CAN CARTILAGE & NERVE BE REGENERATED??

RESEARCH SAYS YES!!!!

J Biomed Opt. 2011 Aug;16(8):080902. doi: 10.1117/1.3614565.

Laser-induced regeneration of cartilage.

Sobol E[1], Shekhter A, Guller A, Baum O, Baskov A.
Author information

Abstract

Laser radiation provides a means to control the fields of temperature and thermo mechanical stress, mass transfer, and modification of fine structure of the cartilage matrix. The aim of this outlook paper is to review physical and biological aspects of laser-induced regeneration of cartilage and to discuss the possibilities and prospects of its clinical applications. The problems and the pathways of tissue regeneration, the types and features of cartilage will be introduced first. Then we will review various actual and prospective approaches for cartilage repair; consider possible mechanisms of laser-induced regeneration. Finally, we present the results in laser regeneration of joints and spine disks cartilages and discuss some future applications of lasers in regenerative medicine.

Studies on Cold Laser Therapy and its Effects on Cartilage Regeneration

By **Dr Schnee** · July 12, 2010 · Filed in **Cold Laser Therapy, Osteoarthritis**

Over the years, several studies have been performed to determine the effects of cold laser therapy on cartilage regeneration.

One study took a cartilage sample from the right knee of a 19 year old patient. Chondrocytes (cartilage cells) were isolated and suspended for cultivation, and cultures were incubated for 10 days. The cultures were then separated into 4 groups. The first three groups of cultures received cold laser treatments for 10 minutes for five consecutive days. Each culture had different laser parameters assigned to it. Group 4 was the control group and did not receive any treatments. The Groups that were treated with laser showed great results in terms of cell viability and higher levels of Calcium and alkaline phosphate as compared to the untreated group. This study concluded that laser therapy improved chondrocyte activity without causing any damage to the cell.

And in a separate study published in *Biotechnology* cold laser therapy was performed on holes drilled in mice's ears to determine if cartilage would grow back. Mice were chosen as the subject because the chondrocytes (cartilage cells) in mice's ears are similar to those in human cartilage. In the study, holes were drilled in both ears. The left ear was treated with cold laser therapy while the right ear was left untreated. The results indicated that after two days only the treated ear showed clear evidence of perichondrium (precursor to cartilage) while the untreated ear showed NONE. After four days the treated ear had significant ingrowth of perichondrium into the hole versus the control group

were there was only an active perichondrium zone. Macroscopical and histological examinations revealed that cold laser therapy had a direct effect on cartilage regeneration.

Cartilage Regeneration Cold Laser Clinical Studies

The following is a summary of some of the clinical studies that were conducted using cold laser to treat cartilage regeneration. These studies are presented here to demonstrate the wide uses of a cold lasers in the treatment of different medical conditions.

Histological and clinical responses of articular cartilage to low-level laser therapy: Experimental study

I. Ruiz Calatrava1 , J. M. Santisteban Valenzuela1, R. J. GÃ³mez-Villamandos1, J. I. Redondo1, J. C. GÃ³mez-Villamandos1 and I. Avila Jurado1 (1) Department of Veterinary Clinical Pathology-Surgery, Faculty of Veterinary Medicine, University of Cordoba, Avda. Medina Azahara, 9, 14005 CÃ³rdoba, Spain

Received: 30 July 1996 Revised: 18 September 1996 Accepted: 20 November 1996

This study was carried out to evaluate the effects of low-level laser irradiation on experimental lesions of articular cartilage. A standard lesion was practiced on the femoral trochlea of both hind-limbs of 20 clinically normal Californian rabbits. These animals were divided into two groups of 10 individuals each, depending on the laser equipment used for treatment.

One group was treated with He-Ne laser (8 J cm-2, 632.8 nm wavelength) and the other with infra-red (IR) laser (8 J cm-2, 904 nm wavelength). In both groups, five points of irradiation to the right limb alone were irradiated per session for a total of 13 sessions, applied with an interval of 24 h between sessions. These points were the following: left and right femoral epicondyles, left and right tibial condyles and the centre of articulation. The distance between these points was approximately 1 cm.

The untreated left limb was left as a control. During treatment, extension angle and periarticular thickness were considered. At the end of the treatment, samples were collected for histopathologi-cal study and stained with: Haematoxylin-Eosin, PAS and Done. The

results show a statistically higher anti-inflammatory capacity of the IR laser ($p < 0.0001$). The functional recovery was statistically similar for both treatments ($p < 0.176$). Histological study showed, at the end of the treatment, hyaline cartilage in the IR group, fibrocartilage in the He-Ne group and granulation tissue in the control limbs. Clinical and histological results indicated that this laser treatment had a clear anti-inflammatory effect that provided a fast recuperation and regeneration of the articular cartilage.

"LLLT triggers biostimulative-regenerative processes inside the cell and subsequently causes revitalisation of the tissue as well. Second effect of LLLT refers to the vasodilatation and neovascularisation of local blood and lymph vessels, thus causing a better removal of waste products and, on the other hand, improved oxygenation and nutrition of damaged tissue. Analgesic and anti-inflammatory effects of LLLT are also significant when irradiating certain dermatological changes."

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The Groups that were treated with laser showed great results in terms of cell viability and higher levels of Calcium and alkaline phosphate as compared to the untreated group. This study concluded that laser therapy improved chondrocyte activity without causing any damage to the cell.

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the study, holes were drilled in both ears. The left ear was treated with cold laser therapy while the right ear was left untreated. The results indicated that after two days only the treated ear showed clear evidence of perichondrium (precursor to cartilage) while the untreated ear showed NONE. After four days the treated ear had significant ingrowth of perichondrium into the hole versus the control group were there was only an active perichondrium zone.

Macroscopical and histological examinations revealed that cold laser therapy had a direct effect on cartilage regeneration.

Many patients who were diagnosed with 'bone on bone' knee pain, and osteoarthritis of the knee have turned to Cold Laser Therapy with regular in-home treatment, which has helped them experience knee pain relief so that they could avoid knee surgery.

1.Biostimulation Of Human Chondrocytes With Ga-Al-As Diode Laser: 'In Vitro' Research. Morrone G, Guzzardella G A, Tigani D Et Al. Lasers Surg Med. 1997;21(5):480-4.

2. THE INFLUENCE OF LOW LEVEL INFRA RED LASER THERAPY ON THE REGENERATION OF CARTILAGE TISSUE P.Lievens , Ph.Van Der Veen. Biotechnology. 2000; 28(2):193-201.

Cold Laser Research on Arthritis and Cartilage Issues

Here are just a handful of additional studies that show how effective cold laser treatment is for relief from knee pain and Arthritis:

There are over 35 years of worldwide clinical success, 2,500 published papers and 120 randomized, controlled trials for cold lasers. It is the only therapeutic modality with a cumulative effect on cells and tissues. Both NASA and the US Defense Advanced Research Projects Agency have engaged in cold laser therapy research over the last decade, with noteworthy success.

The Effect of Low Power Laser Therapy (Cold Laser) on Osteoarthritis of the Knee

Basirnia A., Sadeghipoor G., Esmaeeli Djavid G. et al. Radiol Med (Torino).1998 April; 95 (4):303-9.

...We achieved **significant improvement in** ***pain relief and quality of life in 70% of patients.***

Positive Outcomes for Infrared diode laser in low reactive-level laser therapy (cold laser) for knee osteoarthritis.

M.A. Trelles, J.Rigau, P. Sala, G. Calderhead, T. Ohshiro. Laser Therapy, (1991): 3(4): 149-153.

82% reported significant removal of pain and recovery of joint mobility. Cold Laser Therapy is

concluded to be a safe effective and noninvasive alternative to conventional surgical and medical treatment modalities for DJD patients.

The Influence Of Low Level Infra Red Laser Therapy On The Regeneration Of Cartilage Tissue.

P. Lievens, Ph. Van der Veen.Abstract from Laser Florence 2002. Laser in Medical Science. 2002:17(4).

This study concerns the influence of Laser treatment on the regeneration process of cartilage tissue. There is no need saying that the regeneration of cartilage tissue is a very big problem in rheumatic diseases for example. The lack of blood supply is one of the most important factors involved. *Lots of previous publications give us proof of the regeneration capacities of Laser Therapy.* In this study we have chosen to experiment on cartilage tissue of the ear of mice....Microscopic as well as histological evaluations were performed on the cartilage regeneration of both ears... *After the second day, only in the irradiated group there is a clear activation of the perichondrium (the connective tissue surrounding cartilage).*

Beneficial Effects of Laser Therapy in the early stages of Rheumatoid Arthritis onset

Ailioaie C, Lupusoru-Ailioaie LM. Laser Therapy (1991) 11(2); 9-87

The purpose of this study was to determine the effects of laser therapy in pain reduction and /or recovery of patients at the onset of Rheumatoid Arthritis, comparatively with the traditional non-steroidal anti-inflammatory drugs (NSAIDS). Group 1 received laser therapy, Group 2 received placebo laser therapy, Group 3 was treated with only NSAIDS....*The overall efficacy rate in these studies was **86% in the first group (who just had laser)***, 50% in the placebo group, and 40% in the NSAIDS treated group. **After 4 months of treatment,** *our investigations showed the laser therapy group promoted the restoration of function, relieved pain and limited the complications of Rheumatoid Arthritis.*

Improvement of Pain and disability in elderly patients with degenerative osteoarthritis of the knee treated with low power light therapy (cold laser therapy)

Stelian J, Gil I , Beni-Habot, Rosenthal M, Abramovici I, Kutok N, Khalil A. Journal American Geriatric Society. (January 1992) 40 (1); 23-26.

Low power light therapy (Cold laser therapy) is effective in relieving pain and disability in degenerative osteoarthritis of the knee.

Cold Lasers, Electrical Stimulation Curb Knee Pain

Boggs, Will MD. BMC Musculoskeletal Disorders. (June 22, 2007).

People with knee pain caused by osteoarthritis may find relief with... electrical nerve stimulation, (and) low-level laser therapy (cold lasers), research shows.

...Electrical stimulation and low-level laser therapy have fewer and less severe side-effects than NSAIDS, and unlike oral drugs they seem to... maintain the positive effect for some weeks after treatment has stopped...

Dr. Bjordal, MD said, "In our opinion, there is currently more short-term potential in refining these safe treatment methods for osteoarthritis than there are for drugs."

Laser Therapy More Effective than Medication?

...From the findings of a recent Norwegian Health Technology Assessment Report, laser therapy was given the potential of becoming at least twice as effective as NSAIDS(non-steroidal anti-inflammatory drugs), if applied with optimal dose and energy... Although the number of laser trials is still smaller than for NSAIDS, ***the unequivocal scientific findings so far, has earned cold laser therapy a top spot in levels of evidence and treatment recommendations for knee osteoarthritis issued by the Norwegian Drug Agency.***

Non-Drug Alternative for the Management of Chronic Pain

Chow RT, David MA, Armati PJ. 830nm laser irradiation induces varicosity formation, reduces mitochondrial membrane potential and blocks fast axonal flow in small and medium diameter rat dorsal root ganglion neurons: implications for the analgesic effects of 830nm laser: J Peripher Nerv Syst. 2007 Mar; 12(1):28-39.

Most dramatically and recently, Australian researchers have identified a direct effect on the flow of cellular materials down the long axon that makes up the "wiring" of nerve cells. Researchers have discovered that laser-induced neural blockade is a consequence of such changes and provides a mechanism for... laser induced pain relief. The application of low level laser therapy for chronic pain may provide a non-drug alternative for the management of chronic pain.

Breakthrough in the Relief of Chronic Pain Without Drugs!

Goepp, Julius MD. Life Extension. October 2008: 63-70.

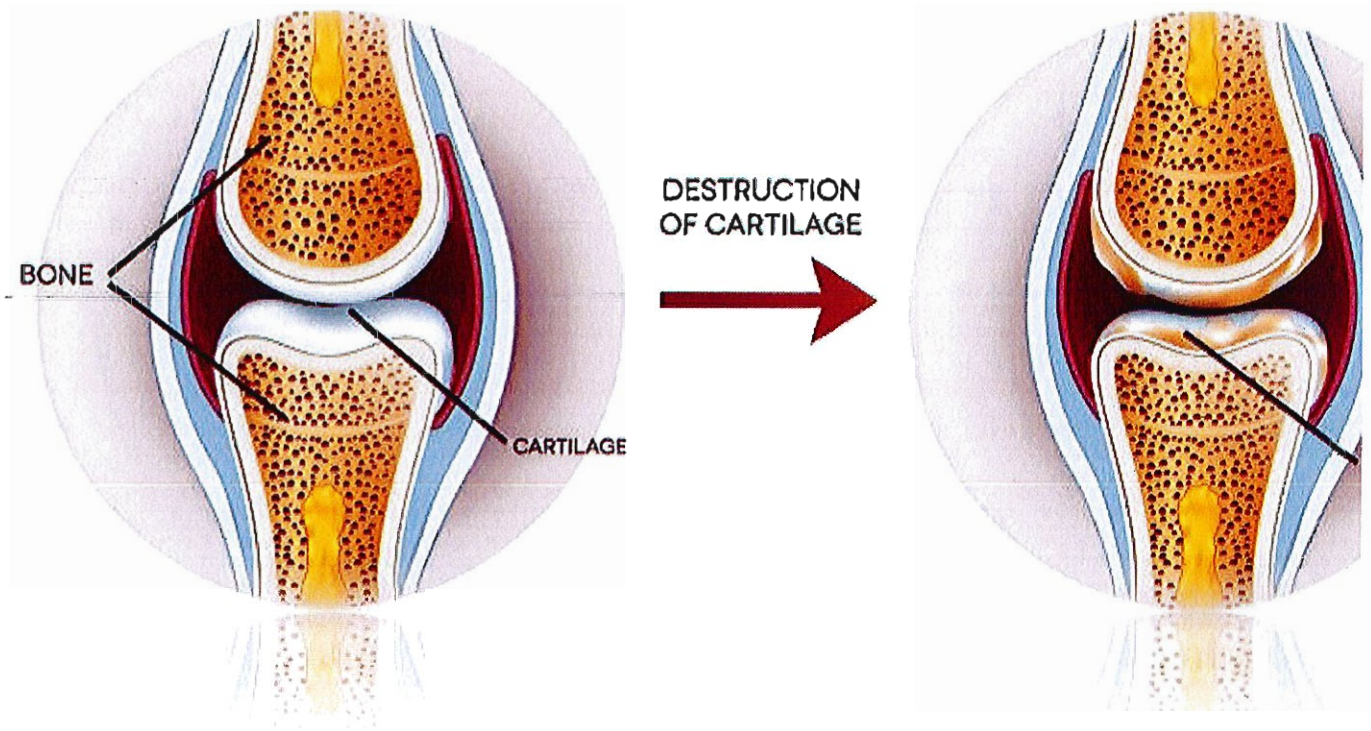
Dr. Norquist discusses his clinical outcomes for patients that received low-level laser treatments. *"Out of 300 patients more than 90% have reported total pain relief. And more than half the others have experienced at least partial relief of their pain after 10 full treatments. Only about 2-3% of patients have truly had no beneficial effects."*

Cold Laser Research for Knee Pain

These are overwhelmingly positive results from various Cold Laser Therapy Studies on the Treatment of Knee Pain. Knee pain doctors continue to use Cold Laser Therapy to Relieve Knee Pain with great success. Many individuals report getting their own Scalar Wave Laser and using it at home to accomplish similar or better results due to the ease and convenience of getting more cold laser therapy treatments more often and for a longer time period. Thus producing superior results than time limited studies.

HOW PEMFS STIMULATE REGROWTH OF CARTILAGE

OSTEOARTHRI



Research has been conducted on how **PEMFs stimulate regrowth of cartilage** to reduce the number of knee replacement surgeries.

The regrowth of cartilage is possible, however, joint cartilage is unable to regrow on its own. Is it possible that this natural shock absorber could be stimulated to grow again with the consistent use of PEMF therapy?

This article will take a look at the breakdown of cartilage in areas of the knees and hips, and we'll delve into how PEMFs work to stimulate the regrowth of this cartilage as made evident through research of medical professionals.

PEMFS STIMULATE REGROWTH OF CARTILAGE AND MARROW

The growth of cartilage isn't just about the cartilage. The growth all starts with the stimulation of bone marrow as well.

Studies conducted using PEMFs for the purpose of studying the growth rate of articular cartilage. This is the cartilage that covers the end of your bones.

Articular cartilage prevents your bones from rubbing together. Should this cartilage disappear it can give the bones too much space to rub together, causing damage.

This is the type of cartilage that cannot regrow on its own. During the process of therapy with PEMFs, bone growth may also occur.

This is good news for those who have experienced bone loss either before or after the cartilage has worn away. Damage to the cartilage can occur by way of a fall ,sports-related injury, or otherwise.

What happens in the process of a session using PEMF therapy that causes this *regrowth of cartilage* occur?

1. **Stimulation of the chondrocytes.** Chondrocytes are the only cells found in healthy cartilage, and these cells make up what is known as a cartilaginous matrix. The two main components that make up this matrix include collagen and proteoglycans. Collagen is a protein that aids in the binding ability of connective tissue, but it is also what we call a "structural protein". This protein is found in the skin, hair, and nails as well. With the stimulation of chondrocytes, it is easy to see how the regrowth of cartilage can occur.
2. **Stimulation of proteoglycans.** Proteoglycans work together with collagen to create the binding effects that are necessary to give the connective tissue strength. This is how tissues, muscles, joints, and even bone get their elasticity, strength, and serve their own protective purpose. Cartilage does not contain blood vessels or nerves. It is for this reason that any regrowth of cartilage occurs slowly. This is another reason why PEMFs are needed to stimulate the regrowth of cartilage.

Using PEMF therapy consistently will improve blood flow, and thus it can cause the healing of the surrounding tissues to occur.

When cartilage wears down, and there is a lack of chondrocytes as well as proteoglycans, there is also a progression of disease. What diseases are caused by the severe degeneration of cartilage that is left untreated?

STIMULATE REGROWTH OF CARTILAGE AND PREVENT FURTHER DEGENERATIVE DISEASE

This month we have touched on the painful condition of osteoarthritis (OA), a common type of arthritis among aged adults.

This is one of the primary diseases that is brought on by the destruction of cartilage. OA generally shows up in the knees and hips first before it shows up anywhere else.

This means that cartilage wears away, and can cause the ends of the bones to rub together.

Bursitis may also occur when cartilage has become worn down. This can cause the bursa sacs to become inflamed. These tiny sacs contain synovial fluid. This is the fluid that aids in lubricating the joints.

The cartilage itself can also become inflamed throughout, leading to costochondritis. This condition causes inflammation in the ribs, and it is also common among lupus patients around the sternum.

Regardless of the condition, PEMF therapy can accelerate the growth of cartilage. When the regrowth of cartilage occurs it may reduce or eliminate the pain over time.

Reducing pain and inflammation is always the first desire of someone who suffers from these degenerative conditions, but overall, the hope is that the cartilage will be repaired and stronger than it was prior.

Cartilage is important regardless of age because it protects the bones. Once the cartilage begins to wear down it can interfere with the life of an individual.

Those who hope to eliminate pain and increase mobility will want to begin using PEMF therapy on a consistent basis.

PEMFs can begin to regrow the cartilage as well as aid with increasing range of motion. Have you been diagnosed with osteoarthritis?

Are you experiencing chronic joint pain, stiffness, or perhaps you feel inflammation in your lower extremities. PEMF therapy can be beneficial for you if you use it on a consistent basis.

Lasers Med Sci. 2018 Sep 27. doi: 10.1007/s10103-018-2620-8. [Epub ahead of print]

Photobiomodulation with single and combination laser wavelengths on bone marrow mesenchymal stem cells: proliferation and differentiation to bone or cartilage.

Fekrazad R[1,2], Asefi S[3], Eslaminejad MB[4], Taghiar L[4], Bordbar S[4], Hamblin MR[5,6,7].
Author information

Abstract

Tissue engineering aims to take advantage of the ability of undifferentiated stem cells to differentiate into multiple cell types to repairdamaged tissue. Photobiomodulation uses either lasers or light-emitting diodes to promote stem cell proliferation and differentiation. The present study aimed to investigate single and dual combinations of laser wavelengths on mesenchymal stem cells (MSCs). MSCs were derived from rabbit iliac bone marrow. One control and eight laser irradiated groups were designated as Infrared (IR, 810 nm), Red (R, 660 nm), Green (G, 532 nm), Blue (B, 485 nm), IR-R, IR-B, R-G, and B-G. Irradiation was repeated daily for 21 days and cell proliferation, osseous, or cartilaginous differentiation was then measured. RT-PCR biomarkers were SOX9, aggrecan, COL 2, and COL 10 expression for cartilage and ALP, COL 1, and osteocalcin expression for bone. Cellular proliferation was increased in all irradiated groups except G. All cartilage markers were significantly increased by IR and IR-B except COL 10 which was suppressed by IR-B combination. ALP expression was highest in R and IR groups during osseous differentiation. ALP was decreased by combinations of IR with B and with R, and also by G alone. R and B-G groups showed stimulated COL 1 expression; however, COL 1 was suppressed in IR-B, IR-R, and G groups. IR significantly increased osteocalcin expression, but in B, B-G, and G groups it was reduced. Cartilage differentiation was stimulated by IR and IR-B laser irradiation. The effects of single or combined laser irradiation were not clear-cut on osseous differentiation. Stimulatory effects on osteogenesis were seen for R and IR lasers, while G laser had inhibitory effects.

J Biomed Opt. 2017 Sep 1;22(9):91515. doi: 10.1117/1.JBO.22.9.091515.

Laser-induced micropore formation and modification of cartilage structure in osteoarthritis healing.

Sobol E[1], Baum O[2], Shekhter A[3], Wachsmann-Hogiu S[4], Shnirelman A[5], Alexandrovskaya Y[1], Sadovskyy I[6], Vinokur V[6].
Author information
Abstract

Pores are vital for functioning of avascular tissues. Laser-induced pores play an important role in the process of cartilage regeneration. The aim of any treatment for osteoarthritis is to repair hyaline-type cartilage. The aims of this study are to answer two questions: (1) How do laser-assisted pores affect the cartilaginous cells to synthesize hyaline cartilage (HC)? and (2) How can the size distribution of pores arising in the course of laser radiation be controlled? We have shown that in cartilage, the pores arise predominately near chondrocytes, which promote nutrition of cells and signal molecular transfer that activates regeneration of cartilage. In vivo laser treatment of damaged cartilage of miniature pig joints provides cellular transformation and formation of HC. We propose a simple model of pore formation in biopolymers that paves the way for going beyond the trial-and-error approach when choosing an optimal laser treatment regime. Our findings support the approach toward laser healing of osteoarthritis.

Tissue Eng Part B Rev. 2018 Apr;24(2):144-154. doi: 10.1089/ten.TEB.2017.0294. Epub 2017 Nov 17.

Pulsed Electromagnetic Fields and Tissue Engineering of the Joints.

Iwasa K[1], Reddi AH[1].
Author information
Abstract

BACKGROUND:

Bone and joint formation, maintenance, and regeneration are regulated by both chemical and physical signals. Among the physical signals there is an increasing realization of the role of pulsed electromagnetic fields (PEMF) in the treatment of nonunions of bone fractures. The discovery of the piezoelectric properties of bone by Fukada and Yasuda in 1953 in Japan established the foundation of this field. Pioneering research by Bassett and Brighton and their teams resulted in the approval by the Food and Drug Administration (FDA) of the use of PEMF in the treatment of fracture healing. Although PEMF has potential applications in joint regeneration in osteoarthritis (OA), this evolving field is still in its infancy and offers novel opportunities.

METHODS:

We have systematically reviewed the literature on the influence of PEMF in joints, including articular cartilage, tendons, and ligaments, of publications from 2000 to 2016.

CONCLUSIONS:

PEMF stimulated chondrocyte proliferation, differentiation, and extracellular matrix synthesis by release of anabolic morphogens such as bone morphogenetic proteins and anti-inflammatory cytokines by adenosine receptors $A2_A$ and A3 in both in vitro and in vivo investigations. It is noteworthy that in clinical translational investigations a beneficial effect was observed on improving function in OA knees. However, additional systematic studies on the mechanisms of action of PEMF on joints and tissues therein, articular cartilage, tendons, and ligaments are required.

KEYWORDS:

PEMF; articular cartilage; regeneration

Bioelectromagnetics. 2011 Oct;32(7):543-51. doi: 10.1002/bem.20663. Epub 2011 Mar 15.

Chondroprotective effects of pulsed electromagnetic fields on human cartilage explants.

Ongaro A[1], Pellati A, Masieri FF, Caruso A, Setti S, Cadossi R, Biscione R, Massari L, Fini M, De Mattei M.

Author information

Abstract

This study investigated the effects of pulsed electromagnetic fields (PEMFs) on proteoglycan (PG) metabolism of human articular cartilageexplants from patients with osteoarthritis (OA).

Human cartilage explants, recovered from lateral and medial femoral condyles, were classified according to the International Cartilage Repair Society (ICRS) and graded based on Outerbridge scores. Explants cultured in the absence and presence of IL-1β were treated with PEMF (1.5 mT, 75 Hz) or IGF-I alone or in combination for 1 and 7 days. PG synthesis and release were determined. Results showed that explants derived from lateral and medial condyles scored OA grades I and III, respectively. In OA grade I explants, after 7 days exposure, PEMF and IGF-I significantly increased (35) S-sulfate incorporation 49% and 53%, respectively, compared to control, and counteracted the inhibitory effect of IL 1β (0.01 ng/ml). The combined exposure to PEMF and IGF-I was additive in all conditions. Similar results were obtained in OA grade III cartilage explants. In conclusion, PEMF and IGF-I augment cartilage explant anabolic activities, increase PG synthesis, and counteract the catabolic activity of IL-1β in OA grades I and III. We hypothesize that both IGF-I and PEMF have chondroprotective effects on human articular cartilage, particularly in early stages of OA.

Int Orthop. 2011 Jan;35(1):143-8. doi: 10.1007/s00264-010-0994-8. Epub 2010 Mar 26.

Pulsed electromagnetic field therapy results in healing of full thickness articular cartilage defect.

Boopalan PR[1], Arumugam S, Livingston A, Mohanty M, Chittaranjan S.

Author information
Abstract

This study aimed to determine the efficacy of PEMF (pulsed electromagnetic field) treatment in experimental osteochondral defect healing in a rabbit model. The study was conducted on 12 New Zealand white rabbits. Six rabbits formed the study group and six rabbits the control group. The right knee joints of all 12 animals were exposed and a 3.5-mm diameter osteochondral defect was created in the trochlear groove. The defect was filled with calcium phosphate scaffold. Six animals from the study group were given PEMF of one hour duration once a day for six weeks with set parameters for frequency of 1 Hz, voltage 20 V, sine wave and current ±30 mA. At six weeks the animals were sacrificed and histological evaluation was done using H&E, Safranin O, Maissons trichrome staining and immunohistochemistry for type 2 collagen. The quality of the repair tissue was graded and compared between groups with the Wakitani histological grading scale and a statistical analysis was done. The total histological score was significantly better in the study group ($p = 0.002$) with regeneration similar to adjacent normal hyaline cartilage. Immunohistochemistry for collagen type II was positive in the study group. PEMF stimulation of osteochondral defects with calcium phosphate scaffold is effective in hyaline cartilage formation. PEMF is a non-invasive and cost effective adjuvant treatment with salvage procedures such as abrasion chondroplasty and subchondral drilling.

Osteoarthritis Cartilage. 2007 Feb;15(2):163-8. Epub 2006 Aug 14.

Proteoglycan synthesis in bovine articular cartilage explants exposed to different low-frequency low-energy pulsed electromagnetic fields.

De Mattei M[1], Fini M, Setti S, Ongaro A, Gemmati D, Stabellini G, Pellati A, Caruso A.
Author information
Abstract

OBJECTIVE:

To investigate the role of pulsed electromagnetic field (PEMF) exposure parameters (exposure length, magnetic field peak amplitude, pulse frequency) in the regulation of proteoglycan (PG) synthesis of bovine articular cartilage explants.

METHODS:

Bovine articular cartilage explants were exposed to a PEMF (75 Hz; 2 mT) for different time periods: 1, 4, 9, 24 h. Then, cartilageexplants were exposed for 24 h to PEMFs of different magnetic field peak amplitudes (0.5, 1, 1.5, 2 mT) and different frequencies (2, 37, 75, 110 Hz). PG synthesis of control and exposed explants was determined by Na2-35SO4 incorporation.

RESULTS:

PEMF exposure significantly increased PG synthesis ranging from 12% at 4 h to 17% at 24 h of exposure. At all the magnetic field peak amplitude values, a significant PG synthesis increase was measured in PEMF-exposed explants compared to controls, with maximal effect at 1.5 mT. No effect of pulse frequency was observed on PG synthesis stimulation.

CONCLUSIONS:

The results of this study show the range of exposure length, PEMF amplitude, pulse frequency which can stimulate cartilagePG synthesis, and suggest optimal exposure parameters which may be useful for cartilage repair in in vivo experiments and clinical application.

Arch Oral Biol. 1993 Jan;38(1):67-74.

Autoradiographic study of the effects of pulsed electromagnetic fields on bone and cartilage growth in juvenile rats.

Wilmot JJ[1], Chiego DJ Jr, Carlson DS, Hanks CT, Moskwa JJ.
Author information

Abstract

Application of pulsed electromagnetic fields (PEMF) has been used in growth and repair of non-union bone fractures. The similarities between the fibrocartilage callus in non-union bone fractures and the secondary cartilage in the mandibular condyle, both histologically and functionally, lead naturally to study the effects of PEMFs on growth in the condyle. The purposes of this study were: (1) to describe the effects of PEMFs on the growth of the condyle using autoradiography, [3H]-proline and [3H]-thymidine, and (2) to differentiate between the effects of the magnetic and electrical components of the field. Male pre-adolescent Sprague-Dawley rats (28 days old) were divided into three experimental groups of five animals each: (1) PEMF-magnetic (M), (2) PEMF-electrical (E) and (3) control, and were examined at three different times-3, 7 and 14 days of exposure. Each animal was exposed to the field for 8 h per day. Histological coronal sections were processed for quantitative autoradiography to determine the mitotic activity of the condylar cartilage and the amount of bone deposition. The PEMF (magnetic or electrical) had statistically significant effects only on the thickness of the articular zone, with the thickness in the PEMF-M group being the most reduced. Length of treatment was associated with predictable significant changes in the thickness of the condylar cartilage zones and the amount of bone deposition.