Following are descriptions of recent studies, published in peer-reviewed scientific journals, on the impact of treatment with magnetic fields on a variety of conditions.

Alzheimer's Disease
This article reports on two Alzheimer's patients who experienced significant improvement in visual memory and drawing performance following the external application of electromagnetic fields ranging from 5 to 8 Hz. Improvements were also seen in other cognitive functions, including spatial orientation, mood, short-term memory, and social interactions.[1]

Noting that the disorganization of circadian rhythm (the daily biological clock) may be causally related to memory deterioration in old age and possibly to Alzheimer's disease, this article argues that the use of magnetic fields could lead to memory improvement among the elderly by means of resynchronization, or resetting, of the circadian rhythms.[2]

Amyotrophic Lateral Sclerosis (Lou Gehrig's Disease)
This article reports on three patients with amyotrophic lateral sclerosis who experienced beneficial effects following treatment consisting of three sessions per week of pulsed magnetic fields administered via a Magnobiopulse apparatus. Patients received upwards of 75 total sessions prior to achieving maximum recovery.[3]

Ankle Sprain
Results of this double-blind, placebo-controlled study indicated that treatment with two 30-minute sessions of noninvasive pulsed radiofrequency therapy is effective in significantly decreasing the time required for edema reduction in patients suffering from lateral ankle sprains.[4]

Arthritis
This study found that 3 hours of exposure to a 50-Hz magnetic field significantly inhibited experimentally induced inflammation and suppressed arthritis in rats.[5]

This double-blind, placebo-controlled study examined the effects of pulsed electrical fields administered over a period of 4 weeks in the treatment of arthritis of the hand. Results showed significant clinical improvement in patients receiving the therapy relative to controls.[7]

In this general review article on the treatment of patients with psoriatic arthritis with magnetic fields, the authors state that an alternating low-frequency magnetic field (30-40 mT) from such generators as "Polius-1" and "Polius-101" improves the clinical state of afflicted joints. Such treatments are normally carried out for 30 minutes per day over a period of 15 to 20 days.[8]

This study examined the effects of magnetolaser therapy either itself or in combination with conventional drugs in patients suffering from rheumatoid arthritis. Magnetolaser therapy involved the use of an AMLT-01 device and consisted of 6-minute exposures daily over a total of 14 days. Results showed a marked improvement following the first 3 days of magnetolaser therapy, with the strongest positive effects experienced by patients

characterized as suffering from mild to moderate levels of the disease. At the end of the magnetolaser therapy course, 90 percent of patients showed improvement.[9]

This study examined the effects of low-frequency magnetic fields (from a "Polius-1" device) in patients 7 to 14 years old suffering from juvenile rheumatoid arthritis. Treatment consisted of 10 daily exposures of 10 to 12 minutes each. Results showed beneficial effects in 58, 76, and 37 percent of patients in each of three experimental groups.[10]

This study examined the effects of low-frequency and constant magnetic fields in patients suffering from rheumatoid arthritis and osteoarthrosis. Low-frequency magnetic fields were shown to produce beneficial effects in patients with both stage I and II rheumatoid arthritis and with osteoarthrosis deformans, especially with respect to the wrists, knees, and ankles.[11]

Blepharitis (infection of the eyelid)

Results of this study indicated that the use of an alternating magnetic field in conjunction with a magnetic ointment containing reduced iron powder had beneficial effects in patients with chronic blepharitis.[12]

Bone Fractures

This study examined the effects of bone grafting and pulsed electromagnetic fields on a group of 83 adults with ununited fractures. Results showed a successful healing rate of 87 percent in the 38 patients originally treated with bone grafts and PEMF for ununited fractures with wide gaps, synovial pseudarthrosis, and malalignment. A healing rate of 93 percent was shown among the 45 patients who had initially been unsuccessfully treated with PEMF alone and had bone-grafting and were re-treated with pulsing electromagnetic fields.[14]

This study examined the effects of pulsing electromagnetic fields on 125 patients suffering from ununited fractures of the tibial diaphysis. Results showed a healing rate of 87 percent.[15]

Results of this study showed treatment with pulsed electromagnetic fields resulted in an overall success rate of at least 75 percent in patients suffering from tibial lesions.[16]

This review article makes the following observations with respect to the use of pulsed electromagnetic fields in treating ununited fractures, failed arthrodeses, and congenital pseudarthroses. The treatment has been shown to be more than 90 percent effective in adult patients. In cases where union does not occur with PEMFs alone after approximately four months, PEMF treatment coupled with fresh bone grafts ensures a maximum failure rate of only 1 to 1.5 percent. For those with delayed union three to four months following fracture, PEMFs appear to be more successful than in patients treated with other conservative methods. For more serious conditions, including infected nonunions, multiple surgical failures, long-standing atrophic lesions, failed knee arthrodeses after removal of infected prostheses, and congenital pseudarthroses, PEMF treatment has exhibited success in most patients.[17]

Results of this study found that 35 of 44 nonunited scaphoid fractures 6 months or older healed in a mean time of 4.3 months during pulsed electromagnetic field treatment using external coils and a thumb spica cast. [18]

This double-blind, placebo-controlled study examined the effects of pulsed electromagnetic fields in femoral neck fracture patients undergoing conventional therapy. PEMF treatment was started within two weeks of fracture, and patients were instructed to make use of the electromagnetic device for 8 hours per day over a 90-day period. Results showed beneficial effects relative to controls after 18 months of follow-up.[19]

This review article on pulsing electromagnetic fields in the treatment of bone fracture observes that the surgically noninvasive outpatient method approved by the FDA in 1979 produced confirmed end results in 1007 ununited fractures and 71 failed arthrodeses, with an overall success rate at Columbia-Presbyterian Medical Center of 81 percent; an international success rate of 79 percent, and a success rate with other patients in the U.S. of 76 percent.[22]

Results of this double-blind study showed significant healing effects of low-frequency pulsing electromagnetic fields in patients treated with femoral intertrochanteric osteotomy for hip degenerative arthritis.[25]

In this study, 147 patients with fractures of the tibia, femur, and humerus who had failed to benefit from surgery received treatment with external skeletal fixation in situ and pulsed electromagnetic fields. Results indicated an overall success rate of 73 percent. Femur union was seen in 81 percent and tibia union in 75 percent.[26]

This study examined the effects of extremely-low-frequency electromagnetic fields (1-1000 Hz, 4 gauss) on new bone fractures of female patients. Results led the authors to suggest that EMF treatment accelerates the early stages of fracture healing.[27]

This study examined the preventive effects of low-frequency pulsing electromagnetic fields against delayed union in rat fibular osteotomies and diaphyseal tibia fractures in humans. Results indicated such treatment modulated and accelerated fracture union in both groups.[29]

This article discusses the cases of two children with bone malunion following lengthening of congenitally shortened lower legs. Pulsed sinusoidal magnetic field treatment was beneficial for both patients.[30]

Results of this study showed that 13 of 15 cases of long-bone nonunion treated with pulsed electromagnetic fields in combination with Denham external fixator united within several months.[31]

Results of this study found electromagnetic field stimulation to be an effective treatment for nonunion among a group of 37 French patients.[32]

Results of this study found treatment induced pulsing to be beneficial in patients suffering from nonunions unresponsive to surgery.[33]

In this interview with Dr. C. Andrew L. Bassett, a physician researching the use of pulsed electromagnetic fields for the past 30 years at Columbia University's Orthopedic Research Lab, Dr. Bassett notes that approximately 10,000 of the 12,000-plus orthopedic surgeons in the U.S. have used pulsed electromagnetic fields on at least one patient. Many such surgeons have incorporated the therapy on a more regular basis. He estimates that a total of at least 65,000 patients nationwide have received the treatment, with a probable success rate of between 80 and 90 percent. Use of the treatment has been primarily in patients suffering from nonunited fractures, fusion failures, and pseudoarthrosis.[34]

Results of this study showed pulsed electromagnetic fields to have beneficial healing effects in patients suffering from difficult to treat and surgically resistant bone nonunions.[35]

This review article notes that the use of pulsed electromagnetic fields began in 1974, and that 250,000 nonunion patients have received the treatment since. The author argues that success rates are comparable to those of bone grafting, and that PEMF treatment is more cost-effective and free of side effects. The FDA approved PEMF use in 1982, although it remains widely unused due to physician misunderstanding and lack of knowledge concerning the treatment.[36]

This 7-year study examined data on more than 11,000 cases of nonunions treated with pulsed electromagnetic fields for up to 10 to 12 hours per day. Results indicated an overall success rate of 75 percent.[37]

This study examined the effects of low-frequency electromagnetic fields (1-1000 Hz) on middle-aged female patients suffering from fresh radius fractures. Results showed significant increases in scintimetric activity surrounding the fracture area after two weeks of EMF treatment relative to controls.[38]

This study examined the effects of constant magnetic fields in patients suffering from fractures. Results showed that magnetic exposure reduced pain and the onset of edema shortly after trauma. Where edema was already present, the treatment exhibited marked anti-inflammatory effects. The strongest beneficial effects occurred in patients suffering from fractures of the ankle joints.[39]

Results of this study found that 10 hours per day of electromagnetic stimulation (1.0-1.5 mV) produced complete union in 23 of 26 patients receiving the treatment for nonjoined fractures.[40]

This review article looks at the history of pulsed electromagnetic fields as a means of bone repair. The author argues that success rates have been either superior or equivalent to those of surgery, with PEMF free of side effects and risk.[41]

Bronchitis

Results of this double-blind, placebo-controlled study indicated that both low-frequency electromagnetic field treatment and treatment with pulsed electromagnetic fields proved effective in patients suffering from chronic bronchitis when coupled with standard drug

therapies. Magnetic field treatment consisted of a total of 15 15-20-minute daily exposures.[42]

Cancer

Results of this study found that prolonged exposure to a 7-tesla uniform static magnetic field for a period of 64 hours inhibited growth of three human tumor cell lines in vitro.[43]

This study examined the effects of a rotational magnetic field on a group of 51 breast cancer patients. Results showed a significant positive response in 27 of them.[44]

Results of this study indicated that exposure to a rotational magnetic field inhibited Walker's carcinoma tumor growth as much as 90 percent in some cases.[45]

Results of this study indicated that pulsed magnetic field stimulation increased the incorporation of antitumor agents into cells, and thus increased antitumor activity shifting the cell cycle to a proliferative from a nonproliferative phase.[46]

Results of this study found that 20-30 sessions of magnetotherapy administered preoperatively exhibited antitumor effects in patients suffering from lung cancer.[47]

This study examined the effects of microwave resonance therapy (MRT) in patients suffering from various forms of cancer. Results showed that MRT treatment prior to surgery reduced the spread of cancer-associated conditions and reduced the risk associated with surgery in 87 percent of patients. MRT applied postoperatively had beneficial effects in 68 percent.[50]

Results of this study proved that the combination of weak pulsed electromagnetic fields with antioxidant supplementation is beneficial in the treatment of patients suffering from tongue cancer, improving speech, pain control, and tolerance to chemotherapy.[51]

Results of this controlled study indicated that treatment with a constant magnetic field significantly improved long-term (3-year) survival time in patients undergoing radiation therapy for cancer of the throat. Constant magnetic field therapy consisted of the application of 300 mT for 30 minutes to tumor and metastasizing regions immediately prior to each irradiation.[52]

Results of this Russian study indicated that the use of whole body eddy magnetic fields, coupled with more conventional cancer therapies (including magnetotherapy) is effective in the treatment of patients suffering from a variety of different malignancies.[53]

This article reports on the case of a 48-year-old-woman with breast cancer who was treated successfully with magnetotherapy. Infiltration showed a marked decrease following 30 whole body exposures to an eddy magnetic field for 60 minutes. One metastatic node disappeared while the size of others was reduced following 60 such exposures. A total regression of tumor and metastases was seen following the completion of a course of 110 exposures.[54]

This study examined the effects of whole body magnetic fields (16.5-35 G, 50-165 Hz) on patients suffering from different forms of cancer. Treatment consisted of 15 cycles,

each 1-20 minutes in duration, and was coupled with more traditional cancer therapies. Results showed that the magnetotherapy had overall beneficial effects, particularly with respect to improved immune status and postoperative recovery.[55]

Cardiovascular/Coronary Heart Disease

Results of this study found that the addition of magnetotherapy to the treatment of patients suffering from ischemic heart disease and osteochondrosis led to clinical improvements.[57]

Results of this study involving 23 parasystolic children found that low-frequency magnetic field exposure improved humoral and cellular processes involved in the regulation of cardiac rhythm.[58]

The authors of this study report on their development of a polymagnetic system called Avrora-MK-01 used to administer impulse magnetic fields to diseases of the leg vessels. Results indicated positive effects on peripheral capillaries in 75-82 percent of patients receiving the treatment at a pre-gangrene stage.[59]

Results of this study showed exposure to low-frequency alternating magnetic fields had beneficial effects in children with primary arterial hypertension, as seen in the attenuation of sympathetic and vagotonic symptoms.[60]

This study demonstrated that traveling pulsed magnetic field and magnetic laser treatment produced beneficial effects in patients suffering from the initial stages of essential hypertension.[61]

In this article, the authors propose a new approach to treating atherosclerosis through the alteration of biophysical properties both intracellularly and extracellularly. Citing their own preliminary data, they suggest atherosclerotic lesions might be selectively resolved without harming normal blood vessels allowing the lesions to take up the magnetically excitable submicron particles and then applying an external alternating electromagnetic field.[62]

This study examined the effects of constant MKM2-1 magnets on essential hypertension patients. Results indicated the treatment decreased arterial pressure in stage II patients, with magnetotherapy being shown to produce beneficial effects on the central hemodynamics and microcirculation.[63]

Results from several recent studies conducted the author are reviewed. Conclusions are that pulsed electromagnetic fields exhibit protective effects against necrosis from acute ischemia in rats, cerebral infarcts in rabbits, and myocardium infarcts in rats.[64]

This study examined the effects of extremely high frequency electromagnetic radiation (EHF EMR) in 93 patients suffering ischemic heart disease. EHF treatment consisted of 10 to 15 exposures of the lower end of the sternum from a 'Yav'-1-7,1 device. Treatment was performed five times weekly for a total of 30 minutes per day, with drug therapy being maintained during this period. Positive results tended to occur after 5 to 6 treatment sessions, with a good or satisfactory response being reported in 82 of 93 patients, and lasting as long as 11 months after hospital release.[65]

This review article concerning the clinical application of electromagnetic fields notes that microwave therapy has been shown to improve local circulation and vascular tone, increase the volume of functional capillaries, lower hypertension, stimulate protein and carbohydrate metabolism, stimulate the pituitary-adrenal system, produce anti-inflammatory effects, and improve digestive organ function. Studies have shown decimeter wave therapy capable of stimulating the secretory function of the stomach, as well as blood circulation, respiratory function, and the immune system. Side effects have been reported in both human and animal studies.[67]

In this study, 30 myocardial infarction patients received millimeter-wave (MW) therapy in the form of 10 exposures of 30 minutes per day, with a 2-day interruption after the fifth exposure. Patients continued conventional drug treatment during the MW therapy period. Better results were seen in those patients exposed to the MW therapy relative to an equal number of patients receiving conventional treatment only.[68]

This study examined the effects of millimeter wave therapy in approximately 450 patients suffering from a variety of diseases, including those of the musculoskeletal, digestive, pulmonary, and nervous systems. Treatment consisted of 25-30 minutes per day using the "Porog-1" apparatus and generally lasted for a period of up to 10 days. Results showed positive effects in over 87 percent of the patients.[69]

Results of this study found that the use of magnetophore therapy (constant magnets applied to adrenal regions 10 hours per day for 15 days) significantly improved symptoms associated with hypertension in about 35 percent of patients studied, with mild improvement seen in 30 percent, and no improvement in 35 percent. Patients receiving decimeter-band waves (460 MHz, field intensity of 35-45 W, for 10-15 minutes per day for a total of 15 days) experienced similar results.[70]

Results of this placebo-controlled study demonstrated a 76-percent effectiveness rate for running impulse magnetic field therapy in a group of arterial hypertensive patients. Treatment consisted of two 25-minute exposures per day over a period of 10-20 total exposures, at frequencies of 10 or 100 Hz and magnetic field intensity of 3 or 10 mT.[71]

This study examined the efficacy of the reinfusion of autologous blood following magnetic field exposure in hypertensive patients. Positive effects were found in 92 percent of patients receiving the treatment.[73]

This double-blind, placebo-controlled study examined the effects of magnetotherapy in patients suffering from first- or second-stage hypertension. A magnetic field of 50 Hz, 15-25 mT was applied to acupuncture points He-Gu and Shen'-Men for 15-20 seconds per day for a total of 9-10 days. Results: The treatment improved headaches in 88 percent of patients, dizziness in 89 percent, and irritability in 88 percent. In general, 95 percent of hypertensive patients experienced beneficial effects from the treatment, and the morbidity rate decreased twofold following one course extended over a period of 5-6 months.[74]

This placebo-controlled study examined the effects of constant and of running magnetic fields in patients suffering from stage II hypertension. Results found that constant magnetic fields exhibited benefits in 68 percent of patients treated, and running magnetic

fields were helpful in 78 percent. Only 30 percent of controls showed improvement. Constant magnetic field treatment consisted of constant magnets applied to the inner side of the wrist on each hand for 35-40 minutes daily over a period of 7-10 days. Running magnetic field treatment involved the use of a "Alimp-1" apparatus for 20 minutes per day for a total of 12-15 days.[76]

This double-blind, placebo-controlled study found that magnetotherapy was effective in the treatment of symptoms associated with stage II hypertension, such as headache, dizziness, and cardiodynia. The therapy consisted of permanent circular magnets (16 mT) applied to the inner forearm for 30-45 minutes per day over a period of 10 sessions.[77]

This controlled study examined the effects of magnetotherapy in patients suffering from neurocirculatory hypotension (low blood pressure) or hypertension (high blood pressure). Treatment consisted of a running pulsed magnetic field generated an "ALIMP" device (0.5 mT, 300 Hz) administered for 20 minutes per day over a course of 10 days. Patients suffering from hypotension did not benefit significantly from the magnetotherapy. Hypertension patients, however, showed a marked improvement with respect to symptoms including headache, chest pain, extremity numbness, abnormal systolic and diastolic blood pressure, and work capacity.[80]

This double-blind, placebo-controlled study found that low-frequency, low-intensity electrostatic fields (40-62 Hz) administered for 12-14 minutes per day helped normalize blood pressure in patients suffering from hypertension.[81]

This study examined the effects of low-frequency alternating magnetic fields in patients suffering from arteriosclerosis or osteoarthrosis deformans. Treatment involved 10-15 minute daily leg exposures over a total of 15 days. Results showed the treatment to be effective in 80 percent of arteriosclerosis patients and 70 percent of those with osteoarthrosis deformans.[82]

This study examined the effects of low-frequency magnetic fields (25 mT) in patients suffering atherosclerotic encephalopathy. Treatment involved 10-15 minute daily exposures over a total of 10-15 applications. Results showed clinical improvements with respect to chest pain, vertigo, headache, and other symptoms.[83]

Chronic Venous Insufficiency

This study examined the effects of alternating magnetic fields (15-20 minutes per day over a period of 20 days) in patients suffering from chronic venous insufficiency, varicose veins, and trophic shin ulcers. Results showed good effects in 236 of the 271 patients receiving the treatment. Thirty-four patients reported satisfactory effects. Only one patient experienced no effects.[85]

This review article notes that magnetotherapy in a variety of forms has been successfully used in the treatment of chronic venous insufficiency and is a commonly used physical therapy for the condition.[86]

This study examined the effects of running impulse magnetic fields in patients suffering from vessel obliteration diseases of the legs. Treatment consisted of 15-20 whole body exposures (0.5-5 mT, 1-2 Hz) lasting 15-20 minutes each. Results showed treatment led

to a significant reduction in the number of patients experiencing leg pain while at rest. Among patients previously unable to walk a 500-m distance, 52 percent were able to complete the distance following treatment. Circulation improved in 75-82 percent of patients.[87]

Dental Problems

This placebo-controlled study examined the effects of micromagnets in the treatment of periodontal disease. Micromagnets were attached to the skin over areas of inflammation for a period ranging from 1 to 8 days, with the number of magnets used at once varying from 1 to 6. The course of treatment lasted as long as 4 weeks. Results indicated that patients receiving the micromagnet therapy experienced earlier and more trouble-free recoveries following oral surgery, as well as less pain relative to controls.[99]

This controlled study examined the effects of adjunctive Diapulse electromagnetic therapy on oral surgery recovery. Patients received the therapy once per day beginning between 3 to 5 days prior to oral surgery. Therapy was maintained until the point of hospital release. Results found the therapy produced significant healing relative to controls, who received conventional treatment only.[100]

This study found that patients suffering from various oral diseases experienced more rapid healing when treated with both conventional therapies and 30 minutes per day of pulsed electromagnetic fields (5 mT, 30 Hz), as opposed to conventional therapies alone.[101]

Depression

This review article examined the literature concerning the use of transcranial magnetic stimulation in the treatment of depression. Results showed the high-frequency, repetitive transcranial magnetic stimulation treatment to be an effective, side-effect free therapy for depression that may hold promise for treating related psychiatric disorders as well.[103]

Noting that there is good reason to believe the pineal gland is a magnetosensitive system and that application of magnetic fields in experimental animals has a similar effect to that of acute exposure to light with respect to melatonin secretion, the authors propose that magnetic treatment could be a beneficial new therapy for winter depression in humans.[104]

This review article notes that transcranial magnetic stimulation has been shown to elicit antidepressant effects, electically stimulating deep regions of the brain.[105]

In this theoretical paper, the author argues that deep, low-rate transcranial magnetic stimulation can produce therapeutic effects equivalent to those of electroconvulsive therapy but without the dangerous side effects.[106]

This study examined the effects of millimeter wave (MW) therapy as a supplemental treatment in patients suffering from various types of depression. MW therapy involved the use of a "Yav'-1" apparatus (5.6 mm wavelength, 53 GHz), and consisted of up to 60 minutes of exposure per day, 2 to 3 times per week, for a total of as many as 15 exposures. Results showed that combined MW/conventional treatment produced a complete recovery in over 50 percent of cases studied, a significant improvement in 41

percent, and some improvement in 8 percent. Recovery rates among controls (conventional treatment only) were 4, 48, and 41 percent, respectively.[108]

Results of this study led researchers to conclude that patients suffering from major depression experienced a significant reduction of depressive symptoms following treatment with transcranial magnetic stimulation coupled with standard medication relative to patients taking the medicine. This was true after just three TMS treatments.[109]

Dermatitis
This study examined the effects of conventional treatments combined with millimeter wave (MW) therapy (54- to 70-GHz frequency, 8-15 daily exposures of 15-30 minutes each) on patients suffering from atopic dermatitis. Results indicated that the MW therapy was well-tolerated all patients, with the rash generally regressing after 7-8 exposures. Marked recovery was seen among 78 percent of patients receiving the combination treatments. Two-year follow-up showed a 23-percent relapse rate among combination patients, compared to 54 percent among controls.[110]

Diabetes
In this study, 320 diabetics received impulsed magnetic field treatment while 100 diabetics (controls) received conservative therapy alone. Results showed beneficial effects with respect to vascular complications in 74 percent of the patients receiving magnetotherapy combined with conservative methods, compared to a 28-percent effectiveness rate among controls.[111]

This study involving 72 diabetics with purulent wounds found that magnetic fields aided healing significantly.[113]

Diseases of the Larynx
Results of this study found that alternative magnetic field of sound frequency proved to be an effective treatment in patients suffering from acute inflammatory diseases of the larynx.[117]

Duchenne-Erb Disease
This study examined the effects of electromagnetic fields in the treatment of 5-year-old children suffering from Duchenne-Erb disease. Children were exposed to either UHF or DMW therapy for 8-12 minutes per day on alternating days over a period of approximately 10 days. Following the electromagnetic fields course, children received mud applications on the collar area and injured extremity. Results showed that treatment decreased contractures in shoulder and elbow joints, increased mobility and muscle strength, and improved general function of the arm.[118]

Endometriosis
This study found that a combined treatment consisting of magnetic-infrared-laser therapy (10-15 min/day ever other day over a period of 10-14 exposures, then repeated in 2-3 months) and conventional drug therapy proved highly effective in women suffering from endometriosis.[119]

Endometritis
Results of this study found that the administration of constant magnetic field in

combination with other treatment modalities led to significant beneficial effects in patients suffering from acute endometritis following abortion.[120]

Epilepsy

This article reports on the cases of three patients with partial seizures who received treatment with external artificial magnetic fields of low intensity. Such treatment led to a significant attenuation of seizure frequency over a 10-14-month period.[121]

Experimental results indicated that the administration of modulated electromagnetic fields of 2-30 Hz suppressed epilepsy in rats.[122]

This review article cites one study in particular in which results showed that pretreatment with 30 minutes of exposure to a 75-mT pole strength, DC-powered magnetic field significantly prevented experimentally induced seizures in mice.[123]

This double-blind, placebo-controlled study examined the effects of 2-hour exposure to weak magnetic fields (0.2-0.7 G, irregularly oscillating 0.026-0.067 Hz) produced 3 pairs of orthogonal Helmholtz coils on pain perception in healthy subjects. Results showed that magnetic treatment significantly reduced the perception of pain.[124]

This article reports on the case of a severe epileptic who experienced a significant lessening of behavior disturbances and seizure frequency following treatment with low-frequency, external artificial magnetic fields.[125]

Low-frequency, external artificial magnetic field treatment was shown to significantly reduce seizures in four adult epileptic cases.[126]

Gastroduodenitis

Results of this study indicated that treatment with decimeter-band electromagnetic fields improved motor function of the stomach and reduced dyspepsia and pain in children suffering from chronic gastroduodenitis. Treatment made use of the "Romashka" apparatus (a cylinder applicator, 100 mm in diameter, power of 6-8 W) applied to the gastroduodenal region, and consisted of 6-12 minute exposures every other day for a total of 8-12 exposures.[129]

This controlled study examined the effects of sinusoidally modulated currents (100 Hz) coupled with conventional therapy in children suffering from chronic gastroduodenitis. Children received 8-10 exposures lasting between 6 and 10 minutes. Results showed that the treatment reduced inflammation in 72 percent of patients relative to just a 45-percent rate among controls. About 77 percent of treatment patients experienced elimination of gastro-esophageal and duodeno-gastral refluxes, compared to 29 percent of controls.[130]

General

Results of this study indicated that the optimal frequency of pulsed magnetic fields ranges between 10.0 and 25.0 Hz in the treatment of chronic inflammatory conditions of the locomotor apparatus, ischemia of the blood vessels of the lower extremities, dyspeptic syndrome, lactation mastitis, and other diseases. Treatment proved best when the therapeutic cycle was repeated after a 2-3 month period.[131]

This article reviews the use of magnetotherapy in Czechoslovakia. Noting that this modality has been used for more than a decade, the author states that magnetotherapy has been shown to be effective in treating rheumatic diseases, sinusitis, enuresis, and ischemic disorders of the lower extremities. Positive findings have also been shown with respect to multiple sclerosis and degenerative diseases of the retina.[132]

This review article notes that pulse-type electromagnetic fields (PEMF) are the most frequently used type of electromagnetic therapy. Another form is pulsed radio frequency; PRF therapy generally includes daily sessions of 30-minute exposure and is primarily used in cases of pain and edema, with results being apparent quickly when the therapy is effective. PEMF treatment is most successful when used in bone healing, with results occurring over a longer period of time.[133]

This study examined the effects of electromagnetic fields administered over a period of 10 days on 354 patients suffering from various orthopedic conditions. Results showed the effects to be positive, with the greatest benefit experienced among patients with acute lesions.[134]

Noting that beneficial effects of low-energy, time-varying magnetic fields have been shown since the early 1970s, this review article cites studies pointing to its success in the treatment of a wide range of conditions. The best results for this modality obtained in the area of bone healing.[135]

This review article claims that over a quarter of a million patients worldwide with chronically ununited fractures have experienced beneficial results from treatment with pulsed electromagnetic fields. In addition, the author cites studies pointing to the treatment's efficacy with respect to other conditions such as nerve regeneration, wound healing, graft behavior, diabetes, heart attack, and stroke.[136]

This review article notes that low-intensity millimeter waves have been used for treating a wide variety of medical conditions in the former Soviet Union since 1977, with more than a million patients treated and more than a thousand treatment centers in existence. This therapy has been approved for widespread use the Russian Ministry of Health, and over 300 scientific publications have described its effects. A typical course of treatment involves 10-15 daily exposures ranging from 15 to 60 minutes each.[137]

This study concluded that the use of millimeter wave (MW) therapy was effective in the treatment of both children and adults suffering from a variety of orthopedic diseases, including osteochondrosis, arthrosis, infantile cerebral paralysis, Perthes' disease, and inborn femur dislocation. MW therapy made use of the G4-142 apparatus (55-65 GHz). Exposure was for 15-30 minutes in children or 30-60 minutes in adults over a period of 10-12 total exposures.[138]

This research examined the effects of low-frequency pulsed electromagnetic fields on patients suffering from a wide range of disorders, including musculoskeletal disorders, neurological disorders, circulatory diseases, traumatic disorders, gastroenterological problems, and stress-related morbidity. Treatment made use of the Rhumart apparatus, which produced waveforms with peak amplitudes up to 30 G. Results, based on the

patients' own subjective ratings, indicated the treatment to be beneficial across most conditions, with the strongest effects seen in those suffering from musculoskeletal and traumatic disorders.[139]

This review article summarizes findings presented at the Third Workshop on the use of low-intensity millimeter waves in medicine, held in Zvenigorod, Moscow Region, Russia. Such findings pointed to the efficacy of MW therapy with respect to alcoholism and its associated symptoms, gastric and duodenal ulcers, psoriasis, chronic furunculosis, and cardiovascular diseases.[140]

This study examined the effects of magnetotherapy on patients suffering from a variety of eye and brain vascular disorders. Treatment made use of the "Polius-1" apparatus (50 Hz), with most patients receiving a course of 15-20 daily exposures. Results showed overall general improvements in 95 percent of patients with eye diseases.[141]

This review article notes that low-frequency electromagnetic therapy has been used for a variety of purposes. Those specifically identified the author include cell growth promotion, pain reduction, improved blood circulation, bone repair, increased wound healing, sedative effects, enhanced sleep, and arthritic relief.[142]

This review article notes that treatment with an "Infita" apparatus, used to deliver low-frequency magnetic fields, has been shown to improve general hemodynamics and microcirculation in addition to exhibiting anti-inflammatory, sedative, and analgesic effects in Olympic-level Russian athletes.[143]

This review article cites studies pointing to the efficacy of low-frequency magnetic fields in the treatment of a wide variety of conditions, including burns, arthritis, fractures, arterial aneurysms, PMS, phantom pain, tuberculosis, ischemic heart disease, hypertension, bronchial asthma, and ulcerated varicose veins, among others.[144]

This study examined the effects of extremely-low-frequency magnetic fields (TAMMAT device) in the treatment of a group of 650 patients suffering from a host of various diseases. Treatment consisted 15-25 minute daily exposures 5 days per week over a total of 20-25 days. Most patients experienced improvements after 2-3 exposures. Marked improvements were seen with respect to analgesic, anti-inflammatory, anti-tumor, and immune-enhancing effects.[145]

This article reports on the efficacy of a Russian electromagnetic stimulation apparatus termed "Cascade." The authors state that data from 508 patients suffering from various ailments who were treated with the device indicate it to be anywhere from 75 to 100 percent effective. Examples of conditions in which the device was used include stubborn fractures, post-traumatic contractures, crush syndrome, and Perthes' disease.[146]

This review article on the use of pulsed magnetotherapy in Czechoslovakia points to its efficacy across a variety of conditions, including joint problems, enuresis, multiple sclerosis, diabetes, and carpal tunnel syndrome.[147]

Glaucoma

In this study, patients with primary open-angle glaucoma with compensated intraocular

pressure were administered magnetotherapy using an ATOS device with 33-mT magnetic field induction. The procedure was administered to a patient in a sitting posture with a magnetic inductor held before the eye. Sessions lasted 10 minutes and each course included 10 sessions. Following 4-5 months of therapy, results showed improved vision acuity 0.16 diopters, on an average of 29 out of 30 eyes with vision acuity below 1.0.[149]

Hair Loss

This double-blind, placebo-controlled study examined the effects of pulsed electromagnetic fields on hair loss in men suffering from male pattern baldness. PEMF exposures were administered to the head for 12 minutes and were given weekly or twice weekly over a period of 36 weeks. Results found the PEMF treatment both prevented hair loss and promoted regrowth without side effects.[151]

Headache

Results of this double-blind, placebo-controlled study demonstrated that the administration of a pulsed magnetic field for less than one hour to headache patients produced significant beneficial effects, as shown subjective patient reports, as well as EEG activity.[152]

This article reports on the case of an acute migraine patient who was successfully treated with external magnetic fields.[153]

This article examined the effects of millimeter wave therapy in the treatment of 107 patients suffering from headaches of varying causes. Treatment consisted of the Nao-Hu, Bai-Huei, and Hua-Chai acupuncture points being exposed to 5.6- and 4.9-mm wavelengths via the use of "Yav'-1-5.6" or "Electronka-KVCh" devices, respectively. Exposure lasted up to 60 minutes per day over a course of 10 days. All patients experienced positive results following 3-5 exposures. After one year, 48 percent of patients remained free of headaches, with a significant decrease in another 41 percent.[154]

This study examined the effects of pulsed electromagnetic fields (20 minutes per day for 15 days) in the treatment of patients suffering from chronic headaches. Results indicated the treatment to be most effective in patients suffering from tension headaches, with 88 percent of such patients reporting positive results. Beneficial results were also experienced patients suffering from migraines (60 percent), cervical migraines (68 percent), and psychogenic headaches (60 percent).[155]

In this study, 90 headache patients were treated with pulsating electromagnetic fields via large coils to the body for 20 minutes per day for a total of 15 days. Results found the treatment to be either excellent or good for those patients suffering from migraine, tension, and/or cervical headaches. Patients experiencing post-traumatic or cluster headaches did not experience such benefits.[156]

Results of this study indicated that pulsating electromagnetic fields (12 Hz and 5 mT) were an effective prophylactic treatment for patients suffering from cervical and migraine headaches.[157]

This placebo-controlled, double-blind study examined the effects of pulsed electromagnetic fields (2-5 Hz and flux densities of 3-4 mT) on patients suffering from

migraine headaches. PEMFs were administered to the head for 10-15 minutes per day over a period of 30 days. Results showed a mean improvement level of 66 percent in patients receiving the treatment, compared to just 23 percent among controls.[158]

Hemophilia
In this study, hemophiliacs suffering from joint hemorrhage received millimeter wave (MW) therapy at biologically active points beginning on the first day of hospital release. Adults were treated with an "Electronica-KVCh" device (61 GHz, 5 mW maximum power) and children were treated with a "Porog" device, which generates low-intensity wide-band MMW noise. Exposures in both groups lasted for 20-25 minutes per day and were extended over a period of 10 days. Results indicated the treatment to be more effective than conventional therapy with respect to alleviation of pain, need for medication, and other parameters.[159]

Hepatitis
This double-blind, placebo-controlled study examined the effects of millimeter wave therapy combined with conventional methods in the treatment of viral hepatitis in children. Making use of a "Yav'-1-5,6" or "Yav'-1-7,7" device, MW therapy involved 14-15 exposures of, on average, 30 minutes per day at wavelengths of either 5.6 or 7.1 mm. Results indicated the combined treatment to be more effective than conventional treatment only, leading to a more rapid restoration of liver function.[160]

Results of this study showed that the use of magnetic fields was effective in treating patients suffering from viral hepatitis who had previously not benefited from conventional drug therapies.[161]

This study examined the effects of magnetotherapy in children suffering from various forms of viral hepatitis. Magnetotherapy consisted of alternating magnetic fields applied to the liver area daily over a total of 10-15 days. Results indicated magnetotherapy led to more rapid and trouble-free recovery.[162]

Herniated Disk
This double-blind, placebo-controlled study examined the effects of magnetotherapy in patients following herniated disk surgery. Results showed that 52 percent of patients receiving the treatment compared to 30 percent of controls reported being free of symptoms at the time of hospital release.[163]

Hip Problems
This double-blind study examined the effects of pulsed electromagnetic fields on loosened hip prostheses. Results showed an increase of bone density in all patients receiving PEMF treatment compared to only 60 percent of controls. The authors argue such findings suggest PEMF elicits early bone reconstruction, which enhances early weight bearing.[164]

This study examined the effects of pulsed electromagnetic fields (50 Hz, 50 G) in treating aseptic loosening of total hip prostheses. PEMF therapy consisted of 20 minutes per day for 6 days per week over a total of 20 such sessions and was begun, on average, a year and a half following the start of loosening. Results showed PEMF to have some

beneficial effects with respect to loosened hip arthroplasties, although it was not effective in patients suffering severe pain due to extreme loosening.[165]

Joint Disease
Results of this 11-year study involving 3014 patients found pulsed magnetic field treatment at low frequencies and intensities to be a highly effective, side-effect-free therapy for joint disease.[168]

Kidney Problems
This review article notes that placebo-controlled studies have shown positive results concerning the use of pulsed magnetic field therapy in the treatment of secondary chronic pyelonephritis.[171]

Lung Disease
This study examined the effects of low-frequency magnetic fields coupled with conventional therapies in rats suffering from inflammatory lung disease. Results showed that rats receiving the magnetic fields experienced significant reductions in lung abscesses and associated symptoms, and similar beneficial effects were seen among a group of 165 human patients receiving comparable treatment.[177]

Lupus Erythematosus
This review article examined the data concerning impulsed magnetic fields in the treatment of lupus erythematosus. Studies indicate that the treatment can be beneficial due to its anti-inflammatory and analgesic effects, its positive action on microcirculation, and immunological reactivity.[178]

This double-blind, placebo-controlled study examined the effects of UHF and microwave therapy in treating patients suffering from systemic lupus. Twenty-six patients were given 30-35 W of microwave irradiation administered to the adrenal region. Twenty-five patients were given 30-35 W UHF administered bilaterally to the temporal region. The treatment regimen for both groups included 18-20 daily sessions. A group of 11 patients were used as controls. Results showed both treatments to be effective, with 27 percent of microwave patients and 66 percent of UHF patients reporting total elimination of polyarthralgia, myalgia, and painful contractures.[179]

Results of this study indicated that the bitemporal application of ultrahigh-frequency electromagnetic fields to the hypothalamo-hypophyseal area daily over a period of 18-20 days had beneficial effects in patients suffering from systemic lupus erythematosus.[180]

Multiple Sclerosis
This article reports on the case of a 55-year-old female chronic progressive multiple sclerosis patient who received a single external application of low magnetic fields (7.5-picotesla; 5-Hz frequency) which lasted 20 minutes. The treatment quickly led to improvements in a variety of areas, including fatigue, sleep, vision, bladder function, movement and speech problems, and mood.[182]

This study reports on four cases of multiple sclerosis who experienced improvements in visuospatial and visuomotor functions following treatment with external application of low magnetic fields.[183]

This article reports on the case of a 50-year-old female chronic progressive multiple sclerosis patient who received a single external application of low magnetic fields who experienced significant improvements following the treatment.[184]

This article reports on the cases of three patients suffering from long-time symptoms of multiple sclerosis who received treatment with extracerebral pulsed electromagnetic fields over a period of between 6 and 18 months. Results showed all three patients experienced significant improvements in cognitive functions.[185]

This is a report on the cases of two chronic multiple sclerosis patients exhibiting severe speech problems. Symptoms were completely resolved following 3-4 weeks of treatment with pulsed electromagnetic fields.[186]

This article reports on the cases of three multiple sclerosis patients suffering from alexia (lack of understanding of written words) who experienced a reversal of the alexia following the start of picotesla-range electromagnetic field treatment.[187]

This article reports on the case of a middle-aged disabled female patient with a 19-year history of chronic relapsing-remitting multiple sclerosis. Within one day of receiving experimental treatment with picotesla electromagnetic fields, the patient exhibited improvements in her condition. The patient continued with 1-2 treatments per week over a period of 32 months. During this time, significant improvements were seen with respect to a range of physical symptoms, as well as cognitive functions.[188]

The cases of three female multiple sclerosis patients exhibiting suicidal behavior are discussed in this article. Treatment with pulsed picotesla-level electromagnetic fields resolved the suicidal behavior in all three patients, an improvement that was maintained over a follow-up period of 3.5 years.[189]

This article reports on the case of a 36-year-old man severely disabled with partial paralysis and lack of coordination. Three treatment sessions per week with pulsed electromagnetic fields over a period of one year led to a range of improvements, including improvements in gait, balance, bowel and bladder functions, vision, mood, and sleep. No progression of symptoms associated with multiple sclerosis was seen throughout the course of EMF treatment.[190]

This article reports on the cases of two multiple sclerosis patients suffering from chronic ataxia who performed poorly on human figure drawing tests administered to measure body image perception. Treatment with extracerebral applications of picotesla flux electromagnetic fields led to improvements in gait and balance as well as a normalization in body image perception as seen on a repeat of the same test each patient.[191]

This article reports on the case of a 51-year-old female patient with remitting-progressive multiple sclerosis who experienced a successful reduction in carbohydrate craving believed to be associated with the exacerbation of her condition following treatment with a series of extracranial AC pulsed applications of picotesla flux intensity electromagnetic fields.[192]

This article reports on the cases of three multiple sclerosis patients suffering from a chronic progressive course of the disease who experienced a reduction in tremors following treatment with brief external applications of pulsed EMFs of 7.5-pT intensity.[195]

This article reports on the cases of three female chronic multiple sclerosis patients who experienced a reversal of cognitive deficits following treatment with brief external applications of alternating pulsed electromagnetic fields in the picotesla range of intensity.[196]

This article reports on the cases of three female multiple sclerosis patients with poor word fluency who experienced a 100-percent increase in word output following 4-5 sessions of treatment with external applications of extremely weak electromagnetic fields in the picotesla range of intensity.[197]

This article reports on the case of a 58-year-old male multiple sclerosis patient with a 37-year history of the disease. Treatment with external application of magnetic fields in the picotesla range led to a speedy improvement of neurological symptoms in the areas of walking, balance, sensory symptoms, and bladder function. Improvements in numerous cognitive functions were seen within 24 hours of treatment as well.[198]

This article reports on the case of a 36-year-old multiple sclerosis patient who experienced immediate improvements in visuoperceptive functions following treatment with external application of picotesla-range magnetic fields.[199]

This article reports on the cases of three multiple sclerosis patients suffering from falls due to rapid deterioration in balance and triggered distracting external auditory stimuli. Treatment with a series of extracranially applied, low-frequency picotesla-range intensity electromagnetic fields quickly resolved such symptoms associated with a loss of balance.[200]

This article reports on the cases of three multiple sclerosis patients experiencing continuous and debilitating daily fatigue over the course of several years. Treatment with extracranially applied picotesla flux electromagnetic fields dramatically improved symptoms of fatigue in all three patients.[201]

This article reports on the cases of two female patients with chronic progressive-stage multiple sclerosis who suffered from regular worsening of their symptoms starting approximately a week prior to menstruation and abating at menstruation onset. Such symptoms were resolved in both patients two months following the start of treatment with the extracranial application of weak electromagnetic fields.[205]

This article reports on the case of a 64-year-old female patient with a 22-year history of chronic progressive multiple sclerosis. Two 30-minute treatments with low-level electromagnetic fields produced a marked improvement in a variety of symptoms.[207]

Results of this double-blind, placebo-controlled study found that pulsed electromagnetic fields administered daily over a period of 15 days proved to be an effective treatment in reducing spasticity and incontinence associated with multiple sclerosis.[209]

Results of this double-blind, placebo-controlled study indicated that pulsed electromagnetic fields administered daily over a period of 15 days is a generally effective treatment in reducing symptoms associated with multiple sclerosis, with the most positive improvements involving the alleviation of spasticity and pain.[210]

Results of this double-blind, placebo-controlled study indicated that exposure to magnetic fields produced beneficial clinical effects in patients suffering from cerebral paralysis and in patients with multiple sclerosis.[211]

Muscle Injury

This study examined the effects of pulsed electromagnetic fields on recovery following muscle injury in rats. Results showed that both pulsed and constant magnetic fields were equally effective, with the constant field being more intense.[212]

This study examined the effects of pulsed electromagnetic fields (Gyuling-Bordacs device) in patients suffering from peripheral muscle paralysis. Treatment consisted of 20-minute exposures (2-50 Hz, 70 G). Results showed 50-Hz pulsed electromagnetic fields to be the most effective level of treatment and that such therapy enhanced muscle irritability in peripheral paralysis patients as well as in healthy controls.[213]

Neck Pain

This double-blind, placebo-controlled study examined the effects of low-energy pulsed electromagnetic fields administered via soft collars on patients suffering from persistent neck pain. Results indicated significantly beneficial effects following three weeks of treatment.[214]

Nerve Damage

This controlled study found that exposure to pulsed electromagnetic fields enhanced the speed and degree of peripheral nerve regeneration twofold in rats with experimentally severed sciatic nerves.[215]

Results of this controlled study demonstrated that treatment with 15 minutes per day of pulsed electromagnetic fields enhanced recovery time of experimentally-injured nerves in rats.[216]

Results of this study indicated that the use of pulsed electromagnetic fields on experimentally divided and sutured nerves in rats sped up regeneration of damaged nerves and the time it took for limb use to be recovered.[219]

This study examined the effects of a Soviet Polyus-1 low-frequency magnetotherapy device used to administer approximately 10 mT for approximately 10 minutes in patients with optic nerve atrophy. Patients underwent 10-15 sessions per course. Results showed that vision acuity in patients with low acuity values (below 0.04 diopters) improved in 50 percent of cases. It was also found that the treatment improved ocular blood flow in cases of optic nerve atrophy. Optimal benefits were experienced after 10 therapy sessions.[220]

Neurological Disorders

This article summarizes clinical results obtained the authors in using pulsed

electromagnetic fields (Gyuling-Bordacs device) in the treatment of neurological and locomotor disorders among a group of 148 patients in a hospital setting over a period of 3 years. The authors claim that 58-80 percent of such patients experienced benefits of some kind over the course of magnetotherapy.[221]

This study examined the effects of magnetotherapy on patients suffering from nervous system diseases. Treatment consisted of 10-12 6-minute exposures (10-20 kG, 0.1-0.6 Hz). Results indicated beneficial effects in 25 of the 27 patients receiving the treatment.[222]

Results of this study found that the use of magnetic fields (30-35 mT, 10 and 100 Hz) produced beneficial effects in 93 percent of patients suffering from nerve problems.[223]

Osteoarthritis

Results of this double-blind, placebo-controlled study indicated that exposure to pulsed electromagnetic fields had beneficial effects in the treatment of patients suffering from painful osteoarthritis of the knee or cervical spine. PEMF therapy consisted of 18 exposures lasting 30 minutes and administered 3-5 times per week.[224]

This double-blind, placebo-controlled study indicated that treatment with pulsed electromagnetic fields produced significant favorable effects in patients suffering from osteoarthritis.[226]

This double-blind, placebo-controlled study showed that treatment with pulsed electromagnetic fields yielded significant benefits in patients suffering from osteoarthritis of the knee or cervical spine. PEMF therapy (25 G, 5-24 Hz) consisted of 18 30-minute exposures over a period of 3-4 weeks.[227]

This controlled study examined the effects of changeable magnetic fields (Polus-101 device) coupled with more conventional therapies in the treatment of patients suffering from osteoarthrosis. Magnetic therapy consisted of daily 20 minute exposures for a total of 12 sessions. Results showed more rapid improvements of immunological indices and alleviation of symptoms associated with the disease among patients receiving the combination therapy compared to those treated only conventionally.[228]

Osteochondrosis

This study examined the effects of alternating magnetic fields (50 Hz, 10-50 mT) combined with conservative therapy in patients suffering from spinal osteochondrosis. Treatment consisted of 20-minute exposures over a total of 20-25 such exposures per course. Results showed clinical benefits in 95 percent of patients receiving the combination treatment compared to just 30 percent among controls.[229]

Osteonecrosis

This pilot study found that the use of pulsed electromagnetic fields produced beneficial effects in patients suffering from osteonecrosis of the femoral head.[230]

This study examined the use of pulsed electromagnetic fields in the treatment of osteonecrosis. Compared to published findings concerning surgical treatment, results showed PEMF therapy to be superior in producing improvement.[231]

Osteoporosis

This study examined the effects of pulsed electromagnetic fields on postmenopausal osteoporosis in 10-month-old female rats. Results showed that EMF treatment for one hour per day for 4 months with a 30-gauss maximum pulse reduced bone mass loss to within 10 percent, while a 70-gauss maximum pulse reduced bone mass loss entirely.[232]

This study examined the effects of long-term pulsing electromagnetic fields in the form of repetitive pulse burst waves over a period of 6 months in osteoporotic rats. Results showed increased bone volume and formation activity.[234]

This study examined the effects of a 72-Hz pulsating electromagnetic field administered for 10 hours per day over a period of 12 weeks on bone density in women prone to osteoporosis. Results found significant increases in bone mineral density in the area of EMF exposure.[235]

In this study, osteoporosis patients received treatment with pulsed electromagnetic fields (50 G, 50-100 Hz) for 30 minutes per session over a period of two years involving 20 sessions. These subjects were compared to similar patients treated with calcitonin. Results indicated PEMF to be effective in reducing pain, and to be even more so when combined with the conventional drug treatment.[236]

This controlled study examined the effects of pulsed electromagnetic fields in women suffering from postmenopausal osteoporosis. Treatment consisted of daily 30-minute exposures for 20 days every six months. Results showed that PEMF treatment combined with 100 IU per day of nasal spray synthetic salmon calcitonin arrested bone decrease and significantly increased bone mass relative to patients receiving drug therapy alone.[237]

Results of this study found the use of total-body low-frequency magnetic fields (60 G, 50-100 Hz) to be effective in the treatment of patients suffering from osteoporosis-related symptoms. Treatment consisted of a total of 15 exposures of 30 minutes each.[238]

Otitis Externa

This study examined the effects synchronizing pulse waves in the impaired area when treating patients suffering from acute diffuse otitis externa with low-level magnetic fields in combination with conventional therapies. Patients were divided into three groups. The first received ultrahigh-frequency or very-high-frequency electromagnetic waves. The second received 15-minute daily exposures to 50-Hz alternating or pulsating 20-mT magnetic fields. The third group of patients were treated switching on the same magnetic fields only during propagation of the pulse wave through the ear vessels. Results showed a 100 percent recovery rate in patients across all three groups, with recovery taking the least amount of time among those in group 3.[239]

Pancreatitis

This study found that sinusoidal and continuous low-frequency alternating magnetic field generated a Polius-1 apparatus exhibited beneficial effects in patients suffering from chronic pancreatitis.[241]

This controlled study examined the effects of combining pulsed electric stimulation and laser light with conventional treatment in patients suffering from acute pancreatitis.

Results showed the combined therapy to have the most significant effects in patients with severe forms of the disease.[242]

Parkinson's Disease

This article reports on the case of a 73-year-old male Parkinson's patients suffering from disabling resting and postural tremors in the right hand, as well as other symptoms. Two successive 20-minute treatments with AC pulsed electromagnetic fields of 7.5-picotesla intensity and 5-Hz frequency sinusoidal wave led to improvements in visuospatial performance and a legible signature. Significant improvements in Parkinsonian motor symptoms were also seen following additional treatments.[243]

This article reports on the case of a medicated 61-year-old Parkinson's patient who experienced rapid reversal of symptoms following a single external application of picotesla-range magnetic fields.[244]

This article reports on four Parkinson's patients who experienced significant improvement in symptoms following treatment with picotesla-range magnetic fields. Two additional patients suffering from Parkinson's-related dementia experienced significant improvements in visuospatial impairment.[245]

Noting that transcranial magnetic stimulation (TMS) is a new and noninvasive method of direct cortical neuron stimulation, this review article discusses recent studies showing that TMS has led to improvements in symptoms associated with Parkinson's disease and depression.[246]

Results of this study showed that the application of ELF magnetic fields via a plastic helmet device housing a set of coils (generating fields of 8 Hz and 7.5 pT) produced beneficial clinical effects after 30 minutes in patients suffering Parkinson's disease and multiple sclerosis.[247]

This article reports on the cases of two Parkinson's patients who experienced improvements in motor symptoms following treatment with external application of weak electromagnetic fields in the picotesla range.[248]

This article reports on the cases of three Parkinson's patients on full medication who exhibited an improvement in right hemispheric functions following a series of treatments with external application of electromagnetic fields in the picotesla range.[249]

This article reports on the case of a nonmedicated 49-year-old male Parkinson's patient who experienced a dramatic improvement in motor, depressive, and cognitive symptoms following treatment with brief extracranial applications of picotesla-range electromagnetic fields.[251]

This article reports on the case of a 61-year-old Parkinson's patient who experienced improvements in the severity of motor problems 30 minutes after treatment with external application of weak electromagnetic fields in the picotesla range. Sham treatment had no such effects in the same patient.[252]

This article reports on the cases of five Parkinsonian patients on full medication who experienced a marked improvement in performance on Thurstone's Word-Fluency Test following treatment with a series of extremely-low-intensity electromagnetic fields in the picotesla range and of 5-8 Hz frequency.[253]

This article reports on the case of a 69-year-old Parkinsonian patient who was able to discontinue most medication for two weeks following two treatment sessions with extracranial picotesla-range magnetic fields. Symptoms recurred after three weeks and the patient received four more magnetic field sessions on consecutive days after four weeks. The patient was then able to discontinue medications completely.[254]

This article reports on the cases of five medicated Parkinsonian patients who experienced improvements in motor, behavioral, and autonomic functions, and in visuoconstructional tasks following treatment with extracranial application of magnetic fields in the picotesla range.[255]

This article reports on the cases of three medicated Parkinsonian patients who experienced relief from disabling periods of freezing gait following treatment with extracerebral applications of pulsed electromagnetic fields in the picotesla range.[256]

The cases of four nondemented Parkinsonian patients under full medication are discussed in this article. These patients performed poorly on human figure drawing tests administered to measure body image perception. Treatment with extracerebral applications of picotesla-range intensity electromagnetic fields led to marked improvements in body image perception as seen on a repeat of the same test each patient.[257]

This article reports on the cases of four medicated Parkinsonian patients who experienced reversal of visuospatial impairments as measured the Clock Drawing Test following treatment with externally applied weak electromagnetic fields of picotesla-range intensity.[258]

This article reports on the case of a 68-year-old male patient suffering from Parkinson's disease over a period of 7 years. The patient had experienced little relief from traditional medical therapy. Treatment with external application of picotesla-range magnetic fields led to quick improvements with respect to tremor and foot dystonia, gait, postural reflexes, mood, anxiety, and cognitive and autonomic functions.[259]

This article reports on the cases of four Parkinsonian patients who exhibited significant improvements in motor symptoms following treatment with externally applied magnetic fields of picotesla-range intensity.[260]

This article reports on two cases of fully medicated Parkinson's patients who experienced enhanced visuoperceptive functions as measured numerous drawing tests following extracranial treatment with picotesla-range magnetic fields.[261]

This article reports on the case of a 69-year-old Parkinsonian patient on full medication who experienced a marked improvement on several different drawing tests following 30 minutes of treatment with picotesla-range magnetic fields.[262]

This article reports on the case of a Parkinson's patient suffering from severe movement problems who received treatment with external artificial weak magnetic fields with a frequency of 2 Hz and intensity of 7.5 picotesla over a period of 6 minutes. Results showed a significant attenuation in disability and near total reversal of the symptoms lasting approximately 72 hours. The patient then applied equivalent magnetic fields on a daily basis at home. Sustained improvement was seen throughout an observation of one month.[263]

This article reports on the case of a 67-year-old male patient suffering from Parkinson's disease and levodopa-related motor fluctuations. Treatment with the application of external weak magnetic fields led to improvements in general Parkinsonian symptoms along with the amelioration of "on-off" symptoms.[264]

Peripheral Neuritis

In this study, patients suffering from peripheral neuritis were exposed to high-frequency electromagnetic radiation on acupuncture points. EMR was generated Electronica-EnF, Aria, and Porog devices with tunable frequencies ranging between 53 and 78 GHz. Treatments were daily and lasted 25 minutes. Results showed full restoration of nerve function in 87 percent of patients.[265]

Pneumonia

Results of this study showed that magnetic laser therapy decreased the severity of acute respiratory insufficiency and treatment course, and prevented destructive complications in children with infiltrative acute destructive pneumonia between the ages of 1 and 12 years.[266]

Post-Herpetic Neuralgia

This study found both pulsed magnetic field treatment (20-30 minutes per day) and whole body alternating current magnetic field treatment (30 minutes per day) to be effective therapies for post-herpetic neuralgia in older patients. Pulsed magnetic field treatment consisted of 0.6-T (6-kG) samarium/cobalt magnets surrounded spiral coils generating a maximum 0.1-T pulse. Pads were pasted on the sensory areas innervated the dorsal root of the spinal cord where there was scar-association pain or paresthesia. Stimuli were delivered at 280 V and 8 Hz. Alternating current magnetic field treatment involved a treatment bed consisting of 19 electrodes containing paired coils and with a maximum magnetic flux density around the electrodes of 0.08 T.[267]

Pseudoarthrosis

In this study, 92 congenital pseudoarthrosis patients received treatment with pulsing electromagnetic fields. Results indicated a 76-percent rate of lesion recovery.[270]

In this study, 34 patients with congenital pseudoarthrosis-associated infantile nonunions received treatment with pulsing electromagnetic fields. Results indicated that 50 percent experienced full healing, 21 percent experienced healing with need for protections, and 29 percent experienced failure. The majority of failures were among men with a history of early fracture. Following the demonstration of coil effects, the PEMF treatment was combined with surgical realignment, immobilization, and grafting.[271]

In this study, 29 congenital pseudoarthrosis patients received extremely-low-frequency pulsing electromagnetic fields. Results: Over 70 percent experienced full healing, 21 percent experienced healing with need for protections, and 29 percent experienced failure. The majority of failures were among men with a history of early fracture.[272]

In this article, the authors report on their own clinical use of electrodynamic field therapy in the treatment of 271 pseudoarthrosis patients over a period of 8 years. They report bony healing in 92 percent of such cases.[273]

This study examined the effects of pulsed electromagnetic fields on 91 patients with congenital pseudoarthrosis of the tibia. Results showed an overall success rate of 72 percent.[274]

Results of this study indicated that treatment with pulsed electromagnetic fields had beneficial effects in children suffering from congenital pseudoarthrosis.[275]

Results of this study indicated that pulsed electromagnetic fields (72 Hz) can be an effective therapy for patients suffering from lesions associated with congenital pseudoarthroses when treatment is combined with appropriate orthopedic management.[276]

Psychiatric Disorders

Noting the well-established dangers associated with electroconvulsive therapy, the author, in this theoretical article, argues that transcranial magnetic stimulation should be looked at as an alternative psychiatric treatment. The author asserts that TMS has several advantages over ECT in that it is painless, noninvasive, and more effective on deep structures of the brain.[277]

Respiratory Problems

Results of this study showed that the use of low-frequency magnetic fields helped to prevent and treat critically ill patients suffering from pyoinflammatory bronchopulmonary complications, and to prevent such complications as well.[278]

This article reports on the case of a schizophrenic patient suffering from respiratory difficulties associated with neuroleptic withdrawal. Treatment using external application of picotesla-range magnetic fields quickly attenuated the severity of such problems.[279]

Sexual Disorders

Results of this placebo-controlled study showed that magnetotherapy exhibited beneficial effects with respect to cavernous blood flow in male patients suffering from sexual problems.[280]

This study examined the effects of a combination pulsing magnetic field (PMF)/vacuum therapy in the treatment of impotence. Vacuum therapy consisted of the penis being placed into a hermetic cylinder with a negative pressure of 180-260 mmHg for 10-12 minutes per exposure for a total of 12-15 exposures. PMF therapy consisted of the same length and number of exposures, with 6 Hz, 30 mT being applied to the penile area at the same time as vacuum therapy. Results showed that, following the combination therapy, sexual function was restored in about 71 percent of patients, was improved in 17 percent,

and did not change in 17 percent. For those patients receiving vacuum therapy only, the numbers were 51, 24, and 24 percent, respectively.[281]

This double-blind, placebo-controlled study examined the effects of weak magnetic fields in men suffering from various sexual disorders, including decreased erection and premature ejaculation. The three different magnetic stimulators used included the "Biopotenzor," "Eros," and "Bioskan-1" devices. All patients wore one of the three devices for a 3-week period. Results showed full restoration of sexual function in 38 percent of patients in the Biopotenzor group, 31 percent in the Eros group, 36 percent in the Bioskan-1 group, and in just 15 percent of the controls. Improvements in sexual function were seen among 42 percent, 39 percent, 47 percent, and 18 percent, respectively.[282]

Sleep Disorders

Results of this double-blind, placebo-controlled study indicated that low-energy-emission therapy significantly improved sleeping patterns among patients suffering from chronic psychophysiological insomnia. Therapy was administered 3 times per week, always in late afternoon and for 20 minutes, over a period of 4 weeks.[284]

This double-blind, placebo-controlled study examined the effects of low-energy emission therapy (27 MHz amplitude-modulated electromagnetic fields) in patients suffering from insomnia. Treatment consisted of 3 exposures per week over a 4-week period. Results showed significant increases in total sleep time among patients in the treatment group relative to controls.[285]

This review article notes that studies have found low-energy emission therapy to be effective in the treatment of chronic insomnia, and suggests that it may also be of value for patients suffering from generalized anxiety disorders.[286]

Spinal Cord Injury

Results of this study found that exposure to constant magnetic fields improved healing in rats with experimentally induced spinal cord injury, and in human patients suffering from spinal cord trauma as well.[287]

This study examined the effects of functional magnetic stimulation used to treat spinal cord injury in seven male patients. Results showed the treatment to be an effective noninvasive approach.[288]

Stroke

Results of this study demonstrated that treatment with sinusoidal modulated currents coupled with transcerebral magnetic fields proved more effective than either therapy on its own in the treatment of stroke patients during the period of early rehabilitation.[290]

This study found that exposure to pulsed electromagnetic fields following focal cerebral ischemia provided significant protection against neuronal damage, in rabbits.[291]

Results of this study pointed to the efficacy of magnetic field therapy in the treatment of patients suffering from a variety of conditions associated with different brain vascular diseases.[292]

Synovitis
This study examined the effects of magnetic fields on synovitis in rats. Results showed that the placement of a 3800-gauss magnet on the bottom of the cage significantly suppressed inflammation associated with the condition, relative to controls.[293]

Tendonitis
Results of this double-blind, placebo-controlled study indicated that pulsed electromagnetic field therapy exhibited significant beneficial effects in the treatment of patients suffering from persistent rotator cuff tendonitis.[294]

Tourette's Syndrome
This article reports on the case of a 6-year-old boy suffering from Tourette's syndrome who experienced improvements in visuoconstructional and visuomotor skills, along with more general symptomatic improvements, following the extracranial application of electromagnetic fields in the picotesla range of intensity.[295]

Tuberculosis
This study examined the efficacy of millimeter waves combined with conventional drug treatment in patients suffering from tuberculosis. MW therapy consisted of 10 exposures of the thymus area for 60 minutes per day using a "Yavor" apparatus (6.4 or 7.1 mm wavelength). Controls received drug treatment only. Results indicated that while MW/drug therapy had no effect on the clearance of the tuberculosis bacteria, it did facilitate clinical recovery faster than drug therapy alone.[296]

This study examined the effects of extremely-high-frequency therapy as administered via a "Yav'-1-7,1" apparatus (7.1 mm wavelength) on tuberculosis patients. Results showed a 25-percent improvement in patients receiving the therapy as a pathogenic treatment. A 72-percent improvement rate was seen among patients who received the therapy as treatment for concurrent diseases.[297]

This controlled study examined the effects of constant elastic electromagnetic fields (40 mT) in patients suffering from pulmonary tuberculosis. Therapy consisted of 30-45 minute daily application of either a single magnet or a pair of magnets placed on the chest at an area high in skin temperature over a 1-3 month period. When coupled with conventional treatments, one third of patients receiving the constant electromagnetic fields experienced healing of tubercular cavities. contrast, only one fifth of patients receiving conventional treatment alone experienced such effects. One month into combination treatment, there was no evidence of mycobacterium tuberculosis in the sputum in half the patients relative to only one third of controls.[298]

Ulcers (Gastric and Duodenal)
Results of this study showed that the administration of millimetric electromagnetic waves helped to normalize blood properties, subsequently improving the effectiveness of more conventional gastric and duodenal ulcer treatment.[303]

This study examined the effects of millimeter wave (MW) therapy in 317 patients suffering from duodenal and gastric ulcers. MW therapy consisted of 30 minutes per day exposure of the epigastric area ("Yav'-1" apparatus, 10 mW/cm2, 5.6-mm wavelength)

until complete ulcer cicatrization was achieved. Results showed a 95-percent rate of ulcer cicatrization in patients receiving the treatment compared to a 78-percent rate in controls. One year follow up showed a 54-percent ulcer recurrence rate in MW-treated patients, which was markedly less than the rate for controls.[306]

This controlled study found extremely-high-frequency therapy to be an effective treatment in patients suffering from duodenal ulcers. Treatment consisted of 5-10 exposures, lasting 20-30 minutes, and making use of the G4-142 apparatus (53.5-70.0 GHz frequency range).[308]

This study compared the effects of traditional drug treatment (TDT) to those of microwave resonance therapy (MRT) in patients suffering from duodenal ulcers. Results indicated the mean hospital stay for patients in the TDT group was approximately 22 days. Throughout this period, ulcers healed in 38 percent of patients, were reduced in 17 percent, showed no change in 43 percent, and increased in 2 percent. No pain relief was seen in 32 percent. contrast, mean discharge time for patients in the MRT group was approximately 12 days. Pain was generally stopped in 3-6 days. Complete healing occurred in 81 percent, a decrease was seen in 16 percent, and ulcer size did not change in just 3 percent. Remission occurred in 98 percent of such patients.[310]

In this study, microwave resonance therapy (MRT) was administered to 2642 patients suffering from duodenal ulcers and to 78 with gastric ulcers. Treatment involved the use of a G4-142 device (53.6-78.3 GHz, less than 2 mW/cm2 incident power) as well as "Electronika-KVCh" and "Porog-1" devices. Patients received 6-12 daily exposures of between 20 and 25 minutes. Results showed a total ulcer cicatrization in 80 percent of patients, and arrested pain syndrome in almost 100 percent.[311]

Ulcers (Trophic)

This study examined the use of magnetotherapy coupled with galvanization and intratissue electrophoresis in 86 patients suffering from trophic ulcers. A "Potok-1" apparatus with a density of current equal to 0.05-0.1 mA/cm2 was used to create an electrical field. The "MAG-30" apparatus for low-frequency magnetotherapy with induction of 30 mT and area of exposure of 20 cm2 was applied to a trophic ulcer site at the same time. Results led the authors to conclude that magnetogalvanotherapy is the recommended treatment for trophic ulcers of the lower extremities.[299]

This review article discusses the theoretical and clinical applications of magnetic field therapy in the treatment of trophic ulcers of the lower limbs.[300]

This study looked at the effects of conventional trophic ulcer treatment alone and in combination with alternating magnetic field (AMF) or constant magnetic field (CMF) exposures in a group of patients suffering from various types of trophic ulcers of the lower limbs. Results showed an average hospital stay of 31 days in the CMF group and 27 days in the AMF group, compared to 40 days among controls. Based on these and related findings, the authors suggest combination AMF therapy to be most effective.[304]

This placebo-controlled study examined the effects of pulsed electromagnetic fields in the treatment of decubitus ulcers in hospitalized elderly patients with stage II and III

pressure ulcers. Patients received daily PEMF stimulation in conjunction with conventional treatment for a period of up to 5 weeks. The findings were that combined PEMF/conventional treatment was superior to conventional treatment and to the placebo received controls.[305]

Results of this study found that the daily use of electromagnetolaser therapy decreased mean healing time in patients suffering from lower extremity trophic ulcers to approximately 18 days, compared with approximately 26 days in patients receiving laser therapy alone.[307]

This double-blind, placebo-controlled study found that treatment with nonthermal pulsed electromagnetic energy (PEMET) accelerated would healing in spinal cord injury patients suffering from stage II and III pressure ulcers. PEMET treatment consisted of pulsed 27.12-MHz energy produced via a Diapulse device. Energy was delivered the use of a treatment head placed in wound dressings, in 30-minute periods twice a day for 12 weeks or until sores healed.[312]

This double-blind, placebo-controlled study examined the effects of pulsed electromagnetic fields (75 Hz, 2.7 mT) applied 4 hours per day for a maximum of 3 months coupled with conventional therapies in patients suffering from trophic lesions. Results showed the treatment to have positive effects, but only on small lesions.[314]

Urinary Problems

In this article, the authors report on their successful use of magnetic-laser therapy in inflammations of the urinary system in a urological clinic setting.[316]

Results of this study showed magnetolaser therapy to be effective in the treatment of patients suffering from urolithiasis (stone formation). Magnetolaser therapy involved the use of a Milita device with a 35-mT magnetic field.[317]

Wound Healing

This study examined the effects of static magnetic fields on postoperative wounds in 21 patients undergoing plastic surgery. Magnetic patches ranging in thickness from 1 to 6 mm, and 2450 to 3950 G field strength were administered over the area of operation for a total of 48 hours. Thirteen patients received the magnets after pain or edema had appeared and 8 received them prophylactically. Results showed a decrease in pain, edema, and coloration in approximately 60 percent of patients. Such symptoms disappeared entirely in 75 percent.[321]

Results of this study indicated that treatment with pulsating electromagnetic field either alone or in combination with laser therapy exhibited healing effects with respect to peripheral nerve lesions and general wound healing relative to controls.[322]

This double-blind, placebo-controlled study examined the effects of a magnetic treatment device taped over the carpal tunnel against wrist pain sustained at work among a group of turkey plant employees. Results showed that the device was effective in alleviating such pain and that it was free of side effects.[323]

Results of this controlled study showed that low-frequency pulsed electromagnetic fields produced significant beneficial cutaneous wound healing effects in rats.[324]

This double-blind, placebo-controlled study found that treatment with nonthermal pulsed radiofrequency energy accelerated would healing in spinal cord injury patients suffering from stage II and III pressure ulcers. RF treatment consisted of pulsed 27.12-MHz energy produced via a Diapulse device, with energy delivered via a treatment head placed in wound dressings, in 30-minute periods twice a day for 12 weeks or until sores healed.[325]

After a discussion of the mechanics involved in the use of pulsed electromagnetic energy in the treatment of disease, the author discusses findings from recent studies pointing to the therapy's effectiveness with respect to the treatment of acute soft-tissue lesions.[326]

Results of this placebo-controlled study indicated that low-intensity continuous microwave radiation administered over a period of 7 days was effective in treating post-operative purulent wounds associated with abdominal surgery.[327]

Results of this study showed that combined magneto/laser therapy reduced inflammation and wound suppuration, and enhanced tissue healing significantly in patients suffering from gunshot wounds relative to conventional treatment only.[328]

Noting that pulsed electromagnetic fields have been used in bone healing for more than 20 years, this review article cites recent results from both animal and human studies pointing to the efficacy of PEMF in the treatment of soft-tissue injuries as well.[329]

This double-blind study examined the effects of postoperative nonthermal pulsed high-frequency electromagnetic fields on edema formation and bruise healing in boys undergoing orchidopexy. Treatment involved exposure 3 times daily for the first 4 days following surgery. Significant effects with respect to rate of bruise resolution were reported in patients receiving the treatment relative to controls.[330]

This controlled study examined the effects of pulsed electromagnetic fields in patients suffering from chronic productive inflammation or orbital tissue. PEMF treatment consisted of 7-10 minute daily exposures over a period of 10 days. Controls received conventional treatment only. Both groups showed good improvement, but patients treated with the PEMFs recovered significantly faster than did controls.[331]

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