National Aeronautics and Space Administration

Health, Medicine and Biotechnology

Noninvasive Therapy for Cartilage Regeneration

Magnetotherapy can restore damaged joints

Innovators at NASA Johnson Space Center researching time-variance magnetic field (TVMF) therapies have developed a pulsed electromagnetic field (PEMF) device that can alleviate cartilage degradation in synovial joints by promoting the growth of new cartilage. Joint disorders, whether induced by rheumatism, joint dysplasia, trauma, or surgery, often degrade cartilage and result in intense patient pain. Noninvasive and painless regeneration of a patient's own tissue offers fewer side-effects than surgical joint replacement or tissue engineering procedures. The PEMF device could simply be wrapped around synovial joints where cartilage-degrading inflammation is located. The "Electromagnetic Time-Variance Magnetic Fields (TVMF) to generate, and re-grow Cartilage Cells by a Noninvasive Method" is at technology readiness level (TRL) 5 (which means component and/or breadboard validation has occurred in a relevant environment) and the related patent is now available for your company to license for development into a commercial product, including NASA-owned U.S. patents available for licensing.

BENEFITS

- Non-invasive: PEMF therapy requires no surgery or invasive procedure
- Regenerative: PEMF therapy relies on upregulation of genetic factors to promote growth and restoration of compromised cartilage
- Potential for FDA approval: PEMF therapeutic devices have been approved by the FDA for use in the stimulation of bone regrowth in artificial joint disunions

technology solution

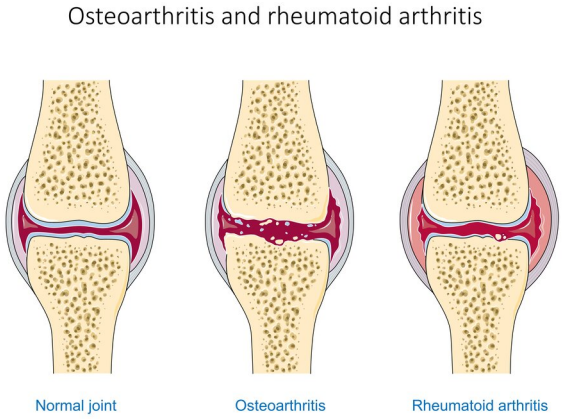
THE TECHNOLOGY

Research has shown that exposure of mammalian cartilage and bone tissue to tuned magnetic fields modifies genetic regulation at a cellular level. PEMF therapy relies on modulation and resonance of weak metals (ions) such as Ca2+, K+, Li+, and Mg2+ which can be made to move at the sub-cellular level when exposed to magnetic flux. This NASA technology is a device and method for modifying genetic regulation of cartilage and bone in response to PEMF therapy and may serve as the basis for development of novel therapies for cartilage diseases.

In initial studies, cultured human chondrocyte cells (HCH) from patients with early-stage osteoarthritis were exposed to PEMF stimulation using a variety of tuned electro-magnetic pulse characteristics such as flux magnitude, slew rates, rise and fall times, frequency, wavelength, and duty cycle. Waveforms used in testing were monophasic, bi-phasic, square, sinusoidal, and triangular in nature. Frequencies were generally low, ranging from 6-500 Hz, and the waveforms used high rising and falling slew rates on the order of Tesla/sec, promoting pulses or bursts.

Cellular catabolic and anabolic gene expression analyses comprised of fold-change (in expression) were accomplished by a survey of 47,000 human genes using an AFFYMETRIX® Gene Array. Results show that variation of waveform used in PEMF therapies, independent of flux intensity, influences genetic regulation of HCH from patients with early-stage osteoarthritis.

Please note that NASA does not manufacture products itself for commercial sale.



Shown is a comparison of healthy and inflamed synovial joints.

APPLICATIONS

The technology has several potential applications:

- Medicine: treatment of cartilage degenerative joint disorders in patients resulting from rheumatism, trauma, or surgery

PUBLICATIONS

Patent No: 8,795,147; 9,896,681; 10,724,030

More Information

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Agency Licensing Concierge

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