What is Bioregulation Therapy?

Electromagnetic field (EMF) therapies are based upon the principle of treating the body with specially designed EMF signals that allow each cell to respond, through sympathetic resonance, in a manner that reinforces its own internal vibration [Lakhovsky, 1939]. EMF therapeutics now stands on a solid foundation of clinical, laboratory and theoretical evidence, with a number of EMF therapies having been shown to produce clinically relevant results [Shupak, 2003]. Among the most successful therapeutic modalities are those employing time-varying, i.e. pulsed EMF (PEMF) signals. The use of PEMF signals has several advantages over constant stimuli, including the ability to convey specific frequency and amplitude patterns into the body, the use of low duty cycles to target tissues without producing heating of tissues, and the induction of electric fields by transmitting a time-varying magnetic component [Shupak, 2003]. The therapeutic use of PEMFs is now well-established, with a growing number of double-blind placebo controlled studies and a growing number of modalities now approved by the US FDA and regulatory bodies worldwide for pathologies such as bone repair, pain, inflammation, and chronic repair [Pilla, 2006]. LENYO Bioregulation Therapy (BRT) devices employ PEMF signals uniquely designed to couple with the body's own vibrations, thus providing therapeutic benefits through an enhancement of the body's own natural healing abilities.

History of Pulsed Electromagnetic Field Therapies

Based upon the well-established fact that the body's endogenous EMF vibrations play fundamental roles in normal development of the organism and vital physiological functions [Funk et al., 2006] including mitosis, meiosis [Zhao et al., 2012a] and gene expression [Zhao et al., 2012b], modern PEMF technology has origins in early 20th century advances in EMF therapeutics. At the turn of the 20th century, Nikola Tesla, the great electrical engineer and inventor, who was world famous at the time for his invention of alternating current dynamos and motors, promoted the concept that electromagnetic fields could be constructed specifically for therapeutic purposes [Tesla 1898]. Tesla advocated a therapeutic technique of passing high frequency EMFs through the human body using coils of up to three feet in diameter. In the 1920's, Georges Lakhovsky, a contemporary and collaborator with Tesla, designed and patented a Multi-Wave Oscillator (MWO) for therapeutics, based upon the idea of, in Lakhovsky's words, "*covering all frequencies from 3 meters to the infra-red, so that every cell can find its natural frequency and vibrate in resonance*" [Lakhovsky, 1934]. MWO devices employing a broad spectrum of EMF frequencies were used in French cancer clinics in the 1920's and 1930's. Lakhovsky developed methods for detecting ultraviolet (UV) emissions from plants and cells, leading him to state that, "*Every living being emits radiations. From what we have just learned in connection with our physical studies of electromagnetic waves, it follows that emission of radiations necessarily implies an oscillatory phenomenon.*" [Lakhovsky, 1939]. These results were subsequently confirmed in human subjects by Albert Nodon, President of the Societe Astronomique of Bordeaux, who wrote, "*It appears from the recorded facts that the vital cells of the human body emit electrons generated by an actual radio-activity whose intensity would seem to be much more considerable than that observed in insects and plants*"[Nodon, 1927].

Concurrently, in 1923 the Ukranian histologist Alexander Gurwitsch made his famous discovery of ultraviolet (UV) light emission during cell division in onion roots [Beloussov, 1997]. He subsequently found that these forms of UV light could stimulate cell division, and posited the existence of "mitogenic rays" governing basic processes of growth and repair. In recent years, the observations of Gurwitsch have been further developed in the biophoton research of Popp and Beloussov [Beloussov, 1995; Popp, 1992] and cell-cell communication via biophoton emission has been demonstrated in several studies [VanWijk, 2001]. Further work reported that coherent biophoton signalling could explain many regulatory functions (Popp and Chang, 1998), including cell-cell orientation detection (Albrecht-Buehler, 1992), biophoton-mediated secretion of regulatory neurotransmitters (Galantsev et al., (1993), respiratory activity in white blood cells [Shen et al., 2000], accelerated seed germination [Kuzin et al., 1995]. Thus, biophoton research demonstrates that coherent endogenous EMF information generated by living cells play basic functional roles in biological function, intercellular communication and cognition [Plankar et al., 2013].

Principles of PEMF Therapy

It has now been conclusively demonstrated that *nonthermal* PEMFs, which produce no heating of cells and tissues, have a wide variety of biological effects [Funk et al., 2009], demonstrating that nonthermal PEMFs act directly on cellular processes, rather than simply warming cells and tissues. Resonances for nonthermal PEMF signals have also been shown to occur, yielding enhanced or inhibited effects when the frequency and/or amplitude of the applied PEMF matches specific values for which cells or tissues have increased or decreased sensitivity. In recent years, it has been firmly established that EMF resonances exist in a wide range of biological systems, such as: brain waves and neural calcium efflux [Adey, 1980]; membrane transport [Liboff et al., 1987a]; 45Ca incorporation in human lymphocytes [Liboff et al., 1987b]; calcium flux in bone cells [Fitzsimmons et al., 1994]; liposome permeability [Ramundo-Orlando et al., 2000]; calcium signal transduction in the lymphocytes [Yost and Liburdy, 1992]; neurite outgrowth in PC-12 cells [Blackman et al., 1994a, 1994b, 1999; Trillo et al., 1996]; myosin phosphorylation [Markov et al., 1992]; calcium efflux though lipid vesicles [Koch et al., 2003]; glutamic acid currents in aqueous solution [Zhadin et al., 1998; Pazur, 2004; Comisso et al., 2006; Alberto, 2008a,b]; IGF-II expression for human osteosarcoma bone cells [Brain et al., 2003]; survival curve for mice infected with Ascites Ehrlich carcinoma [Novikov et al, 2009]; and cytokine release from osteoblasts in response to different intensities of PEMF stimulation [Li, 2007]. PEMF therapy is based upon such observations of resonances for nonthermal PEMF bioeffects, employing PEMF signals designed to couple sympathetically with these resonances in order to boost the natural vitality of cells and tissues [Lakhovsky, 1939]. LENYO Bioregulation Therapy PEMF resonance devices employ very low nonthermal magnetic field strengths (maximum 10 μT) to stimulate the body's own vibrations. The functional state of cells and tissues is improved, and thus the therapeutic benefits of EMF therapy occur through an enhancement of the body's own natural healing abilities.

A central principle of PEMF therapy is the enhancement of cell-cell communication. Intercellular communication is critical for normal embryogenesis and development, neural activity, gamete production, endocrine function, immune function, cardiovascular function, and the regulation of cell proliferation, apoptosis, and differentiation [Ruch, 2002]. Defects in cell-cell communication are associated with a wide variety of diseases, including, diabetes, autoimmune disorders, atherosclerosis, cancer, neuropathy, infertility, and other diseases [Trosko et al., 1998]. The activation of intercellular signaling mechanisms has been shown to be a key mechanism underlying the therapeutic effects of PEMFs [Seegers, 2001]. For example, a review of electric field therapies concluded that "*a study of many in vitro and in vivo reports revealed that the beneficial effects can be attributed to the activation of membrane proteins, and specifically proteins involved in signal-transduction mechanisms*" [Seegers, 2001].

Of particular interest to PEMF enhancement of cell-cell communication is the large body of research that has shown effects on signaling by the messenger molecule nitric oxide (NO). NO plays key roles in the promotion of microcirculation, reduction of inflammation, and initiation of a variety of growth and repair processes, and it has been conclusively demonstrated that NO signaling plays a central role in PEMF transduction, with reports of: enhancement of microvascular blood perfusion [Mayrovitz et al., 1992]; diabetic microcirculation and angiogenesis [Pan et al., 2012]; modulation of growth factor and cytokine release [Seegers et al., 2001; Brighton et al., 2001; Aaron et al., 2004; Li et al., 2007; Callaghan et al., 2008; Fitzsimmons et al., 2008; Rohde et al., 2009]; down-regulation of the inducible isoform of NOS, iNOS, in monocytes [Reale et al., 2006]; modulation nitric oxide synthase expression in the human keratinocyte cell line [Reale et al., 2010]; enhanced expression of neuronal nitric oxide synthase and phospholipase C-gamma1 in regenerating murine neuronal cells by pulsed electromagnetic field [Kim], reduction in pro-inflammatory cytokines in human keratinocytes [Vianale et al., 2008]; modulation of the sequential expression of iNOS, eNOS and cyclooxygenase-2 (COX-2) in human keratinocytes, [Patruno et al., 2010]; protective effect on dopaminergic neurons from several types of toxicity [Casper et al., 2006]; increase in cGMP in MN9D dopaminergic neurons [Casper et al., 2008]; increase in cGMP in endothelial cells [Tepper et al., 2004; Callaghan et al., 2008]; NO-mediated effects of pulsed electromagnetic field stimulation on osteoblast proliferation and differentiation [Diniz et al., 2002]; increase in articular chondrocyte proliferation though an NO-mediated pathway[Fitzsimmons et al., 2008]; increased rat osteoblast differentiation and maturation via activation of NO-cGMP-PKG pathway [Cheng et al., 2011]; increase in NO transient expression in MN9D cells [Pilla, 2012]. Thus, PEMF therapeutics has been shown to act via NO-signalling pathways, providing further supporting evidence that a key mechanism of PEMF therapies is the enhancement of cell-cell communication [Seegers, 2001].

LENYO Bioregulation Therapy

LENYO BRT devices employ very low-amplitude PEMF signals, with a maximum magnetic field strength of 10 μT, (peak to peak) or approximately 20% of the Earth's magnetic field. The existence of bioeffects for PEMF signals of this strength has been firmly established, and the mechanisms by which extremely low frequency (ELF) μT-range magnetic fields can

directly influence biological processes are now more clearly elucidated [Milyaev et al., 2006; Binhi et al., 2007; Machlup, 2007; Muehsam et al., 2009a,b]. In addition to a large literature on bioeffects due to geomagnetic-range field strength's [Volpe, 2003], a growing body of evidence has also shown that effects can also occur at much lower field strengths, on the order of nanoTesla, including effects on: development in chick embryos [Juutilainen et al., 1987; Berman et al., 1990]; in vitro breast cancer cell proliferation [Liburdy et al., 1993]; in vivo tumor growth [Novikov et al., 1996; Novikov, 2004; Novikov et al., 2005]; of planarian fission and regeneration [Novikov et al., 2008; Belova et al., 2007]; allergic encephalomyelitis in rats [Persinger et al., 1999]; gravitropism of plants [Belova et al., 2001]; MCF-7 breast cancer cell growth [Blackman et al., 2001]; and an Alzheimer's model in mice [Bobkova et al., 2005].

The specific PEMF signal patterning employed by LENYO BRT devices has been developed through 20-plus years of experience with thousands of patients. This has allowed for the development of PEMF treatments employing particular variations in frequency, pulse characteristics and treatment regime to treat specific pathologies. LENYO BRT devices are an evolutionary step forward from early-stage devices invented in the 1970's by Franz Morell and Erich Rasche. Subsequent development by Hans Brügemann of the Brügemann Institute resulted in the creation of devices which were shown in several studies to be effective [Henneck, 1997; Fedorowski et al., 2004; Nienhaus et al., 2006; Heredia-Rojas et al., 2011]. In addition to the evidence of PEMF resonances described above, sensitivity to specific PEMF signal patterning has been demonstrated in human brainwaves [Cook et al., 2009] and pain perception in animals [Thomas et al., 1997], further supporting the use of patterned PEMF signals for specific pathologies.

LENYO BRT devices operate in two ways: 1) Endogenous Field BRT devices make use, in real time, of the body's own EMF output by creating an extremely low current resonant connection between the patient and the device. Through specialized signal processing of the patient's own EMF signature, endogenous field BRT modifies this signature to produce an EMF treatment tailored to the patient; 2) Exogenous Field BRT devices employ a low intensity, broad frequency spectrum of harmonic energies so that, through the principle of resonance, each cell would "*pick out exactly the proper frequency needed to reinforce its own internal vibration*" [Lakhovsky, 1939]. Everyone is different, and cells and tissues exhibit varying PEMF sensitivity/activity depending upon their state of growth, repair or injury [Muehsam et al., 1999]. To account for this, LENYO BRT endogenous field devices make use of each individual's unique EMF signature to create a therapy that is unique for that person. Exogenous field BRT uses broad spectrum, pulsed electromagnetic field (PEMF)signals to allow the body to choose those frequencies to which it is most responsive [Lakhovsky, 1939], coupled with signal patterning designed to evoke specific therapeutic responses.

LENYO BRT devices employ PEMF technology constructed to couple with the specific naturally-occurring resonant responses of the body, enhancing the body's own natural healing abilities using ambient-range magnetic field strengths. A large and growing body of evidence exists describing clinical effects, nonthermal EMF bioeffects, and the enhancement of intercellular communication by PEMF treatment. With more than 20 years

of clinical development, LENYO Bioregulation Therapy is based upon this body of proven scientific research demonstrating the therapeutic efficacy and basic biological processes underlying PEMF therapies.

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