Research on PEMF

PEMF is short for Pulsed Electro Magnetic Field" Therapy. PEMF is an established recognized FDA approved treatment for non-union bone fractures. (specific waveform approved) The mechanism by which it works is not fully understood. The article "Underlying Signaling Pathways and Therapeutic Applications of Pulsed Electromagnetic Fields in Bone Repair" states "PEMFs promote osteoblast differentiation and maturation, exert their therapeutic effect on bone repair, and remarkably reduce the pain of patients by modulating the release of inflammatory cytokines, such as interleukin-1 beta (IL-1]²)". It further states: "In addition, the **anti-inflammatory effect of PEMFs** was also verified by studies". In short it may be the anti-inflammatory effect of PEMFs that make them work for bone healing.

Use of PEMF in other fields is controversial. There are many PEMF equipment manufactures, but none seem to fully disclose their specification on the PEMF waveforms. The waveforms have many attibutes including frequency, duty cycle, pulse width, rise time, fall time, and pulse shape, as well as peak and average magnetic field strenghts. To top that off the radiating antenna (mat) design will have a significate effect on the projection distance and shape of the magnetic field. Manufactures should also publish field intensity specifications versus distance. The PEMF manufactures tendency to advertise equipment based on hype rather than specification, which gives the general industry a dis-reputable reputation. Research Papers on PEMF and Dementia.

Low-Frequency Pulsed Electromagnetic Field Is Able to Modulate miRNAs in an Experimental Cell Model of Alzheimer's Disease

"These results suggest that the electromagnetic fields at low frequencies, if properly used, **may be useful for the treatment of patients with AD**, as suggested by the results of pilot experiments with deep brain stimulation via EMFs, which were reported to produce clinical benefits".

A phase I trial of deep brain stimulation of memory circuits in Alzheimer's disease

"PET scans showed an early and striking reversal of the impaired glucose utilization in the temporal and parietal lobes that was maintained after 12 months of continuous stimulation. Evaluation of the Alzheimer's Disease Assessment Scale cognitive subscale and the Mini Mental State Examination suggested **possible improvements and/or slowing** in the rate of cognitive decline at 6 and 12 months in some patients. There were no serious adverse events."

Electromagnetic Field Treatment Protects Against and Reverses Cognitive Impairment in Alzheimer's Disease Mice

"Although caution should be taken in extrapolating these mouse studies to humans, we conclude that EMF exposure may represent a non-invasive, non-pharmacologic therapeutic against Alzheimer's disease and an effective memory-enhancing approach in general."

Effects of pulsed electromagnetic fields on learning and memory abilities of STZ-induced dementia rats

"PEMF, 10 mT at 20 Hz Our findings indicate that the **pulsed EMF exposure can improve the ability of learning and memory** in STZ-induced dementia rats and this effect may be related to the process of IGF signal transduction, suggesting a potential role for the pulsed EMF for the amelioration of cognition impairment."

Short-term effects of extremely low frequency electromagnetic fields exposure on Alzheimer's disease in rats "The present study indicated that short-term exposure of 100 Î1⁄4T/50 Hz ELF-EMF had no effects on cognition and memory of rats"

Spatial memory recovery in Alzheimer's rat model by electromagnetic field exposure

"Therefore, this study aimed to investigate the effect of ELF-EMF exposure (50 Hz, 10 mT) on spatial learning and memory changes in AD rats. Our results showed that application of ELF-MF not only has improving effect on different cognitive disorder signs of AD animals, but also disrupts the processes of AD rat model formation."

Alzheimer's disease: improvement of visual memory and visuoconstructive performance by treatment with picotesla range magnetic fields

"Recently, I reported that external application of electromagnetic fields (EMF) of extremely low intensity (in the picotesla range) and of low frequency (in the range of 5Hz-8Hz) improved visual memory and visuoperceptive functions in patients with Parkinson's disease. The **rapid improvement in cognitive functions** in response to EMF suggests that some of the mental deficits of AD are reversible being caused by a functional (i.e., synaptic transmission) rather than a structural (i.e., neuritic plaques) disruption of neuronal communication in the central nervous system."

Low-Frequency Pulsed Electromagnetic Field Is Able to Modulate miRNAs in an Experimental Cell Model of Alzheimer's Disease

"suggest that the electromagnetic fields at low frequencies, if properly used, **may be useful for the treatment of patients with AD**, as suggested by the results of pilot experiments with deep brain stimulation via EMFs, which were reported to produce clinical benefits"

Electromagnetic field treatment protects against and reverses cognitive impairment in Alzheimer's disease mice.

"To the contrary, this report presents the first evidence that long-term EMF exposure directly associated with cell phone use (918 MHz; 0.25 w/kg) provides cognitive benefits." <u>A Pulsed Electromagnetic Field Protects against Glutamate-Induced Excitotoxicity by Modulating the Endocannabinoid System in HT22 Cells</u>

"These results suggest that **PEMF exposure leads to neuroprotective effects** against excitotoxicity by facilitating the eCB/CB1R/ERK signaling pathway. Therefore, PEMF may be a potential physical therapeutic technique for preventing and treating neurological diseases."

Long term delivery of pulsed magnetic fields does not alter visual discrimination learning or dendritic spine density in the mouse CA1 pyramidal or dentate gyrus neurons. "Our negative results highlight the lack of deleterious side effects in normal subjects and are consistent with previous studies suggesting that rTMS has a bigger effect on abnormal or injured brain substrates than on normal/control structures."

Research Papers on PEMF and inflammation.

Pulsed electromagnetic fields increased the anti-inflammatory effect of Aâ., A and Aâ. f adenosine receptors in human T/C-28a2 chondrocytes and hFOB 1.19 osteoblasts. "These results demonstrated that PEMF exposure significantly increase the anti-inflammatory effect of A 2A or A3 ARs suggesting their potential therapeutic use in the therapy of inflammatory bone and joint disorders."

Adenosine Receptors as a Biological Pathway for the Anti-Inflammatory and Beneficial Effects of Low Frequency Low Energy Pulsed Electromagnetic Fields

"Moreover, a protective involvement of PEMFs on hypoxia damage in neuron-like cells and an anti-inflammatory effect in microglial cells have suggested the hypothesis of a positive impact of this noninvasive biophysical stimulus."

Effect of pulsed electromagnetic field (PEMF) on infarct size and inflammation after cerebral ischemia in mice

"Both reduction of infarct size and **influence on neuroinflammation** could have a potentially important positive impact on the poststroke recovery process, implicating PEMF as a possible adjunctive therapy for stroke patients. "

Low frequency and low intensity pulsed electromagnetic field exerts its antiinflammatory effect through restoration of plasma membrane calcium ATPase activity_

"The antiinflammatory effect could be partially mediated through the stabilizing action of PEMF on membranes as reflected by the restoration of PMCA and intracellular Ca(2+) levels in blood lymphocytes subsequently inhibiting PGE(2) biosynthesis. The results of this study indicated that PEMF could be developed as a potential therapy for RA in human beings. " effect of pulsed electromagnetic field treatment on programmed resolution of inflammation pathway markers in human cells in culture.

"Based on our results, we propose a model in which **PEMF therapy may promote chronic inflammation resolution** by mediating gene expression changes important for inhibiting and resolving inflammation."

The Role of Peripheral Inflammatory Markers in Dementia and Alzheimer's Disease: A Meta-Analysis

"In conclusion, this meta-analysis provides suggestive evidence of an association between increased peripheral levels of inflammatory markers and increased risk of incident dementia"

Personal Opinion on why PEMF works on inflammation

Exercise, vibration therapy and PEMF are known to reduce inflammation, and I suspect PEMF is exploiting the same principle of the benefit of movement. However the degree of movement varies drastically in each of the three examples. Whole body vibration (WBV) for example has been referred to as an exercise mimetic, decreasing inflammatory responces. Water (main composition of human body) is known to be dia-magnetic. This means that water molecules are repelled by a magnetic field. Personal experimentation has demonstated that PEMF increases the rate of Dissolved Oxygen transfer thru a plastic membrane. This is caused by the micro movement increase of the water at the membrane interface. For example water that is manually circulated also increases the Dissolved Oxygen transfer rate. In short the slight movement of the water molecules caused by the magnetic field caused increased

access to the oxygen molecules exposed thru the membrane. If this theory is transportable to the human body, PEMF may be capable of micro movements that improve normal cellular interaction thru their membranes. Furthermore this may imply two things: One that the effect on healthy cells may be minimal, as normal interaction/circulation is already occuring. Two, that the aspect of PEMF waveform shape should be designed with the purpose to "nudge" the water molecules to enhance normal reactions. Here the author proposes that a low frequency, narrow pulse width be used. The analogy is to give a person a nudge, rather than a prolonged push. The added advantage is the energy required to give a "nudge" is much lower than a "push", and hence likely has a higher degree of safety margin.

"Sundowners" effect from Alheimer's [refs 29-34]

These reports indicate a possible link for Sundowners effect to the levels of Melatonin. Melatonin level in Alheimer's patients don't rise in late day as they do in healthy individuals. Some studies show that supplements of Melatonin at the correct time of day, reduce the symptoms of "Sundowners". It is unclear if PEMF could have any influence on Melatonin levels. One report of healthy human volunteers showed no effect, but a study on trout indicated a rise in the Melotonin level with PEMF.

Reference Links:

1. Assessing the contribution of inflammation in models of Alzheimer's disease

"Inflammation has long been proposed as having a role in AD (Alzheimer's disease), although it remains unclear whether inflammation represents a cause or consequence of AD. Evidence from the clinical setting in support of a role for inflammation in AD includes increased expression of inflammatory mediators and microglial activation in the post-mortem AD brain. Also, epidemiological studies on AD patients under long-term treatment with non-steroidal anti-inflammatory drugs suggest some benefits, although recent prospective trials showed no effect "

2. Inflammation and Alzheimer's disease

"Alzheimer's disease (AD) is classified mainly as a neurodegenerative disease. Recent research, however, has shown that inflammatory mechanisms are also associated with AD and that they could have a role in contributing to the pathogenesis of this disease. The evidence is based on histopathological brain studies, laboratory studies of peripheral inflammation and the fact that certain anti-inflammatory drugs could modify the course of AD. There is wide scope for further research using anti-inflammatory therapies in the prevention/treatment of AD, thereby reducing the burden of this widely prevalent condition in the community."

3. The role of peripheral inflammatory markers in dementia and Alzheimer's disease: a meta-analysis

"Seven studies were identified, combining for a total 5,717 participants, 746 cases of all-cause dementia and 565 cases of AD. An increased level of C-reactive protein was associated with a 45% increased risk of all-cause dementia"

4. High risk of developing dementia in Parkinson's disease: a Swedish registry-based study

"PwP had approximately four times higher risk of developing dementia"

5. Inflammation in Parkinson's Disease: Mechanisms and Therapeutic Implications

"A crucial role of inflammation in developing Parkinsonian symptoms has been suspected for many years since the initial observation of Parkinson-like symptoms in individuals infected with the influenza virus"

6. Decreased Risk of Parkinson's Disease After Rheumatoid Arthritis Diagnosis: A Nested Case-Control Study with Matched Cases and Controls

Individuals with a previous diagnosis of RA had a decreased risk of later developing PD by 30-50% compared to individuals without an RA diagnosis. This relationship was strongest in our conservative analysis, where the first PD diagnosis occurred close to the earliest PD symptoms (odds ratio 0.47 (Cl 95% 0.28-0.75, p = 0.0006); with the greatest risk reduction in females (odds ratio 0.40 (Cl 95% 0,19-0.76, p = 0.002). Our findings provide evidence that individuals diagnosed with RA have a significantly lower risk of developing PD than the general population. Our data should be considered when developing or repurposing therapies aimed at modifying the course of PD.

7. Association Between Rheumatoid Arthritis and Risk of Parkinson's Disease: A Meta-Analysis and Systematic Review

Four population-based studies involving 353,246 patients and one Mendelian randomized study were included in our study. The pooled result showed a significantly reduced risk of PD in patients with RA than in the general population This study supports that people with RA had a lower PD risk than those without RA.

8. Can treatments for arthritis be repurposed for dementia? – Alzheimer's Society comments

'This research suggests drugs used to control inflammation in rheumatoid arthritis may reduce the risk of dementia â€" but as it was an observational study, not a clinical trial, further research is needed before we can draw any firm conclusions about arthritis drugs as a treatment for dementia..

9. Association between Open-Angle Glaucoma and the Risks of Alzheimer's and Parkinson's Diseases in South Korea: A 10-year Nationwide Cohort Study

"Patients diagnosed with OAG have a higher risk of developing AD, but not PD, and the risk differed according to age and sex"

10. The role of inflammation in the pathogenesis of glaucoma

"We review recent studies elucidating a possible role of low-grade inflammation as a causal factor in the pathogenesis of glaucoma."

11. Association Between Psoriasis and Dementia: Current Evidence

"Conclusions: Â The patients with psoriasis and psoriatic arthritis show high prevalence of different types of dementia. Based on the findings of this study, dementia may not be considered a high-risk factor of death from severe psoriasis."

12. Association between psoriasis and dementia: A systematic review

"Most studies included in this review supported the hypothesis that psoriasis constitutes a risk factor for dementia"

13. Dementia after stroke: the Framingham Study

"Stroke increases a subject's risk of dementia as compared with age- and sex-matched controls. Primary and secondary prevention of stroke should significantly decrease the risk of all dementia. Baseline stroke doubled the risk of dementia (hazard ratio [HR]: 2.0; "

14. Inflammation and Stroke: Breaking Down the Body's Defense Mechanism

"Fortunately, inflammation can be reduced through lifestyle and dietary changes, which can also help lower the risk of recurrent stroke. This article will explore the connection between inflammation and stroke, and discuss how it can either be positive or negative depending on the circumstance. Furthermore, we will identify specific steps you can take to help reduce inflammation within your brain and body."

15. Statins and serum cholesterol's associations with incident dementia and mild cognitive impairment

Statin users had two to three-fold lower risk of developing dementia (HR=0.41

16. Statins and inflammation: an update

Statins have anti-inflammatory properties that are clinically important in lowering cardiovascular risk. It is probable, but not definitely proven, that some of the benefits of statins are due to their nonlipid effects.

17. Increased Risk of Dementia in Patients With Chronic Obstructive Pulmonary Disease

This nationwide cohort study demonstrates that the risk of dementia, including AD and PD, is significantly increased in patients with COPD compared with individuals in the general population.

18. Inflammatory mechanisms in patients with chronic obstructive pulmonary disease

Chronic obstructive pulmonary disease (COPD) is associated with chronic inflammation affecting predominantly the lung parenchyma and peripheral airways that results in largely irreversible and progressive airflow limitation.

19. Risk of early-onset dementia among persons with tinnitus: a retrospective case-control study

Our findings showed that pre-existing tinnitus was associated with a 68% increased risk of developing early-onset dementia among young and middle-aged adults. The results call for greater awareness of tinnitus as a potential harbinger of future dementia in this population.

20. Tinnitus And Its Connection to Psoriatic Arthritis

21. Inflammation in Tinnitus (INFLATIN

"In the past decade, inflammation has been implicated in the pathophysiology of tinnitus. In animal models of tinnitus, the expression of proinflammatory cytokines Tumor Necrosis Factor-1± (TNF-1±) and interleukine-11² (IL-11²) was increased throughout the whole auditory tract. Only two studies evaluated cytokine concentrations in tinnitus patients."

22. Clinical trial

23. Inflammation focus

"In recent years, inflammation in the body has become a major focus of researchers investigating a long list of conditions from arthritis to heart disease, diabetes, and even cancer. Such research tends to point to the host immune response creating inflammation as part of our defence process against a wide range of factors."

24. Diabetes mellitus and the risk of dementia

"During the follow-up, 126 patients became demented, of whom 89 had AD. Diabetes mellitus almost doubled the risk of dementia (relative risk [RR] 1.9 [1.3 to 2.8]) and AD (RR 1.9 [1.2 to 3.1]). Patients treated with insulin were at highest risk of dementia (RR 4.3 [1.7 to 10.5])."

25. Inflammation as a central mechanism in Alzheimer's disease

"The mechanism of neuronal insulin resistance appears to be similar with Ab oligomers inducing microglial activation, which in turn release numerous pro-inflammatory cytokines, including TNF-a [275]. Although activation of microglia by Ab is an adaptive physiological response to reducing Ab burden through phagocytosis, chronic inflammation leads to exacerbated AD pathology and metabolic abnormalities, which in turn further exacerbate pathogenesis. These data are providing evidence for links between molecular pathways and biochemical abnormalities associated with inflammatory mechanisms shared between AD and DM."

26. Increased risk of dementia after distal radius, hip, and spine fractures

"Distal radius, hip, and spine fractures increase the risk of dementia. Several plausible factors, including predisposition to balance problems, inflammatory responses accompanying fractures, and treatment-related complications, may influence the high risk of dementia in fracture patients."

27. Increased Risk of Dementia in Patients with Craniofacial Trauma: A Nationwide Population-Based Cohort Study

"Facial bone fracture (standardized incidence ratio, 1.58; 95% confidence interval, 1.25-2.00) was shown to be associated with an increased dementia risk compared with the general population."

28. Dementia risk after traumatic brain injury vs nonbrain trauma: the role of age and severity

"A total of 51,799 patients with trauma (31.5%) had TBI. Of these, 4361 (8.4%) developed dementia compared with 6610 patients with NTT (5.9%) (P < .001). We found that TBI was associated with increased dementia risk (hazard ratio [HR], 1.46; 95% CI, 1.41-1.52; P < .001)."

29. The use of melatonin in Alzheimer's disease

"About 45% of Alzheimer's disease (AD) patients have disruptions in their sleep and sundowning agitation. Since melatonin secretion is greatly inhibited in AD patients we have used melatonin to treat sleep disorders in AD patients since 1995. In a first study [21] we reported, in 7 out of 10 dementia patients treated with melatonin (3 mg p.o. at bed time), a decreased sundowning. In a second study [22] we examined 14 AD patients who received 9 mg melatonin daily for 22 to 35 months, observing a significant improvement of sleep quality with stabilization of behavioral and cognitive parameters. In a third study [23] we reported two monozygotic twins with AD and similar cognitive impairment, one of them receiving 6 mg melatonin at bedtime daily for 3 years. Melatonin treatment improved sleep quality and suppressed sundowning. We now report the effect of melatonin (4-month-long treatment with 6 mg/day) in 45 AD patients with sleep disturbances. Melatonin improved sleep and suppressed sundowning, an effect seen regardless of the concomitant medication employed to treat cognitive or behavioral signs of AD. Melatonin treatment seems to constitute a selection therapy to ameliorate sundowning and to slow evolution of cognitive impairment in AD patients." 30. Melatonin treatment stabilizes chronobiologic and cognitive symptoms in Alzheimer's disease

"Clinically, the patients exhibited lack of progression of the cognitive and behavioral signs of the disease during the time they received melatonin. Sundowning was no longer detectable in 12 patients and persisted, although attenuated, in 2 patients. CONCLUSION. The results suggest that melatonin can be useful for treatment of Alzheimer's disease." 31. The Therapeutic Potential of Melatonin: A Review of the Science

"some studies have demonstrated improvements in sleep disturbances and "sundowningâ€se in patients with Alzheimer's disease."

32. Human melatonin during continuous magnetic field exposure

"We conclude that the intermittent and continuous exposure conditions used in our laboratory to date are not effective in altering nocturnal blood levels of melatonin in human volunteers." 33. Melatonin

"Melatonin regulates the sleep/wake cycle, other circadian and seasonal rhythms, and acts as an immunostimulator and cytoprotective agent. Findings are encouraging to use melatonin as a sleep promoter and in preventing progression of neurodegenerative diseases."

34. The effects of pulsing magnetic fields on pineal melatonin synthesis in a teleost fish (brook trout, Salvelinus fontinalis)

"Fields were generated by Helmholtz coils (maximum flux density 40 microT, frequency 1 Hz, 200 ms on, 800 ms off). Melatonin concentrations were estimated by a specific

radioimmunoassay. MF exposure significantly increased night-time pineal (P < 0.001) and serum (P < 0.01) melatonin levels, as compared with the controls."