chondrocyte cultures by a pulsed electromagnetic field**. *Trans Orthop Res Soc,* 12:273.

DEV: Circular coils. Burst configuration 5 millisecond &15 Hz; quasirectangular

SUM: "The results demonstrate that treatment of confluent articular chondrocytes with PEMF can increase rates of incorporation of 35S-Sulfate into proteoglycans. This effect however appears to be confined to cells grown in the presence of serum with low levels of somatomedin-like stimulatory factors; thus where high control rates were obtained no further increase with PEMF treatment could be measured. Where stimulation was observed (serum B) it appeared to be specific to proteoglycan in that no change in total protein synthesis was evident. Preliminary chromatographic studies indicate that proteoglycan formed in PEMF-treated cultures are of the same size and aggregability as controls suggesting that the cells respond by producing a larger number of normal molecules." (p. 273)

KEYWORD(s): collagen, *in vitro*, animal tissue, PG, cartilage, PEMF

T#:00479

Aaron RK, Ciombor DM, Jolly G (1987). **Modulation of chondrogenesis and chondrocyte differentiation by pulsed electromagnetic fields**. *Trans Orthop Res Soc*, 12:272.

DEV: Electromagnetic coils; pulse bursts of 5 milliseconds & 15 Hz.; quasirectangular WF

SUM: Rats were placed in a PEMF for 8 hours/day. The animals were sacrificed every 2 days from days 4-12. "Our previous studies have suggested that chondrocytes have the ability to change the amount of extracellular matrix molecules produced in response to exposure to PEMFs. This study suggests that not only was the amount of matrix increased but the timing of differentiation and maturation was accelerated as measured by the production of characteristic cartilage-type PG." (p. 272)

KEYWORD(s): *in vivo* (A), ossification, bone repair, GAG-PG, cartilage, fractures, PEMF

T#:01272

Ashley JR (1997). **The safety of overhead power lines**. *IEEE Engineering in Medicine and Biology*: 25-28 (Jan/Feb).

SUM: "IEEE/ANSI Standard C95.1-1992 implies strongly that an electromagnetic field is a transverse electromagnetic (TEM) wave in free space. The measure is watts per square meter. There is no physics justification for the substitution of 'electromagnetic' for 'magnetic' in discussing audio frequency devices and systems. Making this substitution automatically devalues the worth of a document's content. Understanding the engineering of the

transmission and distribution systems in Colorado and California demolishes the idea that the wiring configuration statistics imply magnetic fields are related to cancer risk. There is no other evidence to prove the average magnetic field hypothesis. Continued fear of electromagnetic fields is simply magnetophobia". (pp. 25, 26)

KEYWORD(s): human tissue, safety, EMF

T#:00569

Barnes FS (1992). **Some engineering models for interactions of electric and magnetic fields with biological systems**. *Bioelectromagnetics*, Suppl 1:67-85.

SUM: "We begin with a review of the basic equations by which electric or magnetic fields interact with biological fluids..." (p. 67) "The important feature of these memory networks in learning is that repetitive sequences of electrical signals in time will modify spatial connections.... Thus we have a possible mechanism that allows one to obtain a biological effect from a collection of cells that would not be obtainable from a single cell."(p. 82)

KEYWORD(s): calcium, membrane, ELF

T#:00842

Blank M, ed. (1993). **Electricity and Magnetism in Biology and Medicine**. San Francisco: San Francisco Press.

SUM: Review and research papers. In *Proceedings of the First World Congress for Electricity and Magnetism in Biology and Medicine*, Orlando, FL, 1992.

KEYWORD(s): nerve regeneration, osteoporosis, PEMF

T#:00240

Blank M, Soo L (1991). **Ion activation of the Na, K-ATPase in alternating curren**ts. In: Brighton CT, Pollack SR, eds. *Electromagnetics in Biology and Medicine*. San Francisco, CA: San Francisco Press, Inc, 91-94.

DEV: 100 to 200 Hz

SUM: Window effect at 100 Hz ELF. This experiment demonstrates that an electric current need not penetrate the cell to cause transmembrane signaling. "AC can change the activation of the ion sites on the outer membrane surface, and ion pumping by the enzyme will affect the inner composition of the cell. This could be the way in which induced currents from low-frequency EM signals affect cellular processes even though the currents themselves do not enter the cell." (p. 91)

KEYWORD(s): membrane, RNA/DNA, other tissue, ELF

T#:00216

Blank M (1988). **Recent developments in the theory of ion flow across membranes under imposed electric fields**. In: Marino AA, ed. *Modern Bioelectricity*. New York, NY: Marcel Dekker, Inc., chap 10.

KEYWORD(s): membrane, ELF

T#1429

Bodamyali T, Bhatt B, Hughes FJ, Winrow VR, Kanczler JM, Simon BJ *et al* (1998). **Pulsed electromagnetic fields simultaneously induce osteogenesis and upregulate transcription of bone morphogenetic proteins 2 and 4 in rat osteoblasts in vitro.** *Biochem Biophys Res Comm*, 250:458-461.

ADDITIONAL AUTHORS: J Abbott, DR Blake, CR Stevens.

SUM: "This study shows that clinically applied PEMF have a reproducible osteogenic effect in vitro and simultaneously induce BMP-2 [bone morphogenetic proteins] and -4 mRNA transcription. This supports the concept that the two effects are related." (p. 458)

KEYWORD(s): PEMF, bone, mech action

T#:00481

Braun KA, Lemons JE (1982). **Effects of electromagnetic fields on the recovery of circulation in mature rabbit femoral heads**. *Trans Orthop Res Soc*, 7:313.

DEV: Bi-Osteogen System 204, Electro-Biology, Inc., Fairfield, NJ; 1.4 mV/cm; 2 G; 72 Hz; 380 microseconds WF

SUM: New Zealand white rabbits were used. PEMF were used for 12 hours/day (72 Hz, 380 microseconds duration, 2 gauss, 1.4 mV/cm bone) "The results of this investigation showed an increase in the rate of revascularization and bone remodeling of the femoral head when exposed to a pulsing electromagnetic field. The similar trend, in both the descriptive and quantitative analyses, showed an increased vasculature associated with PEMF exposure occurring in the early stages of circulatory recovery."(p. 313)

KEYWORD(s): *in vivo* (A), ossification, bone repair, other tissue, PEMF

T#:00967

Breger L, Blumenthal NC (1993). **Electromagnetic field enhancement of membrane ion transport**. Proceedings of the Thirteenth Annual Meeting of the Bioelectrical Repair and Growth Society; October 10-13, 1993; Dana Point, CA. *BRAGS*, 38.

SUM: Experiments to test Liboff's hypothesis concerning magnetic fields and calcium diffusion were performed using artificial and biological membranes with no results.

KEYWORD(s): calcium, membrane, nerve regeneration, ELF-PEMF

T#:00287

Brighton CT, Unger AS, Stambough JL (1984). **In vitro growth of bovine articular cartilage chondrocytes in various capacitively coupled electrical fields**. *J Orthop Res*, 2(1):15-22.

DEV: function generator (Wavetek, Model 148A); 10 to 1000V; 60 Hz; sine WF

SUM: Window effect. "Thus, articular cartilage chondrocytes grown in pellet form can be stimulated to increase glycosaminoglycan synthesis or to increase cell proliferation by an appropriate capacitively coupled electric field."(p. 15)

KEYWORD(s): collagen*, in vitro*, bovine, PG, cartilage, electric

T#:00490

Budinger TF, Wong PDC, Yen C-K (1979). **Magnetic field effects on humans: epidemiological study design**. In: Phillips RD, Gillis MF, Kaune WT, Mahlum DD. Biological Effects of Extremely Low Frequency Electromagnetic Fields*. Proceedings of the Eighteenth Annual Hanford Life Sciences Symposium at Richland*, WA. Technical Information Center, U.S. Department of Energy: 379-399.

KEYWORD(s): statistics, EMF

T#:00270

Canaday DJ, Lee RC (1991). **Scientific basis for clinical applications of electric fields in soft-tissue repair**. In Brighton CT, Pollack SR, eds. *Electromagnetics in Biology and Medicine*. San Francisco, CA: San Francisco Press, Inc., chap 44.

KEYWORD(s): PEMF

T#:1417

Chang CK, Chang WH (2003). **Pulsed electromagnetic fields prevent osteoporosis in an ovariectomized female rat model: a prostaglandin E2-associated process.** *Bioelectromagnetics*, 24:189-198.

SUM: "These experiments demonstrated that extremely low intensity, low frequency, single pulse fields significantly suppressed the trabecular bone loss and restored the trabecular bone structure in bilateral ovariectomized rats. We, therefore, conclude that PEMF may be useful in the prevention of osteoporosis resulting from ovariectomized and that PGE2 [prostaglandin E2] might relate to these preventive effects." (p. 189)

KEYWORD(s): PEMF, osteoporosis

T#:00595

Cheng N, Van Hoof H, Bockx E, Hoogmartens MJ Mulier JC De Dijcker FJ, *et al*. (1982). **The effects of electric currents on ATP generation, protein synthesis, and membrane transport in rat skin**. *Clin Orthop*, 171:264-272.

DEV: 1 to 30,000 uA

SUM: "Some of the most important electrical changes occurring in living tissues are (1) piezoelectricity, (2) pyroelectricity provoked by heating biopolymers, and (3) streaming potentials caused by the movement of charged liquids.... The application of an electric or of an electromagnetic field to various biological systems results in stimulation of growth and tissue repair. In vivo electromagnetic treatment of bone tissue improves osteogenesis." (p. 264) "Minimum current intensities of approximately 50 uA are necessary to obtain a maximal stimulatory effect on protein synthesis. When higher currents are applied, the current passing through the skin does not increase significantly. These stimulatory effects are maintained to a level of approximately 1000 uA."(p.269) "DNA metabolism is not affected by electrical stimulation, suggesting that the stimulation and inhibitory effects on protein synthesizing activity occur independently of an effect on transcriptional processes."(p. 270)

KEYWORD(s): bone growth, bone repair, nerve regeneration, fractures, EMF

T#:00413

Chiabrera A, Nicolini C, Schwan HP (1985). **Interactions Between Electromagnetic Fields and Cells.** *NATO ASI series. Series A, Life Sciences*; v. 97. New York, NY: Plenum Press.

KEYWORD(s): EMF

T#1448

Ciombor DM, Lester G, Aaron RK, Neame PJ, Caterson B (2002). **Low frequency EMF regulates chondrocyte differentiation and expression of matrix proteins.** *J Orthop Res*, 20:40-50.

SUM: "The EMF field accelerated chondrogenesis .. .. .. The increased expression of PG and type II collagen mRNA as well as a greater immunoreactivity of 3B3 and 5D4 suggest an increase in the rate of differentiation of chondrocytes and enhanced phenotypic maturation." (p. 40)

KEYWORD(s): EMF, cartilage, collagen, RNA/DNA

T#:00936

Ciombor DM, Aaron RK (1993). **Pulsed fields act synergistically with growth factors to increase cartilage matrix synthesis**. Proceedings of the Thirteenth Annual Meeting of the Bioelectrical Repair and Growth Society; October 10-13, 1993; Dana Point, CA. *BRAGS*, 3.

DEV: EBI 15 Hz burst

SUM: "PEMF acted synergistically with most growth factors to increase PG synthesis. ...It suggests that, with optimum combinations, cartilage from older individuals may be stimulated to synthesize matrix to a degree equal to that of younger cartilage and that the decreased matrix synthesis associated with senescence may be reversible." (p. 3)

KEYWORD(s): *in vitro*, bovine, PG, cartilage, PEMF

T#:00605

Cleary SF, Nickless F, Liu L-M, Hoffman R (1980). **Studies of exposure of rabbits to electromagnetic pulsed fields**. *Bioelectromagnetics*, 1:345-352.

DEV: pulse duration 0.4 us/up to 2 hrs.; 1 to 2 kV/mV; 10-38 Hz

SUM: "Dutch rabbits were acutely exposed to electromagnetic pulsed (EMP) fields.... the dependent variables investigated were pentobarbital-induced sleeping time and serum chemistry (including serum triglycerides, creatine phosphokinase (CPK) isoenzymes, and sodium and potassium)... Over the range of field strengths and pulse durations investigated no consistent, statistical significant alterations were found in the end-points investigated."(p. 345)

KEYWORD(s): public concern, membrane, animal tissue, PEMF

T#:1392

Dasdag S, Sert C, Akdag Z, Batun S (2002). **Effects of extremely low frequency electromagnetic fields on hematologic and immunologic parameters in welders.** *Archives of Medical Research*; 33(1):29-32.

SUM: "These results suggest the EMF electromagnetic fields do not affect the hematologic and immunologic parameters of welders." (p. 29)

KEYWORD(s): EMF, safety, human tissue

T#:00208

De Loecker W, Cheng N, Delport PH (1990). **Effects of pulsed electromagnetic fields on membrane transport**. In: O'Conner ME, Bentall RH, Monahan JC, eds. *Emerging Electromagnetic Medicine*. Berlin: Springer-Verlag Publishers, 45-57.

KEYWORD(s): membrane, PEMF

T#:1393

Diniz P, Shomura K, Soejima K, Ito G (2002). **Effects of pulsed electromagnetic field (PEMF) stimulation on bone tissue like formation are dependent on the maturation stages of the osteoblasts.** *Bioelectromagnetics*, 23:398-405.

SUM: "In conclusion, PEMF has a stimulatory effect on the osteoblasts in the early stages of

culture, which increased bone tissue-like formation. This stimulatory effect was most associated with enhancement of the cellular differentiation, but not with the increase in the number of cells." (p. 398)

KEYWORD(s): PEMF, ossification, bone

T#:00239

Elliott JP, Smith RL, Block CA (1988). **Time-varying magnetic fields: effects of orientation on chondrocyte proliferation.** *J Orthop Res*, 6(2):259-264.

DEV: *Helmholtz* coils (19 cm-diameter) Electrobiology (Fairfield NJ USA); 72 Hz

SUM: The purpose of this study was to determine the effect of orientation of PEMFs on cellular proliferation and extracellular matrix synthesis. Bovine articular chondrocytes were cultured in PEMFs (72 Hz) generated using *Helmholtz* coils oriented either parallel (horizontal) or perpendicular (vertical) to the plane of cell adhesion. The influence of coil orientation suggests that the relationship of electromagnetic vectors to the plane of cell adhesion plays a role in cell proliferation.

KEYWORD(s): *in vitro*, bovine, cartilage, PEMF

T#:00085

Farndale RW, Murray JC (1985). **Pulsed electromagnetic fields promote collagen production in bone marrow fibroblasts via athermal mechanisms**. *Calcif Tissue Int*, 37:178-182.

DEV: Bi-Osteogen apparatus

SUM: Fibroblasts from bone marrow stroma of young rabbits treated with PEMF (Bi-Osteogen apparatus) so that the magnetic field was tangential to the culture surface. Cell proliferation not affected, nor was DNA concentration. Measured temperature using a t-type thermocouple immersed in medium in the culture flask; no increase occurred. Collagen production was not altered until the cultures were post-confluent; elevation of ^{3}H-proline to ^{3}H-hydroxyproline of about 7% on average occurred with PEMF; p value significant. Exploration of the mechanism of action of PEMFs. The PEMF treatment had no effect on cell proliferation, but did promote collagen production in postconfluent cultures.

KEYWORD(s): collagen, cAMP, RNA/DNA, bone, PEMF

T#:00019

Farndale RW, Murray JC (1985). **Low frequency pulsed magnetic fields enhance collagen production in connective tissue.** *Bioelectrochem Bioenerg*, 14:83-91.

KEYWORD(s): collagen, cartilage, PEMF

T#:1386

Fioravanti A, Nerucci A, Collodel G, Markoll R, Marcolongo R (2002). **Biochemical and morphological study of human articular chondrocytes cultivated in the presence of pulsed signal therapy.** *Ann Rheum Dis*, 61:1032-1033.

SUM: "Our study confirmed, for the first time, the effect of PST on human chondrocytes cultured in alginate gel. The observed increased concentration of PGs in the culture medium, supported by ultrastructural and morphological analyses by EM and SEM, confirmed the stimulating activity of this 'non-pharmacological treatment' on chondrocytes." (p. 1033)

KEYWORD(s): PEMF, human tissue, cartilage

T#:1408

Fredericks DC, Nepola JV, Baker JT, Abbot J, Simon B (2000). **Effects of pulsed electromagnetic fields on bone healing in a rabbit tibial osteotomy model.** *J Orthop Trauma,* 14(2):93-100.

SUM: "In this animal model, low-frequency, low-amplitude PEMF significantly accelerated callus formation and osteotomy healing in a dose-dependent manner." (p. 93)

KEYWORD(s): PEMF, bone healing, fractures

T#:1354

Gierse H, Breul R, Faensen M, Markoll R (2000). **Pulsed Signal Therapy (PST) stimulates mitosis of human chondrocytes in culture**. In: *Tenth International Conference on Biochemical Engineering. Singapore: Singapore Humanities Press*: 473-474.

SUM:" Chondrocytes were obtained from the femoral condyles of six patients undergoing reconstructive for osteoarthritis. .. .. The experiment clearly demonstrated that human chondrocyte cell cultures to the specific electromagnetic fields generated by PST attained statistically significant higher mitosis-than chondrocytes in untreated cultures." (pp. 473-474)

KEYWORD(s): PEMF, PG, collagen, in vitro, human tissue, OA

T#:00086

Grande DA, Magee FP, Weinstein AM, McLeod BR (1991). **The effect of low-energy combined AC and DC magnetic fields on articular cartilage metabolism**. *Ann N Y Acad Sci*, 635:404-407.

DEV: Vertically oriented copper wire coils; 14.3 to 16 Hz

SUM: Specifically targeted Ca++ (15 Hz) and K+ (16 Hz) and Mg++ (16 Hz). Increase in thymidine and sulfate uptake. Effects were only observed when cells had grown out to resting phase, were no longer multiplying - personal communication. Magnetic field influence on ion transport across cell membranes is one of the possible mechanisms that has

received recent attention. Liboff et al. proposed the cyclotron resonance theory to describe the influence of magnetic fields on ion transport. The theory uses the Lorenz force equations to define magnetic field conditions that will enhance ion transport across cell membranes. The object of this experiment is to expose resting bovine articular cartilage to magnetic fields that satisfy the Liboff hypothesis and evaluate the effect of metabolism. Prevention of osteopenia.

KEYWORD(s): calcium, membrane, RNA/DNA, cartilage, PEMF

T#:1419

Guerkov HH, Lohmann CH, Liu Y, Dean DD, Simon BJ, Heckman JD (2001). **Pulsed electromagnetic fields increase growth factor release by nonunion cells.** *Clin Orthop*, 384:265-279.

ADDITIONAL AUTHORS: Z. Schwartz, B.D. Boyan.

SUM: "This indicates that human nonunion cells respond to pulsed electromagnetic fields in culture and that transforming growth factor-beta 1 production is an early event. The delayed response of hypertrophic atrophic nonunion cells (>24 hours) suggests that a cascade of regulatory events is stimulated, in growth factor synthesis and release." (p. 265)

KEYWORD(s): PEMF, bone, human tissue

T#1360

Hershler C, Sjaus A (1999). **Pulsed Signal Therapy: treatment of chronic pain due to traumatic soft tissue injury.** *International Medical Journal*, 6(3):167-173.

SUM: Both the OA and the soft tissue injury groups experienced a statistically significant improvement (compared to their pre-treatment state) at six week post PST treatment. The results achieved at six-month follow-up remained statistically significant. (p. 167)

KEYWORD(s): PEMF, OA, therapy

T#1396

Lazar DA, Curra DA, Mohr B, McNutt LD, Kliot M, Mourad PD (2001). **Acceleration of recovery after injury to the peripheral nervous system using ultrasound and other therapeutic modalities.** *Neurosurgery Clinics of North America*; 12(2):353-357.

SUM: Positive data is given for nerve regeneration by electromagnetic stimulation. Additional useful references are also supplied.

KEYWORD(s): EMF, nerve regeneration, therapy

T#:1413

McLeod KJ, Rubin CT (1992). **The effect of low-frequency electrical fields on osteogenesis.** *J Bone Joint Surg,* 74-A(6):920-929.

SUM: "These results suggest a tissue sensitivity that is specific to very low-frequency sinusoidal electrical fields, and they imply that the induced electrical fields need not have complex waveforms to be osteogenic. Since the frequency and intensity range of the sinusoidal fields producing the greatest osteogenic response are similar to the levels produced intrinsically by normal functional activity, these results support the hypothesis that electricity plays a role in the retention of the normal remodeling balance within mature bone." (p. 920)

KEYWORD(s): PEMF, bone, osteoporosis, *in vivo*, animal tissue

T#:1430

Matsumoto H, Ochi M, Abiko Y, Hirose Y, Kaku T, Sakaguchi K (2000). **Pulsed electromagnetic fields promote bone formation around dental implants inserted into the femur of rabbits.** *Clin Oral Impl Res*, 11:354-360.

SUM: "These results suggest that PEMF stimulation may be useful for promoting bone formation around rough-surfaced dental implants. It is important to select the proper magnetic intensity, duration per day, and length of treatment." (p. 354)

KEYWORD(s): PEMF, bone, dental

T#:1409

Mensinger AF, Anderson DJ, Buchko CJ, Johnson MA, Martin DC, Tresco PA *et al* (2000). **Chronic recording of regenerating VIIIth nerve axons with a sieve electrode.** *J Neurophysiol,* 83:611-615.

ADDITIONAL AUTHORS: Robert B. Silver and Stephen M. Highstein.

SUM: "The results demonstrate that axons will regenerate through a sieve electrode and that chronic recordings are possible from these electrodes." (p. 614). Toadfish (Opsanus tau) were used.

KEYWORD(s): nervous system, nerve regeneration, electric

T#:01268

Moulder JE, Foster KR (1999). **Is there a link between exposure to power-frequency electric fields and cancer?** *IEEE Engineering in Medicine and Biology*, 18(2):109-116.

SUM: "Fears about power-frequency electric fields seem to be reappearing following the failure of science to demonstrate hazards from weak magnetic fields. But the over-all case that power-frequency electric fields are causally linked to human cancer is even weaker than that for magnetic fields and can reasonably be called nonexistent. (Table 4)." (p. 114)

KEYWORD(s): ELF, safety

T#:1349

Nerucci A, Marcolongo R, Markoll R (2000). **Pulsed Signal Therapy (PST) enhances proteoglycans concentration in human chondrocyte cultures**. Frederick, MD: BEMS 22nd Annual Meeting Abstract Book; p. 48.

SUM: "Human chondrocyte cultures exposed to PST fields produce significantly greater proteoglycans concentrations." (p. 48)

KEYWORD(s): PEMF, PG, human tissue, cartilage

T#:1364

Pezzetti F, De Mattei D, Caruso A, Cadossi R, Zucchini P, Carinci F, *et al* (1999). **Effects of pulsed electromagnetic fields on human chondrocytes: an in vitro study.** *Calcif Tissue Int,* 65:396-401.

ADDITIONAL AUTHORS: Traina GC, Sollazzo.

SUM: "The data presented in this study show that PEMFs induce an increase in the proliferation of human chondrocytes, measured by the 3H-thymidine incorporation. Both articular and nasal chondrocytes used in our experiments maintained in vitro the expression of Type II collagen, which is a specific marker of the chondrocyte phenotype." (p. 399) "It is then evident that the amount of growth factors in the medium necessary to mediate a proliferative response after PEMF exposures may be dependent on the phenotype of cells exposed. Moreover, different cell types may produce and secrete different growth factors or mitogens necessary to mediate the effect of electromagnetic stimulation." (p. 400)

KEYWORD(s): OA, collagen, PEMF, *in vitro*, human tissue

T#:1358

Pfeiffer K (2000). **Changes in Kirlian photography energy fields following Pulsed Signal Therapy.** In: *The Eleventh International Congress on Stress Abstracts Book*. The American Institute of Stress; no page numbers.

SUM: "This presentation reports the results of Kirlian photography in osteoarthritis before and after PST that confirm significant changes in energy fields following treatment." (pages not numbered)

KEYWORD(s): Kirlian, PEMF

T#:1385

Sakai A, Suzuki K, Nakamura T, Norimura T, Tsuchiya T (1991). **Effects of pulsing electromagnetic fields on cultured cartilage cells.** *Int. Orthop,* 15(4):341-346.

SUM: "These results present evidence that intermittent PEMF stimulation is more effective

on both cell proliferation and GAG synthesis of cartilage cells than continuous stimulation, and that the stimulation could exert effects not by nucleus directly, but by the cellular membrane-dependent mechanism. This study provides basic data to encourage the clinical application of PEMF stimulation on bone and cartilage disorders.

KEYWORD(s): PEMF, cartilage, *in vitro*, bone

MEDICAL APPLICATIONS

T#:00279

Aaron RK, Lennox D, Bunce GE, Ebert T (1989). **The conservative treatment of osteonecrosis of the femoral head. A comparison of core decompression and pulsing electromagnetic fields.** *Clin Orthop*, 249:209-218.

DEV: single pulse configuration/380 microseconds; 72 Hz; quasirectangular WF

SUM: "Both techniques [core decompression and PEMF] reduce the incidence of clinical and roentgenographic progression. Exposure to pulsing electromagnetic fields seems to be more effective in hips with Ficat II lesions than in hips with more advanced lesions."(p. 209) When criteria for clinical and roentgenographic success were used, core decompression was not particularly effective, and PEMFs were."(p. 212)

KEYWORD(s): OA, ossification, placebo, bone, PEMF

T#:00977

Andino RV, Feldman DS (1993). **The use of pulsing electromagnetic fields to treat full thickness skin defects in the rabbit model**. *Proceedings of the Thirteenth Annual Meeting of the Bioelectrical Repair and Growth Society*; October 10-13, 1993; Dana Point, CA. *BRAGS*, 49.

DEV: 2.8 mT; 75 Hz; *Helmholtz* coils

SUM: "Results indicate that the healing rate in the PEMF stimulated animals increased by about 25-30%. The number of neurophils and macrophages were less in both the one and two week stimulated groups when compared with the controls. In the two week stimulated group, the collagen deposition was greater, more densely packed, and more aligned when compared with the control group. This was due to a greater volume fraction of fibroblasts which had migrated to and/or proliferated in the wounds. It appears as though the general effect of the PEMF stimulation was to accelerate and/or augment the naturally occurring healing process." (p. 49)

KEYWORD(s): collagen, animal tissue, fibroblasts, PEMF

T#:00644

Anninos PA, Tsagas N, Sandyk R, Derpapas K (1991**). Magnetic stimulation in the treatment of partial seizures**. *Intern J Neuroscience*, 60:141-171.

SUM: "We localized foci of seizure activity using the mapping technique characterized by the ISO-Spectral Amplitude (ISO-SA) on the scalp distribution of specified spectral components or frequency bands of the emitted MEG Fourier power spectrum. In addition, using an electronic device, we utilized the above recorded activity to emit back the same intensity and frequency of magnetic field to the presumed epileptic foci. Using this method we were able, over the past two years, successfully to attenuate seizure activity in a cohort of over 100 patients with various forms of epilepsy." (p. 141) "We considered a focus to be 'cancelled' if the magnetic power emitted from the affected brain region had returned to a value of <1000 fT/sq. rt. Hz, a power spectrum which is considered to be within normal limits."(p. 150)

KEYWORD(s): pineal melatonin prod., human tissue, EMF

T#:01209

Bassett CAL (1993). **Beneficial effects of electromagnetic fields**. *J Cell Biochem*, 51:387-393.

SUM: As understanding of mechanisms expands, specific requirements for field energetics are being defined and the range of treatable ills broadened. These include nerve regeneration, wound healing, graft behavior, diabetes, and myocardial and cerebral ischemia (heart attack and stroke), among other conditions. Preliminary data even suggest possible benefits in controlling malignancy". (p. 387)

KEYWORD(s): human tissue, soft tissue, disease, cartilage, PEMF, review

T#:00824

Bellamy N (n.d.). **An explanation of the meaning of questions in the WOMAC Osteoarthritis Index Inventory.** Received from Dr. Bellamy.

SUM: Each question on the WOMAC Osteoarthritis Index inventory is explained.

KEYWORD(s): OA, evaluation

T#:00012

Binder A, Parr G, Hazleman B, Fitton-Jackson S (1984). **Pulsed electromagnetic field therapy of persistent rotator cuff tendinitis.** *Lancet*, 695-698.

SUM: The study consisted of 29 patients refractory to steroid injection and other conventional measures, 5 patients had significant benefit compared with placebo treated group of 14 patients during the first 4 weeks of study. During the second 4 weeks, when all the patients were on active treatment, there was no difference between the two groups. In further observations without treatment for 8 weeks, the two groups remained improved. At the end of the study, 19 (65%) of the 29 patients were symptomless and 5 others were

improved. The value of PEMF for the treatment of persistent rotator cuff tendinitis was tested in a double-blind controlled study with 29 patients.

KEYWORD(s): PEMF, tendinitis, therapy

T#:00786

Bullough PG (1981). **The geometry of diarthrodial joints, its physiologic maintenance, and the possible significance of age-related changes in geometry-to-load distribution and the development of osteoarthritis.** *Clin Orthop*, 156:61-66.

SUM: "The normal health function of a diarthrodial joint depends on a number of factors, two of which are stability and an equitable distribution of load across the joint surfaces. These two factors in turn depend upon two structural features of the joint: First, the geometry of the articulating surfaces; second, the material properties [i.e., the strength, resilience and elasticity] of the articular cartilage and underlying subchondral bone which go into making up the articulation." (p. 61) "The increasing maldistribution of load, with age, it is proposed, mechanically overtaxes the previously underloaded and, presumably, atrophic cartilage. Overtaxing the cartilage in turn leads to further depletion of proteoglycans, collagen fraying and eventually osteoarthritis." (p. 65)

KEYWORD(s): collagen, bone, cartilage

T#:1440

Cossu M, Sias N, De Vito G (2001). **Impiego della PST (Terapia a Segnale Pulsante) nell'artrosi del ginocchio [The use of PST (Pulsed Signal Therapy) in osteoarthritis of the knee.** *La Riabilitazione- Revista di Medicina Fisca e Riabilitazione,* 34(4):213-218.

SUM: "This paper reports the results of an investigation of 49 patients suffering from arthritis of the knee and treated with a cycle of sessions of Pulsed Signal Therapy (PST). The evaluation was made at least six months after the treatment was over, adopting two measuring criteria: the analogic-visual scale (VAS) and the algo-functional index by Lequesne. Successful results have been achieved in 74.4% of cases according to VAS and in 87% of cases according to the algo-functional index." (p. 213)

KEYWORD(s): PEMF, study design, OA, knee

T#:1441

Cossu M, Leuci C (1999). **Risultati a lungo termine della terapia a Segnale Pulsante (PST) [Long-term results achieved by Pulsed Signal Therapy (PST)]**. *La Riabilitazione - Revista di Medicina Fisca e Riabilitazione,* 32(1):11-15.

SUM: "The results achieved in 34 patients suffering from arthrosis of the knee and submitted to PST (Pulsed Signal Therapy) are reported. Even one year after the end of the treatment, the response is still satisfactory as regards both pain intensity and functionality." (p. 11)

KEYWORD(s): PEMF, study design, OA, knee, pain

T#:1442

Cossu M, Portale N (1998). **La PST (Terapia a Segnale Pulsante): proposta di condroprotezione con metodiche fisiche [PST (Pulsed Signal Therapy): a proposal for a chondro-protection with physical methods].** *La Riabilitazione - Revista di Medicina Fisca e Riabilitazione,* 31(2):51-59.

SUM: The results provided by an open study are reported.

KEYWORD(s): PEMF, cartilage, OA, knee, PG

T#:00064

Cruess RL, Kan K, Bassett CAL (1983). **The effect of pulsing electromagnetic fields on bone metabolism in experimental disuse osteoporosis**. *Clin Orthop*, 173:245-250.

DEV: 2 vertically mounted Helmholtz-aiding "O" shaped coils; 65 Hz, quasirectangular WF

SUM: Treatment of rats with PEMF increased the rate of synthesis of proteoglycan (PG) and collagen and diminished the rate of bone resorption. Thus, the data indicate that PEMFs diminish abnormal rates of resorption in disuse osteoporosis and increase rates of bone formation.

KEYWORD(s): collagen, bone growth, animal tissue, PG, osteoporosis, PEMF

T#:01218

Dieppe PA, Cushnaghan J, Shepstone L (1997). **The Bristol 'OA500' study: progression of osteoarthritis (OA) over 3 years and the relationship between clinical and radiographic changes at the knee joint.** *Osteoarthritis Cartilage,* 5(2):87-97.

SUM: "However there was no correlation between radiographic and clinical changes. It is concluded that radiographic change may not be a good surrogate for clinical outcome in OA". (p. 87)

KEYWORD(s): OA, X-ray

T#:01185

Dindar H, Zeybek N, Yucesan S, Barlas M, Yurtaslani Z, Yazgan E, Konkan R. Ozguner IF, Gokcora IH (1993). **Augmentation of mucosal adaptation following small-bowel resection by electromagnetic field stimulation in rats.** *Tokai J Exp Clin Med*, 18 (1-2):39-47 (June).

DEV: 43.20 G

SUM: Survival following massive resection of the small intestine is often possible due to substantial hyperplasia of the mucosal surface in the remaining small intestine. We evaluated the ability of electromagnetic field stimulation to augment mucosal hyperplasia following massive small bowel resection in the rat. The first group received EMF stimulation for ten days at a dosage of 43.20 G. EMF stimulation appears to augment mucosal hyperplasia following massive small bowel resection in the rat, in the proximal and distal small intestine.

KEYWORD(s): animal tissue, soft tissue, EMF

T#:1437

Faensen M, Krüger I (2003). **Grundlagen und Ergebnisse der Pulsierenden-Signal-Therapie in der Knorpeltherapie [Principles and findings of Pulsed Signal Therapy for cartilage treatment].** In: *Jerosch J, Heisel J, Imhoff AB, eds. Fortbildung Orthopädie Traumatologie, Knorpelschaden*. Die ASG-Kurse der DGOOC. Darmstadt: Steinkopff-Verlag; 7:114-116.

SUM:Principles and findings of Pulsed Signal Therapy for cartilage treatment

KEYWORD(s): PEMF, cartilage

T#:1439

Faensen M, Breul R (2001). **Prospektive Multizentrische Studie zur Behandlung von Gonarthrosen (Kellgren II und III) mit der Pulsierenden Signal Therapie (PST).** *Orthopädische Praxis,* 37(11):701-709.

SUM: "All results of the investigated parameters showed for paired and unpaired tests (parametric and/or non-parametric tests) highly significant results with $p<0.001$ respectively $p<0.0001$." (p. 701)

KEYWORD(s): PEMF, study design, OA, knee

T#:00385

Fehlings MG, Hurlbert RJ, Tator CH (1992). **An examination of direct current fields for the treatment of spinal cord injury.** *Proceedings of The First World Congress for Electricity and Magnetism in Biology and Medicine*, June 14-19, 1992, (X-4):67-68.

SUM: "With a 14 uA DC field (cathode caudal) applied immediately after injury and maintained for 8 weeks, we observed significant recovery of clinical neurological function as assessed by the inclined plane technique and recovery of descending axonal function as determined by motor evoked potential (MEP) recording." (p. 68)

KEYWORD(s): nerve regeneration, electric

T#:01158

Fiorani M, Biagiarelli B, Vetrano F, Guidi G, Dacha M, Stocchi V (1997). **In vitro effects of 50 Hz magnetic fields on oxidatively damaged rabbit red blood cells.** *Bioelectromagnetics,* 18(2):125-31.

DEV: 50 Hz (0.2-0.5 mT)

SUM: The results reported in this study demonstrate that the effects of the magnetic fields investigated are able to potentiate the cellular damage induced *in vitro* by oxidizing agents.

KEYWORD(s): animal tissue, blood, EMF

T#:00100

Giczi J, Guseo A (1988). **Treatment of headache by pulsating electromagnetic field: A preliminary report.** *J Bioelectricity*, 7(1):125-126.

KEYWORD(s): human tissue, PEMF

T#:1434

Gierse H (2003). **Aktueller Stand der Pulsierenden Signal Therapie zur Behandlung der Arthrose. [Current status of Pulsed Signal Therapy in the treatment of arthrosis].** *Deutsche Zeitschrift für Sportmedizin*, 54(6):212-214.

SUM: "Experimental studies on human chondrocytes show a better growth under PST® [Pulsed Signal Therapy]. Other studies point at more synthesis of proteoglycans and hydroxyproline of human chondrocyte pellets."(p. 212)

KEYWORD(s): PEMF, arthritis, human tissue, OA, PG, cartilage

T#:1380

Horstman J (1999). **Pulsed electromagnetic therapy. In: Arnold WJ, ed., The Arthritis Foundation's Guide to Therapies.** *Arthritis Foundation,* 156-157.

SUM: Positive article concerning therapeutic effects of PEMF and in particular PST. The United States Arthritis Foundation description of Pulsed Signal Therapy (PST) use in countries outside of the United States. The article gives contact addresses and web sites.

KEYWORD(s): OA, PEMF, therapy

T#:00247

Kazis LE, Anderson JJ, Meenan RF (1989). **Effect sizes for interpreting changes in health status**. *Med Care*, 27(3)(suppl): S178-S189.

KEYWORD(s): statistics

T#:01316

Kornhauser SH (1999). **Pulsed Signal Therapy: powerful pain relief and promising potential**. *Medical Electronics,* 30(3):44-49.

SUM: Richard Markoll, MD PhD, responds to questions posed by Dr. Stanley Kornhauser about Pulsed Signal Therapy.

KEYWORD(s): human tissue, PEMF, Markoll, cartilage, OA

T#:01311

Kubota K, Yoshimura N, Yokota M, Fitzsimmons RJ, Wikesjö UME (1995). **Overview of effects of electrical stimulation on osteogenesis and alveolar bone.** *J Periodontol*, 66:2-6.

SUM: An overview of the potential of electrical stimulation for bone regeneration and applications in alveolar and periodontal research. (p. 2)

KEYWORD(s): human tissue, nerve stimulation, bone repair

T#:1381

Lawrence RM, Zucker M. (2001). **Preventing Arthritis.** G.P. Putnam's Sons; 255-257.

SUM: "The patented PST technology is now administered throughout the world for arthritis and sports-type injuries. Recently, studies with PST have shown it to be effective for temporomandibular joint disorder (TMJ) and tinnitus not responsive to other therapies. There are about four hundred clinics in fourteen countries using PST technology." (pp. 255-256)

KEYWORD(s): OA, PEMF, therapy

T#:01163

Lee EW, Maffulli N, Li CK, Chan KM (1997). **Pulsed magnetic and electromagnetic fields in experimental Achilles tendonitis in the rat: a prospective randomized study**. *Arch Phys Me Rehabil,* 78(4):399-404 (Apr).

DEV: PMF of 17 Hz or 50 Hz, or PEMF of 15 Hz or 46 Hz

SUM: The object of the study was to investigate the effects of pulsed magnetic fields (PMF) and pulsed electromagnetic fields (PEMF) on healing in experimental Achilles tendon inflammation. The conclusion was that the tendon returned to histological normality in all groups, but the PMF 17 Hz group showed better collagen alignment by the end of the study. PMF 17 Hz resulted in a greater reduction of inflammation, with a better return of the tendon to histological normality.

KEYWORD(s): animal tissue, collagen, soft tissue, tendinitis, PEMF

T#:1443

Leuci C, Sias N, Cossu M (2000). **Impiego della Terapia a Segnale Pulsante (PST) nell'artrosi della mano [The use of Pulsed Signal Therapy (PST) in osteoarthritis of the hand.** *La Riabilitazione- Revista di Medicina Fisca e Riabilitazione*, 33(3):109-114.

SUM: "The results achieved using Pulsed Signal Therapy (PST) in patients suffering from arthritis of the hand are reported. A follow-up control carried out six months after the end of the therapy showed that the percentage of patients getting benefit from it was significantly high according to both evaluation methods adopted: 76.19 (VAS) and 80.95 (algo-functional index)." (p.109)

KEYWORD(s): PEMF, cartilage, OA, hand, PG

T#:1436

Markoll R, Da Silva Ferreira DM, Toohil TK (2003). **Pulsed Signal Therapy: an overview.** *APLAR Journal of Rheumatology,* 6:89-100.

SUM: "In effect, PST® has been shown to exert positive effects on both cartilage and dense connective tissue and in stimulating the repair of bone-tissue." (p. 89)

KEYWORD(s): PEMF, cartilage, bone, pain, collagen, therapy

T#:1383

Markoll R (2002). **Pulsed Signal Therapy: a practical guide for clinicians. In: Weiner RS, Pain Management: A Practical Guide for Clinicians.** CRC Press; 715-728.

SUM: This medical textbook has an entire chapter (Chapter 57) devoted to the history and description of Pulsed Signal Therapy (PST). Included are history, need, indications, results to date, a comparison of osteoarthritis treatment modalities, a listing and description of PST studies and other medical considerations for which PST has proved or might prove useful.

KEYWORD(s): PEMF, pain, therapy

T#:1382

Markoll R (2000). **Pulsed Signal Therapy in over 100,000 patients with osteoarthritis and evidence of efficacy in syndrome and tinnitus: supportive in vitro cartilage and chondrocyte stimulation studies**. In: *The Eleventh International Congress on Stress Abstracts Book*. The American Institute of Stress.

SUM: Explains the therapeutic use of Pulsed Signal Therapy (PST) in over 100,000 patients with osteoarthritis and evidence of efficacy in TMJ syndrome and tinnitus. Supportive *in vitro* cartilage and chondrocyte studies are described.

KEYWORD(s): OA, PEMF, therapy

T#:01221

Markoll R (1999). **Pulsed signal therapy for the treatment of osteoarthritis double blind and prospective study results in more than 35,000 patients**. *Osteoarthritis Cartilage*, 7(suppl A): S33.

SUM: "Double-blind clinical trials and other open label prospective studies have now been conducted over a ten year period in the USA, Canada, France, Italy and Germany, to determine the effectiveness of the proprietary pulsed electromagnetic field treatment termed Pulsed Signal Therapy (PST). … These studies provide continuing evidence for the use of PST in obtaining improved functionality along with effective and safe relief from chronic

pain associated with Osteoarthritis."

KEYWORD(s): human tissue, cartilage, collagen, PEMF, OA

T#:1403

Marks RA (2000). **Spine fusion for discogenic low back pain: outcomes in patients treated with or without pulsed electromagnetic field stimulation.** *Advances in Therapy,* 17(2):57-67.

SUM: "The use of PEMF stimulation enhances bony bridging in lumbar spinal fusions." (p.57)

KEYWORD(s): PEMF, pain

T#:01303

Matsushima J, Kumagai M, Takeichi N, Miyoshi S, Sakajiri M, Uemi N (1997). **Improved word perception in tinnitus patients following electrical stimulation of the ear: a preliminary report.** *Acta Otolaryngol (Stockh).* Suppl 532:115-118.

ADDITIONAL AUTHOR(S): Ifukube T, Sakai N.

SUM: "The present study showed that there were close relationships between tinnitus relief and improved word perception by means of a grammatically correct but non-sense Japanese word perception test. Fourteen out of 20 patients reported tinnitus relief and improvement in hearing… There were no significant differences in hearing level nor age in patients with and without relief of tinnitus." (p. 115)

KEYWORD(s): human tissue, nerve stimulation, tinnitus

T#:01302

Matsushima J, Kumagai M, Takeichi N, Uemi N, Miyoshi S, Sakajiri M (1997**). Improved word perception following electrical stimulation of the ear in hearing-impaired patients without tinnitus.** *Acta Otolaryngol (Stockh)*, Suppl 532: 119-122.

ADDITIONAL AUTHOR: Sakai N.

SUM: "Improved word perception in hearing-impaired patients following electrical stimulation of ears was shown by means of a grammatically correct but non-sense Japanese 4-segment sentence perception test. ... The present study suggests that electrical stimulation of ears improves word perception in hearing-impaired patients without tinnitus. (p. 119)

KEYWORD(s): human tissue, nerve stimulation, tinnitus

T#:01301

Matsushima J, Sakai N, Sakajiri M, Miyoshi S, Uemi N, Ifukube T (1996). **An experience of the usage of electrical tinnitus suppressor**. *Artificial Organs,* 20(8):955-958.

SUM: "An electrical tinnitus suppressor based on the use of an extracochlear stimulator has been developed at Hokkaido University, Sapporo, Japan, and was implanted in 2 male and 2 female patients. Tinnitus improved in all patients because the auditory nerve was able to be stimulated at home whenever patients wanted treatment. Additional benefits reported after electrical stimulation of the cochlea included sound sleep, relaxation in all cases, and improved hearing acuity in Cases 1,2, and 4. Minimal temporary complications, including habituation and ear drum perforation, were observed." (p. 955)

KEYWORD(s): human tissue, nerve stimulation, tinnitus

T#:01168

Patino O, Grana D, Bolgiani A, Prezzavento G, Mino J, Merlo A, Benaim F (1996). **Pulsed electromagnetic fields in experimental cutaneous wound healing in rats**. *J Burn Care Rehabil,* 17(6 Pt 1):528-531.

DEV: 20 mT

SUM: The objective of this work was to study the effect of pulsed electromagnetic fields on wound healing in rats. The PEMF group had 35 min treatments 2 times per day (20 mT). The results suggest a significant beneficial stimulation in the wound healing process in rats treated with PEMF.

KEYWORD(s): animal tissue, soft tissue, PEMF

T#:01221

Pavek RR (1995). **Current status of alternative health practices in the United States**. *Contemporary Internal Medicine,* 7(8):61-71 (August).

SUM:"New medical applications of nonionizing electromagnetic fields are in the areas of bone repair, neural stimulation, wound healing, osteoarthritis, electroacupuncture, immune system stimulation, and neuroendocrine modulation." (p. 68)

KEYWORD(s): human tissue, soft tissue, collagen, PEMF, OA, bone repair, nervous system

T#:1384

Perrot S, Marty M, Kahan A, Menkes CJ (2002). **Wirkung der PST Pulsierende Signal Therapie bei Schmerzhafter Kniegelenkarthrose. [Efficacy of pulsed electromagnetic therapy in painful knee osteoarthritis.]** *arthritis+rheuma*, 22 (2):101-104.

SUM: "Clinical evaluation confirmed the analgesic and functional efficacy of PEMF in painful knee osteoarthritis." (p. 104)

KEYWORD(s): PEMF, OA, knee, clinical research

T#:1379

Perrot S, Marty M, Kahan A, Menkes CJ (1998). **Efficacy of pulsed electromagnetic therapy in painful knee osteoarthritis.** *Revue du Rhumatisme English Edition,* 11: 715.

SUM: "Clinical evaluation confirmed the analgesic and functional efficacy of PEMF in painful knee osteoarthritis." (p. 715)

KEYWORD(s): PEMF, OA, knee, clinical research

T#:01364

Pezzetti F, De Mattei M, Caruso A, Cadossi R, Carinci F, Traina GC (1999). **Effects of pulsed electromagnetic fields on human chondrocytes: an in vitro study.** *Calcif Tissue Int*, 65:396-401.

ADDITIONAL AUTHOR: Sollazzo V.

SUM: "The data presented in this study show that PEMFs induce an increase in the proliferation of human chondrocytes, measured by 3H-thymidine incorporation. Both articular and nasal chondrocytes used in our experiments maintained *in vitro* the expression of type II collagen, which is a specific marker of the chondrocyte phenotype." (p. 399)

KEYWORD(s): human tissue, in vitro, collagen, PEMF, chondrocytes

T#:1412

Pipitone N, Scott DL (2001). **Magnetic pulse treatment for knee osteoarthritis: a randomized double-blind, placebo-controlled study.** *Curr Med Res Opin,* 17(3):190-196.

SUM: The primary outcome measure was reduction in overall pain assessed on a four-point Likert scale, WOMAC, and the EuroQol. Paired analysis of the follow-up observations on each patient showed significant improvements in the actively treated group at study end compared to baseline. In contrast, there were no improvements in any variable in the placebo-treated group.

KEYWORD(s): PEMF, OA, knee

T#:1353

Quittan M, Schuhfried O, Wiesinger GF, Fialka-Moser V (2000). **Klinische Wirksamkeiten der Magnetfeldtherapie - eine Literaturübersicht.** *Acta Med Austriaca,* 27:61-68.

SUM: A computer-assisted search was done using Medline and Embassy in order to verify the efficacy of electromagnetic fields on various diseases. PEMF were shown to be effective for bone healing and pain relief in most trials.

KEYWORD(s): PEMF, clinical research, review, therapy, bone healing.

T#:01304

Rahko T, Kotti V (1997). **Tinnitus treatment by transcutaneous nerve stimulation (TNS).** *Acta Otolaryngol (Stockh);* Suppl 529:88-89.

SUM: This study showed TNS to not be as good as expected. The study included 26 TNS-treated and 24 control patients. The stimulator was used at home with a treatment schedule of at least two 45-minute sessions each day. The stimulator was a type TNS mini S of 2 Hz, with a 200-microsecond pulse length in bursts of 100 Hz, with burst frequency being 2 Hz. This was analogous with the stimulus type by Kaada et al. (p. 88)

KEYWORD(s): human tissue, nerve stimulation, tinnitus

T#:01299

Roland NJ, Hughes JB, Daley MB, Cook JA, Jones AS, McCormick MS (1993). **Electromagnetic stimulation as a treatment of tinnitus: a pilot study**. *Clin Otolarynogol,* 18:278-281.

SUM: "This paper reports the results of a study to determine whether pulsed electromagnetic stimulation, applied over the mastoid bone, caused an improvement in the level of tinnitus in long-standing tinnitus sufferers.

Fifty-eight patients from the Liverpool Tinnitus Association volunteered to take part in a double-blind placebo controlled trial. Active and placebo devices were randomly allocated to these patients on their first visit. At the end of one week of treatment, each patient noted whether their tinnitus had completely disappeared, was improved, unchanged or made worse by the treatment. Forty-five per cent of the patients who completed the trial were improved by the active device, but only 9% by placebo (P = 0.0013, Mann-Whitney test). We suggest that electromagnetic stimulation may be an effective treatment in some tinnitus sufferers." (p. 278)

KEYWORD(s): human tissue, soft tissue, collagen, PEMF, OA, bone repair

T#:01197

Sandyk R (1994). **Alzheimer's disease: improvement of visual memory and visuoconstructive performance by treatment with picotesla range magnetic fields**. *Intern J Neuroscience*, 76:185-225.

SUM: "The rapid improvement in cognitive functions in response to EMF suggests that some of the mental deficits of AD are reversible being caused by a functional (i.e., synaptic transmission) rather than a structural (i.e., neuritic plaques) disruption of neuronal communication in the central nervous system". (p. 185)

KEYWORD(s): human tissue, disease, EMF, nervous system

T#:01198

Sisken BF, Walker J, Orgel M (1993). **Prospects on clinical applications of electrical stimulation for nerve regeneration**. *J Cell Biochem*, 52:404-409.

SUM: "We present a review of studies using electromagnetic fields that provide evidence for the enhancement of regeneration following nerve injury". (p. 404)

KEYWORD(s): nerve regeneration, EMF

T#:00112

Sisken BF (1990). **Developments for stimulation and analysis of nerve regeneration.** In: O'Connor ME, Bentall RHC, Monahan JC, eds. *Emerging Electromagnetic Medicine*. New York: Springer-Verlag, 159-169.

SUM: “In this report we describe experiments using noninvasive PEMF on a crush nerve model showing that the results obtained with this technique are equal to the results with any chemical method.’’ (p. 159)

KEYWORD(s): nerve regeneration

T#:01291

Steenerson RL, Cronin GW (1999). **Treatment of tinnitus with electrical stimulation**. *Otolaryngology-Head and Neck Surgery*, 121(5):511-513.

SUM: "The purpose of this study was to evaluate the treatment of tinnitus with electrical stimulation. Five hundred patients with tinnitus were treated with probe electrical stimulation. ... Probe stimulation seems to offer some benefit in about half the patients treated for annoying tinnitus."(p. 511)

KEYWORD(s): human tissue, nerve stimulation, tinnitus

T#:01191

Teofoli PO, Benci M, Lotti T (1994). **Intrastructural study of hyaluronic acid before and after the use of a pulsed electromagnetic field, electrorydesis, in the treatment of wrinkles.** *Int J Dermatol*, 33(9):661-663.

KEYWORD(s): human tissue, soft tissue, collagen, PEMF

T#:01305

Watanabe K, Okawara D, Baba S, Yagi T (1997). **Electrocochleographic analysis of the suppression of tinnitus by electrical promontory stimulation**. *Audiology*, 36:147-154.

SUM: "To investigate the origin, and evaluate the mechanism by which tinnitus is suppressed we performed electrical promontory stimulation (EPS) in 56 patients with tinnitus, and measured the compound action potential (CAP) using electrocochleography before and after EPS. In the group of patients in whom tinnitus was suppressed, the CAP amplitudes

increased significantly, whereas the latencies showed no remarkable change. In the group of patients in whom tinnitus was not suppressed, both the CAP amplitudes and latencies exhibited no significant change. These data indicate that the effect on the cochlear nerve plays an important role in the suppression of tinnitus by EPS. The CAP reflects the number of the auditory nerve fibers which discharge synchronously. It is speculated that an increase of the CAP amplitudes is caused by synchronizing discharges of the auditory nerve fibers, and that the mechanism by which EPS suppresses tinnitus may be related to synchronizing these discharges. (p. 147)

KEYWORD(s): human tissue, nerve stimulation, tinnitus

T#:01296

Wright EF, Bifano SL (1997). **Tinnitus improvement through TMD therapy**. *JADA*, 128:1424-1432.

"Patients with temporomandibular disorder report a higher prevalence of tinnitus than do age-matched controls. Also, TMD has been implicated as a cause of tinnitus. Reports indicate that TMD therapy improves tinnitus in 46 to 96 percent of patients who have TMD and coexisting tinnitus. In addition, a survey of patients taken two years after TMD therapy suggests that improvement is sustained over time." (p. 1424)

KEYWORD(s): human tissue, tinnitus

T#:01222

Zizic TM, Hoffman KC, Holt PA, Hungerford DS, O'Dell JR, Jacobs MA, *et al* (1995). **The treatment of osteoarthritis of the knee with pulsed electric stimulation**. *J Rheumatol*, 22:1757-1761.

ADDITIONAL AUTHORS: Lewis CG, Deal CL, Caldwell JR, Cholewczynski JG, Free SM.

SUM: "The improvements in clinical measures for pain and function found in this study suggest that pulsed electric stimulation is effective for treating OA of the knee." (p. 1757) Murray Electronics: Bionicare Stimulator BIO-1000 which required 6-10 h/day for a 4 week treatment period." (p. 1758)

KEYWORD(s): human tissue, PEMF, OA

Key Words in Entire DATABASE:

ABSORPTIOMETRY
AMES TEST
ANIMAL TISSUE
ARTHRITIS
ARTHROPLASTY
ARTHROSCOPY
ASPIRIN
BLOOD
BOLLET
BONE
BONE GROWTH
BONE HEALING
BONE REPAIR
BOVINE
BURSITIS
CALCIUM
cAMP
CANINE TISSUE
CARCINOGENIC
CARTILAGE
CHEMICAL
CHICK
CLINICAL RESEARCH
COLLAGEN
DISEASE
DMBA
DNA
DOG
EARTH'S GEOMAG. FIELD
ELECTRIC
ELECTRICAL STIMULATION
ELECTROCORPORATION
ELF
ELF-PEMF
EMF
EVALUATION
FIBROBLASTS
FIBROSITIS
FRACTURES
HA
HIP
HUMAN TISSUE
IMMUNE SYSTEM
IN VITRO
IN VIVO
KNEE
LYMPHOCYTES
MARKOLL
MECH ACTION
MELATONIN
MEMBRANE
NERVE REGENERATION
NERVE STIMULATION
NERVOUS SYSTEM
NSAIDs
OA
OSSIFICATION
OSTEOPOROSIS
PAIN
PAIN INDEX
PARKINSON'S
PEMF
PG (PROTEOGLYCAN)
PINEAL MELATONIN
PLACEBO
PSORIATIC
RA
RADIOGRAPHY
RECEPTORS
REGENERATION
REITER'S
REVIEW
RNA/DNA
SAFETY
SALMONELLA T
SOFT TISSUE
SPORTS INJURIES
STATISTICS
STREAMING POTENTIAL
STUDY DESIGN
SURFACE GLYCOPROTEIN
TENDINITIS
THERAPY
TINNITUS
TOXICITY
TROCK
WOUND HEALING
X-RAY