PEMF
THERAPY SOLUTIONS

PEMF has proven to improve various physiologic functions and many conditions or disease states. Here are some of the highlights, although this is not an exhaustive list.

DISCLAIMER: PEMF is not a cure for any of the conditions listed below, nor are we claiming such. The information below is a summary of the literature on PEMF.

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CONTENTS

PHYSIOLOGIC EFFECTS OF PEMF

Decreased Inflammation	Optimizes Nitric Oxide Production	Improved Blood Flow and Circulation	Improved Tissue Repair
▸ When left unregulated, Inflammation is a main cause of chronic conditions and autoimmune dysfunction. When your cells have to work harder to receive oxygen to produce energy, they go into oxidative stress. This leads to an overproduction of free radicals and premature cell death (apoptosis). ▸ Reduce and regulate proinflammatory cytokines[1,2,3,4,5,6,7,8]	▸ PEMF Boosts Nitric Oxide Production immediately 9 . Nitric Oxide (NO) is a vasodilator; it acts to open up blood vessels and improve circulation. Nitric Oxide is also an anti-viral. ▸ Nitric Oxide production helps to increase circulation and blood flow, while boosting your immune system with its anti-viral capabilities.	▸ Circulation is increased immediately.[9,10,11] ▸ Mechanically stimulates lymphatic drainage and blood flow[9] ▸ Increased circulation reduces swelling, increases nutrients and immune factors to tissues while helping. Improved circulation helps to decrease inflammation.	▸ Promotes tissue regeneration by regulating immune cell signaling mechanisms[8] as well as Calcium(-Ca2+) binding to CaM.[9] ▸ Improved Tissue Regeneration means faster healing and recovery time. ▸ Calcium (Ca2+) is involved in all types of cellular mechanisms, including metabolism, synaptic plasticity, nerve growth, smooth muscle contraction Cellular functions can be indirectly regulated by CaM.
Muscle Relaxation	**Improved Immune Function**	**Increase Cell Membrane Permeability**	**Improves Mitochondrial Function**
▸ Improved Circulation and flow of ions(Ca2+) help to relax muscles[10] ▸ Reduces the physiological deficits associated with Delayed Onset Muscle Soreness[12]	▸ Achieving homeostasis in the face of acute inflammatory/immune challenges in the human body involves maintaining a balance of highly complex biochemical and cellular interactions. When this delicate balance is upset, acute inflammatory and immune responses designed to quickly eliminate a transient threat become chronic, and inflammatory and/or autoimmune disease sets in..PEMF has the potential to regulate this very delicate balance[8]	▸ Temporarily hyperpolarize and depolarize the membrane thus increasing cellular oxygenation and nutrition. Increased cell membrane permeability allows better oxygen and nutrient uptake by the cells and increased toxins release from the cells[7]	▸ Cells function and create energy more efficiently, less prone to diseases and malfunction. ▸ Enhanced brain mitochondrial function by 50-150% across six established measures[13]

PHYSIOLOGIC EFFECTS OF PEMF

Increase in Antioxidants	Reduce Oxidative Stress	Improved Cartilage function and collagen production	Cellular Proliferation and DNA Synthesis
▸ Increase antioxidant enzymes activity[14] ▸ Antioxidants help to stabilize free radicals. Free radicals cause early cell death by causing the cells to malfunction, and lead to early aging with chronic diseases such as cancer.	▸ Decreased the level of parameters of oxidative stress as well as help to modulate ROS (free radicals)[14, 15, 16] ▸ With prolonged inflammation, Oxidative Stress occurs and free radicals (ROS) are produced. An overproduction of Free radicals lead to early cell , and a number of serious chronic conditions such as various autoimmune disorders and even cancer.	▸ Cartilage allows your joints to move smoother, and act as a cushion at the ends of your bones where they connect to joints. ▸ Chondrocytes are cells found in cartilage that help to produce and maintain the cartilaginous matrix, which consists mainly of collagen and proteoglycans. ▸ PEMF increases proteogylcan[18] as well as increase the number of chondrocytes in the cartilage[19] and their metabolism[20,21,22] ▸ Increases collagen production[23]	▸ DNA Synthesis is the most essential part for biological inheritance. Cellular proliferation is the creation of new cells, essential to life. ▸ Stimulate cellular proliferation and DNA synthesis through opening of voltage-sensitive calcium channels[24]

Apoptosis	Stem Cells	Formation of new blood vessels	Nerve Regeneration
▸ Increase the expression of anti-apoptotic proteins[9, 20, 25, 28] ▸ Programmed cell death (apoptosis) occurs naturally as a part of aging, and is a function of the body to guard against malfunctioning cells that occur in old age. However, this can also occur prematurely due to free radicals running rampant in situations of unregulated oxidative stress.	▸ Stem Cells serve as a repair system for the body. ▸ PEMF has a beneficial effect on stem cell differentiation[20,26]	▸ Positive and restorative effect on proangiogenic molecules such as VEGF[9,10] ▸ Vascular endothelial growth factor (VEGF) is a signalling protein that promotes the growth of new blood vessels. VEGF forms part of the mechanism that restores the blood supply to cells and tissues when they are deprived of oxygenated blood due to compromised blood circulation	▸ Regrowth of nerve fibers (axons) is essential to repair and functional recovery of the spinal cord. ▸ Promotes the release of nerve growth proteins that boost the nerve cells function and allow them to regenerate faster[27]

CONDITIONS IMPROVED WITH PEMF

Arthritis

- PEMF not only alleviates the pain in the arthritis condition but it also affords chondroprotection, exerts anti-inflammatory action and helps in bone remodeling and this could be developed as a viable alternative for arthritis therapy[30]

Degenerative Joint Disease (DJD)

- Improve clinical scores, pain reduction, reduce pain medications, and improve function in patients with osteoarthritis of the knee and should be considered as adjuvant therapies in their management[31, 32, 33, 35]
- There is a strong rationale supporting the in vivo use of biophysical stimulation with PEMFs for the treatment of OA. These data strongly support the clinical use of PEMFs in OA patients[34] . PEMF's Increased the Osteoarthritis chondrocytes[36]

Tendonitis/Carpal Tunnel

- **Carpal Tunnel -** Reduction in pain, improvement in the electrophysiological studies, and hand grip strength. There are no reported side effects, discomforts, or known health risks from PEMF therapy[37]
- There was objective improvement in nerve conduction, and subjective improvement on examination, and pain scores[38]
- **Tendonitis -** Achieved a marked increase of tensile strength[9]

Pain Reduction

- Modulates the pain signal transmission by acting on the Transmembrane Receptors.
- PEMF reduces pain[39,40,41,42,9].
- Pain is often a signal of soft tissue Inflammation. By reducing inflammation, the pain subsides.

Oncology/Cancer

- PEMF treated groups showed an increase in tumor death and induced an anti-tumoral response[43] as well as a slower tumor growth rate when compared with untreated control group[44]
- Due to an increase in cell membrane permeability, there was an increased Drug Uptake (2 Fold) to tumor cells as well as drug effectiveness[45]
- Daily PEMF was found to inhibit growth of breast cancer, causing the tumor to develop proportionately larger areas of necrosis and hypoxia and smaller areas spreading cancer cells[46]
- In combination with Gamma Irradiation, there were significantly fewer lung metastatic sites and slower tumor growth[47]
- PEMF exhibited an antitumor effect[48]

Migraines

- Significant improvement in the days and duration of headaches work-loss hours and number of medications[49]
- Exposure of the inner thighs to pulsing electromagnetic fields for at least 3 weeks is an effective, short-term intervention for migraine[50]

BPH

- Reduce Prostate Volume after 28 days of therapy. Symptoms improved in a short time, with high compliance and no effects on hormonal and sexual function or any side effects[51]
- PEMF and exercise therapy is beneficial in the treatment of BPH[52]

Diabetic Retinopathy

- Patients were treated over a 6 week period. 76% of the patients had a reduction in the level of numbness and tingling[53]

CONDITIONS IMPROVED WITH PEMF

Stroke

- There is a protective effect of PEMFs on hypoxia damage in neuron-like cells which suggest PEMFs could represent a potential therapeutic approach in cerebral ischemic conditions[2]
- Low Frequency PEMF improves motor condition as well as mental efficiency. PEMF significantly boosts the effectiveness of rehabilitation of stroke patients[14]
- Exposure to a PEMF of short duration may have implications for the treatment of acute stroke[54]
- PEMF may be an effective treatment for patients after traumatic or ischemic brain injury[55]

Alzheimers/Dementia

- Prevents or reverses cognitive impairment in Alzheimer's transgenic mice, and also improves memory in normal mice. This could have profound value in the disease's prevention and treatment through intervention at the mitochondrial level[56]

Depression

- Improve effectiveness of anti-depressants[57]
- Patients on active PEMF showed a clinically and statistically significant better outcome than patients treated with sham PEMF, with an onset of action within the first weeks of therapy[57]

Insomnia

- Seventy percent of the patients given active treatment experienced substantial or even complete relief of their Insomnia complaints[58]

Chronic Low Back Pain / Non-specific Low Back Pain

- Magnetotherapy with PEMF parameters and placebo therapy decreased the level of pain and improved the function in subjects[61]
- Safe and effective in improving function in patients with non-specific LBP.[62]
- Superior clinical improvement in pain, functional disability, and lumbar ROM in patients with non-specific low back pain[63]
- Decrease pain, LBP disability, increase lumbar spine mobility, and improve HRQOL in middle-aged university's employees with nonspecific LBP[64]

Tennis Elbow (lateral epicondylitis)

- Pain during exercise and when bending the wrist was significantly reduced in the group that was treated with pulsed magnetic therapy. The study results confirmed that pulsed magnetic therapy quickly reduces pain caused by so-called golf or tennis elbow.[65]
- Effective in decreasing pain and improving function in participants with LE.[66]

Ununited Fractures

- Treatment of ununited fractures has proved to be more successful than noninvasive traditional management and at least as effective as surgical therapies[59]
- Employed to treat patients suffering from delayed fracture healing and nonunions[60]

Nonalcoholic Fatty Liver Disease

- Increase antioxidant enzymes activity and alleviate lipid accumulation in fatty liver[16]

CONDITIONS IMPROVED WITH PEMF

Osteoporosis	Rheumatoid Arthritis	Sciatica	Bone Remodeling
▸ Prevent bone loss and improve lipid metabolism disorders[67] ▸ Stimulate osteoblastogenesis, suppress osteoclastogenesis, and influence the activity of bone marrow mesenchymal stem cells (BMSCs) and osteocytes, ultimately leading to retention of bone mass and strength[60] ▸ Have clinical application in the prevention and treatment of osteoporosis[68]	▸ A novel and highly promising means of treating chronic inflammation and aberrant immunity that exists in diseases such as RA[7] ▸ The positive role treating rheumatoid arthritis (RA) is known[10]	▸ Effective, safe and tolerable treatment for peripheral nerve repair in clinical practice[27]	▸ Helps in bone remodeling[69]

Analgesic Use	Herniated Disk	Mobility and Function	Overactive Bladder Syndrome
▸ The net reduction in pain was equivalent to a low to moderate dose of opioid analgesic in PEMF-exposed patients. when an opiate such as morphine is used in combination with PEMF, the side effects of the opiate may be reduced[39] ▸ Analgesic use during the first 24 hours after C-section was 1.9-times lower in the active-PEMF group. The total analgesic use during the seventh postoperative days was 2.1-times lower in the active-PEMF group than in the sham group[70] ▸ Effective in rapidly reducing use of narcotic medications[41] ▸ Patient use of postoperative pain medication correspondingly also decreased nearly three times faster[9]	▸ Protect tissues from the high inflammatory cytokine environment during disc degeneration[71]	▸ Resulted in improved mobility, pain scores, and energy level in fibromyalgia and chronic musculoskeletal pain patients[72] ▸ Our results suggest that early addition of pulsed electromagnetic field treatment, during cast immobilization of distal radius fractures, has beneficial effects on the pain, exteroceptive sensation, range of motion, and daily functioning of patients[73]	▸ Induced an inhibitory effect on neurogenic detrusor overactivity[74]

CONDITIONS IMPROVED WITH PEMF

Post Operative Recovery	Non Healing Wounds	Lumbar Fusion	
▸ Effective in rapidly reducing post-operative pain.[41] ▸ Typically used for postoperative pain management with the expectation of a significant reduction in the use of narcotics and/or non-steroidal antiinflammatory drugs, earlier hospital discharge, and/or an earlier return to function[14] ▸ Postoperative pain was significantly lower in the active-PEMF group in all the measured periods within the early and the late postoperative periods. Fewer women in the active-PEMF group experienced severe postoperative pain within 24 hours postoperatively[70] ▸ Seven days postoperatively, patients in the active-PEMF group had better wound healing with no exudate, erythema, or edema[70]	▸ In the treatment of chronic non-healing wounds, the recommended treatment is 30 minutes twice per day until the wound is closed. Closure of chronically open wounds may be seen in 6 to 10 weeks with this treatment.[9]	▸ Fusion succeeded in 97.6% of the PEMF group and in 52.6% of the unstimulated group. The observed agreement between clinical and radiographic outcome was 75%. The use of PEMF stimulation enhances bony bridging in lumbar spinal fusion[44]	

REFERENCES:

1. Tang X, Alliston T, Coughlin D, et al. Dynamic imaging demonstrates that pulsed electromagnetic fields (PEMF) suppress IL-6 transcription in bovine nucleus pulposus cells: PEMF SUPPRESS IL-6 TRANSCRIPTION IN NP CELLS. J Orthop Res. 2017. doi:10.1002/jor.23713
2. Vincenzi F, Ravani A, Pasquini S, et al. Pulsed electromagnetic field exposure reduces hypoxia and inflammation damage in neuron-like and microglial cells: PEMFs REDUCE HYPOXIA AND INFLAMMATION DAMAGE. J Cell Physiol. 2017;232(5):1200-1208.
3. Amin HD, Brady MA, St-Pierre J-P, Stevens MM, Overby DR, Ethier CR. Stimulation of chondrogenic differentiation of adult human bone marrow-derived stromal cells by a moderate-strength static magnetic field. Tissue Eng Part A. 2014;20(11-12):1612-1620.
4. Varani K, De Mattei M, Vincenzi F, et al. Characterization of adenosine receptors in bovine chondrocytes and fibroblast-like synoviocytes exposed to low frequency low energy pulsed electromagnetic fields. Osteoarthritis Cartilage. 2008;16(3):292-304.
5. Vincenzi F, Targa M, Corciulo C, et al. Pulsed electromagnetic fields increased the anti-inflammatory effect of A_2A and A_3 adenosine receptors in human T/C-28a2 chondrocytes and hFOB 1.19 osteoblasts. PLoS One. 2013;8(5):e65561
6. Fini M, Pagani S, Giavaresi G, et al. Functional tissue engineering in articular cartilage repair: is there a role for electromagnetic biophysical stimulation? Tissue Eng Part B Rev. 2013;19(4):353-367.
7. Ross CL, Ang DC, Almeida-Porada G. Targeting mesenchymal stromal cells/pericytes (MSCs) with pulsed electromagnetic field (PEMF) has the potential to treat rheumatoid arthritis. Front Immunol. 2019;10:266.
8. Ross CL, Zhou Y, McCall CE, Soker S, Criswell TL. The use of pulsed electromagnetic field to modulate inflammation and improve tissue regeneration: A review. Bioelectricity. 2019;1(4):247-259.
9. Strauch B, Herman C, Dabb R, Ignarro LJ, Pilla AA. Evidence-based use of pulsed electromagnetic field therapy in clinical plastic surgery. Aesthet Surg J. 2009;29(2):135-143.
10. Ganguly KS, Sarkar AK, Datta AK, Rakshit A. A study of the effects of pulsed electromagnetic field therapy with respect to serological grouping in rheumatoid arthritis. J Indian Med Assoc. 1998;96(9):272-275.
11. Bragin DE, Statom GL, Hagberg S, Nemoto EM. Increases in microvascular perfusion and tissue oxygenation via pulsed electro-

REFERENCES:

magnetic fields in the healthy rat brain. J Neurosurg. 2015;122(5):1239-1247.

12. Jeon H-S, Kang S-Y, Park J-H, Lee H-S. Effects of pulsed electromagnetic field therapy on delayed-onset muscle soreness in biceps brachii. Phys Ther Sport. 2015;16(1):34-39.
13. Dragicevic N, Bradshaw PC, Mamcarz M, et al. Long-term electromagnetic field treatment enhances brain mitochondrial function of both Alzheimer's transgenic mice and normal mice: a mechanism for electromagnetic field-induced cognitive benefit? Neuroscience. 2011;185:135-149.
14. Cichon N, Synowiec E, Miller E, et al. Effect of rehabilitation with extremely low frequency electromagnetic field on molecular mechanism of apoptosis in post-stroke patients. Brain Sci. 2020;10(5):266.
15. Funk RH. Coupling of pulsed electromagnetic fields (PEMF) therapy to molecular grounds of the cell. Am J Transl Res. 2018;10(5):1260-1272.
16. Liu Y, Zhai M. Pulsed Electromagnetic Fields Alleviates Hepatic Oxidative Stress and Lipids Accumulation in db/db mice. bioRxiv. 2020. doi:10.1101/2020.04.06.028621
17. S. Ehnert, A. Fentz, A. Schreiner et al., "Extremely low frequency pulsed electromagnetic fields cause antioxidative defense mechanisms in human osteoblasts via induction of •O2− and H2O2," Scientific Reports, vol. 7, no. 1, Article ID 14544, 2017.
18. Zarins, Denise; Gifford, III, Hanson; Deem, Mark; Levin, Howard R.; Gelfand, Mark; Zadno, Nicolas, "Methods and apparatus for monopolar renal neuromodulation"
19. Fitzsimmons RJ, Gordon SL, Kronberg J, Ganey T, Pilla AA. A pulsing electric field (PEF) increases human chondrocyte proliferation through a transduction pathway involving nitric oxide signaling. J Orthop Res. 2008;26(6):854-859.
20. Ongaro A, Pellati A, Masieri FF, et al. Chondroprotective effects of pulsed electromagnetic fields on human cartilage explants. Bioelectromagnetics. 2011;32(7):543-551.
21. Chang S-H, Hsiao Y-W, Lin H-Y. Low-frequency electromagnetic field exposure accelerates chondrocytic phenotype expression on chitosan substrate. Orthopedics. 2011;34(1):20.
22. Luo Q, Li S-S, He C, He H, Yang L, Deng L. Pulse electromagnetic fields effects on serum E2 levels, chondrocyte apoptosis, and

REFERENCES:

matrix metalloproteinase-13 expression in ovariectomized rats. Rheumatol Int. 2009;29(8):927-935.

23. Murray JC, Farndale RW. Modulation of collagen production in cultured fibroblasts by a low-frequency, pulsed magnetic field. Biochim Biophys Acta. 1985;838(1):98-105.
24. Bourguignon GJ, Jy W, Bourguignon LY. Electric stimulation of human fibroblasts causes an increase in Ca2+ influx and the exposure of additional insulin receptors. J Cell Physiol. 1989;140(2):379-385.
25. Kaszuba-Zwoinska J, Chorobik P, Juszczak K, Zaraska W, Thor PJ. Pulsed electromagnetic field affects intrinsic and endoplasmatic reticulum apoptosis induction pathways in MonoMac6 cell line culture. J Physiol Pharmacol. 2012;63(5):537-545.
26. Yin Y, Chen P, Yu Q, Peng Y, Zhu Z, Tian J. The effects of a pulsed electromagnetic field on the proliferation and osteogenic differentiation of human adipose-derived stem cells. Med Sci Monit. 2018;24:3274-3282.
27. Mohammadi R, Faraji D, Alemi H, Mokarizadeh A. Pulsed electromagnetic fields accelerate functional recovery of transected sciatic nerve bridged by chitosan conduit: an animal model study. Int J Surg. 2014;12(12):1278-1285.
28. Funk RH. Coupling of pulsed electromagnetic fields (PEMF) therapy to molecular grounds of the cell. Am J Transl Res. 2018;10(5):1260-1272.
29. Kaszuba-Zwoińska Jolanta, Chorobik Paulina, Nowak Bernadeta, Ziomber Agata, Juszczak Kajetan, Zaraska Wiesław, Thor Piotr, LPS Treatment and Exposure to PEMF induce Cell Death and Change in Secretory Activity of HMVEC-Bd with MM6 Cocultutre, Advances in Bioscience and Bioengineering. Vol. 2, No. 3, 2014, pp. 30-36. doi: 10.11648/j.abb.20140203.12
30. Ganesan K, Gengadharan AC, Balachandran C, Manohar BM, Puvanakrishnan R. Low frequency pulsed electromagnetic field--a viable alternative therapy for arthritis. Indian J Exp Biol. 2009;47(12):939-948..
31. Vavken P, Arrich F, Schuhfried O, Dorotka R. Effectiveness of pulsed electromagnetic field therapy in the management of osteoarthritis of the knee: a meta-analysis of randomized controlled trials. J Rehabil Med. 2009;41(6):406-411.
32. Bagnato GL, Miceli G, Marino N, Sciortino D, Bagnato GF. Pulsed electromagnetic fields in knee osteoarthritis: a double blind, placebo-controlled, randomized clinical trial. Rheumatology (Oxford). 2016;55(4):755-762.
33. Wang T, Xie W, Ye W, He C. Effects of electromagnetic fields on osteoarthritis. Biomed Pharmacother. 2019;118(109282):109282.
34. Fini M, Giavaresi G, Carpi A, Nicolini A, Setti S, Giardino R. Effects of pulsed electromagnetic fields on articular hyaline cartilage: review of experimental and clinical studies. Biomed Pharmacother. 2005;59(7):388-394.
35. De Mattei M, Caruso A, Pezzetti F, et al. Effects of pulsed electromagnetic fields on human articular chondrocyte proliferation. Connect Tissue Res. 2001;42(4):269-279.

REFERENCES:

36. Iannitti T, Palmieri B, Fistetto, Esposito, Rottigni. Pulsed electromagnetic field therapy for management of osteoarthritis-related pain, stiffness and physical function: clinical experience in the elderly. Clin Interv Aging. 2013:1289.
37. Kamel DM, Hamed NS, Abdel Raoof NA, Tantawy SA. Pulsed magnetic field versus ultrasound in the treatment of postnatal carpal tunnel syndrome: A randomized controlled trial in the women of an Egyptian population. J Adv Res. 2017;8(1):45-53.
38. Weintraub MI, Cole SP. A randomized controlled trial of the effects of a combination of static and dynamic magnetic fields on carpal tunnel syndrome. Pain Med. 2008;9(5):493-504.
39. Thomas AW, Graham K, Prato FS, et al. A randomized, double-blind, placebo-controlled clinical trial using a low-frequency magnetic field in the treatment of musculoskeletal chronic pain. Pain Res Manag. 2007;12(4):249-258.
40. Sorrell RG, Muhlenfeld J, Moffett J, Stevens G, Kesten S. Evaluation of pulsed electromagnetic field therapy for the treatment of chronic post-operative pain following lumbar surgery: a pilot, double-blind, randomized, sham-controlled clinical trial. J Pain Res. 2018;11:1209-1222
41. Rohde C, Hardy K, Ascherman J, Taylor E, Pilla A. PEMF therapy rapidly reduces post-operative pain in TRAM flap patients. Plast Reconstr Surg. 2012;130:91-92.
42. Thuile C, Walzl M. Evaluation of electromagnetic fields in the treatment of pain in patients with lumbar radiculopathy or the whiplash syndrome. NeuroRehabilitation. 2002;17(1):63-67.
43. Vadalà M, Morales-Medina JC, Vallelunga A, Palmieri B, Laurino C, Iannitti T. Mechanisms and therapeutic effectiveness of pulsed electromagnetic field therapy in oncology. Cancer Med. 2016;5(11):3128-3139.
44. Marks RA. Spine fusion for discogenic low back pain: outcomes in patients treated with or without pulsed electromagnetic field stimulation. Adv Ther. 2000;17(2):57-67.
45. Kranjc S, Kranjc M, Scancar J, Jelenc J, Sersa G, Miklavcic D. Electrochemotherapy by pulsed electromagnetic field treatment (PEMF) in mouse melanoma B16F10 in vivo. Radiol Oncol. 2016;50(1):39-48.
46. Cameron LS. Daily Pulsed Electromagnetic Field (PEMF) therapy inhibits tumor angiogenesis via the hypoxia driven pathway: therapeutic implications I. D.
47. Cameron IL, Sun L-Z, Short N, Hardman WE, Williams CD. Therapeutic Electromagnetic Field (TEMF) and gamma irradiation on human breast cancer xenograft growth, angiogenesis and metastasis. Cancer Cell Int. 2005;5(1):23.
48. Omote Y, Hosokawa M, Komatsumoto M, et al. Treatment of experimental tumors with a combination of a pulsing magnetic field and an anti-tumor drug. Jpn J Cancer Res. 1990;81(9):956-961.
49. Hatef B, Hashemirad F, Meftahi GH, et al. The efficiency of pulsed electromagnetic field in refractory migraine headaches: a randomized, single-blinded, placebo-controlled, parallel group. Int J Clin Trials. 2016;3(1):24.

REFERENCES:

50. Sherman RA, Acosta NM, Robson L. Treatment of migraine with pulsing electromagnetic fields: a double-blind, placebo-controlled study. Headache. 1999;39(8):567-575.
51. Tenuta M, Tarsitano MG, Mazzotta P, et al. Therapeutic use of pulsed electromagnetic field therapy reduces prostate volume and lower urinary tract symptoms in benign prostatic hyperplasia. Andrology. 2020;8(5):1076-1085.
52. Elgohary HM, Tantawy SA. Pulsed electromagnetic field with or without exercise therapy in the treatment of benign prostatic hyperplasia. J Phys Ther Sci. 2017;29(8):1305-1310.
53. Lau B., School of Medicine, Lomo Linda, USA. "Effect of Low Intensity Electromagnetic Fields on Diabetic Retinopathy".
54. Grant G, Cadossi R, Steinberg G. Protection against focal cerebral ischemia following exposure to a pulsed electromagnetic field. Bioelectromagnetics. 1994;15(3):205-216.
55. Bragin DE, Statom GL, Hagberg S, Nemoto EM. Increases in microvascular perfusion and tissue oxygenation via pulsed electromagnetic fields in the healthy rat brain. J Neurosurg. 2015;122(5):1239-1247.
56. Dragicevic N, Bradshaw PC, Mamcarz M, et al. Long-term electromagnetic field treatment enhances brain mitochondrial function of both Alzheimer's transgenic mice and normal mice: a mechanism for electromagnetic field-induced cognitive benefit? Neuroscience. 2011;185:135-149.
57. Bech P, Gefke M, Lunde M, Lauritzen L, Martiny K. The pharmacopsychometric triangle to illustrate the effectiveness of T-PEMF concomitant with antidepressants in treatment resistant patients: A double-blind, randomised, sham-controlled trial revisited with focus on the patient-reported outcomes. Depress Res Treat. 2011;2011:806298.
58. Pelka RB, Jaenicke C, Gruenwald J. Impulse magnetic-field therapy for insomnia: a double-blind, placebo-controlled study. Adv Ther. 2001;18(4):174-180.
59. Gossling HR, Bernstein RA, Abbott J. Treatment of ununited tibial fractures: a comparison of surgery and pulsed electromagnetic fields (PEMF). Orthopedics. 1992;15(6):711-719.
60. Wang T, Yang L, Jiang J, et al. Pulsed electromagnetic fields: promising treatment for osteoporosis. Osteoporos Int. 2019;30(2):267-276.
61. Galovic P, Celan D, Hernja-Rumpf T. Short term effect of PEMF magnetotherapy on chronic low back pain. J magn. 2018;23(4):553-558.
62. Lisi AJ, Scheinowitz M, Saporito R, Onorato A. A pulsed electromagnetic field therapy device for non-specific low back pain: A pilot randomized controlled trial. Pain Ther. 2019;8(1):133-140.
63. Elshiwi AM, Hamada HA, Mosaad D, Ragab IMA, Koura GM, Alrawaili SM. Effect of pulsed electromagnetic field on nonspecific low back pain patients: a randomized controlled trial. Braz J Phys Ther. 2019;23(3):244-249.
64. Elshiwi AM, Hamada HA, Mosaad D, Ragab IMA, Koura GM, Alrawaili SM. Effect of pulsed electromagnetic field on nonspecific low back pain patients: a randomized controlled trial. Braz J Phys Ther. 2019;23(3):244-249.

REFERENCES:

65. Alahmari K. Effectiveness of pulsed electromagnetic field therapy in the treatment of lateral epicondylitis – Pre-test post-test study. J Integr Health Sci. 2016;4(1):39.
66. Reddy R. Effect of pulsed electromagnetic field therapy on pain, pressure pain threshold, and pain-free grip strength in participants with lateral epicondylitis. Saudi J Sports Med. 2017;17(2):93.
67. Jiang Y, Gou H, Wang S, Zhu J, Tian S, Yu L. Effect of pulsed electromagnetic field on bone formation and lipid metabolism of glucocorticoid-induced osteoporosis rats through canonical Wnt signaling pathway. Evid Based Complement Alternat Med. 2016;2016:4927035.
68. Tabrah F, Hoffmeier M, Gilbert F Jr, Batkin S, Bassett CA. Bone density changes in osteoporosis-prone women exposed to pulsed electromagnetic fields (PEMFs). J Bone Miner Res. 1990;5(5):437-442.
69. Ganesan K, Gengadharan AC, Balachandran C, Manohar BM, Puvanakrishnan R. Low frequency pulsed electromagnetic field--a viable alternative therapy for arthritis. Indian J Exp Biol. 2009;47(12):939-948.
70. Khooshideh M, Latifi Rostami SS, Sheikh M, Ghorbani Yekta B, Shahriari A. Pulsed electromagnetic fields for postsurgical pain management in women undergoing cesarean section: A randomized, double-blind, placebo-controlled trial. Clin J Pain. 2017;33(2):142-147.
71. Tang X, Alliston T, Coughlin D, et al. Dynamic imaging demonstrates that pulsed electromagnetic fields (PEMF) suppress IL-6 transcription in bovine nucleus pulposus cells: PEMF SUPPRESS IL-6 TRANSCRIPTION IN NP CELLS. J Orthop Res. 2017. doi:10.1002/jor.23713
72. Overholt TL, Ross C, Evans RJ, Walker SJ. Pulsed electromagnetic field therapy as a complementary alternative for chronic pelvic pain management in an interstitial cystitis/bladder pain syndrome patient. Case Rep Urol. 2019;2019:5767568.
73. Krzyżańska L, Straburzyńska-Lupa A, Rąglewska P, Romanowski L. Beneficial effects of pulsed electromagnetic field during cast immobilization in patients with distal radius fracture. Biomed Res Int. 2020;2020:6849352.
74. Fergany LA, Shaker H, Arafa M, Elbadry MS. Does sacral pulsed electromagnetic field therapy have a better effect than transcutaneous electrical nerve stimulation in patients with neurogenic overactive bladder? Arab J Urol. 2017;15(2):148-152.
75. Foley-Nolan D, Moore K, Codd M, Barry C, O'Connor P, Coughlan RJ. Low energy high frequency pulsed electromagnetic therapy for acute whiplash injuries. A double blind randomized controlled study. Scand J Rehabil Med . 1992;24(1):51-59.