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Applications of Pulsed Electromagnetic Field Therapy in Skeletal-Muscle System: An Integrative Review

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ABSTRACT
Background: The Pulsed Electromagnetic Field (PEMF) technology has attracted increasing interest since consistent evidence of its therapeutic properties has been demonstrated to treat musculoskeletal conditions. However, this technology is not new, and has already been used in different experimental models and clinical studies for the treatment of tendinopathies, osteoarthritis, increased cell proliferation, bone consolidation, among others. **Methods:** In this work, we carried out an integrative review of clinical and experimental studies published in the last twenty years, on the available scientific evidence that demonstrate the effects of PEMF in different applications for health treatments. Five databases including Medline, Pubmed Central, Scopus, Lilacs and PEDro were searched for studies from 2001 to September 2022. The results were analyzed by the team of researchers and clinical professionals to assure methodological quality of the studies for the elaboration of the theoretical review on the effects of electromagnetic field stimulation on skeletal muscles, tendon or bones. **Results:** Sixty-two studies were included in this review, presenting evidence of the biological effects of PEMF that can suggest it´s possible use to treat different disorders. **Conclusions:** Pulsed electromagnetic fields (PEMF) present relevant clinical and experimental evidence of beneficial effects in the treatment of several musculoskeletal inflammatory disorders, such as tendinopathies and osteoarthritis, in addition to the treatment of urinary incontinence and abdominal diastasis. PEMF can be considered as the evolution of electrical currents for the treatment of musculoskeletal disorders, mainly due to its better tolerance by patients.
Keywords: Tendinopahies; Osteoarthritis; PEMF; Pulsed electromagnetic field; Skeletal muscle; Urinary incontinence; Abdominal diastasis.

BACKGROUND

The original concept of electromagnetic induction was described by Faraday in 1831, one of the strongest contributions to the study of electromagnetism(1). His discoveries encompass the basic principles of electromagnetic induction, diamagnetism, and electrolysis(1). He is considered one of the most influential scientists of all time. Briefly, a coil of wire generates an intense alternating magnetic field, which consequently induces a secondary electrical current in the tissue base where it interacts with neurons(2). The Faraday-Neumann-Lenz law, or Faraday's law of induction, is one of the basic equations of electromagnetism. Mathematical expressions describe and predict how the magnetic field interacts with the electric field and, as a result, the interaction of these forces produces another force called the electromotive force: electromagnetic induction.

The Electromagnetic Wave is a very complex form of interaction, of interlace of the two, apparently distinct phenomena of electricity and magnetism that were studied as separate fields for decades. In 1819 Oersted said that electric charges in motion create magnetic effects. Theoretical models were created to explain the properties of magnets through the movement of electric charges, including the Earth's magnetic field. The theory of Maxwell was able to predicts that if an electric charge moves with a variable speed, oscillating or rotating, then it would create an electric field whose temporal variation is not constant, and consequently the magnetic field was not also constant.

One of the important differences between the well-known electrical currents used in health sciences for treatments, is that the wires propagate linearly from one electrode to the other, and the electromagnetic wave that propagates in 3 axes, or three-dimensionally, generating what we call an electromagnetic field. Theoretically, the electromagnetic field appears significantly more effective in recruiting muscle fibers and producing muscle contraction.

Figure 01 illustrate an electrical current, showing that hypothetically, the electrons move superficially in the skeletal muscles, in a linear fashion, from one pole to the other, that is, from one electrode to the other, according to polarity. We can observe that the skeletal muscle contraction produced by the current is not maximal. In fact, an electrical current capable of producing a maximum muscle contraction would certainly be harmful, or with a high probability of intercurrences such as an electrical burn. Furthermore, the feeling of an electric shock would certainly be unbearable for the patient.

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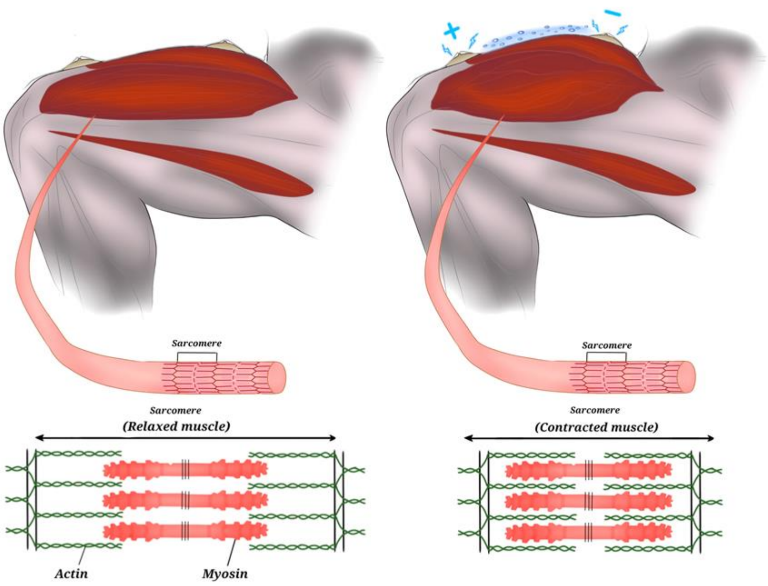

Figure 01: Schematic representation of the effects of electrical currents on skeletal muscle. The illustration shows the electric current acting more superficially on the musculature, causing a submaximal muscle contraction.

Figure 02 illustrate an application of Pulsed electromagnetic field, that potentially evolves the whole muscle, being able to recruit the muscle and to promote maximal muscle contraction. Besides, PEMF does not produce the sensation of electric shock, being significantly more bearable for the patient, especially if we consider elderly individuals.

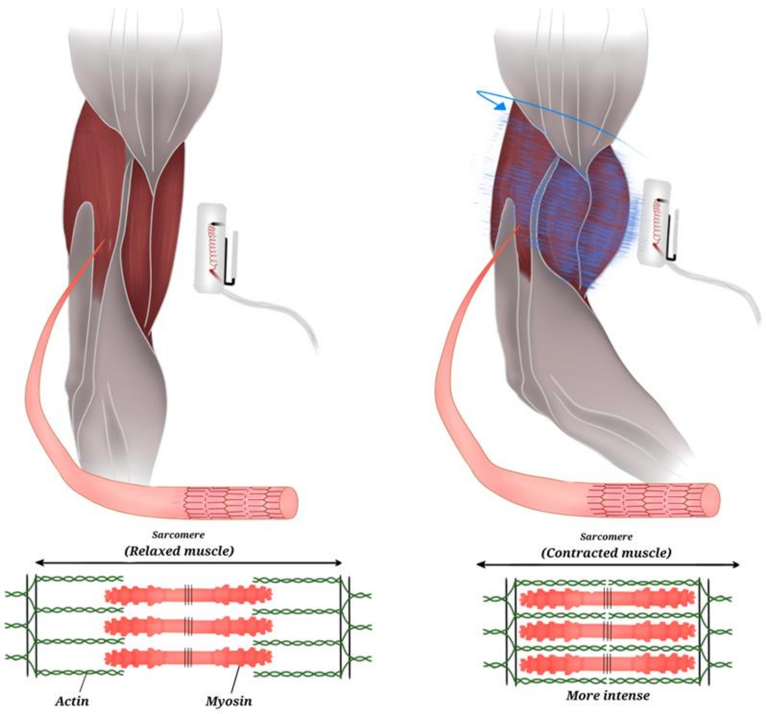

Figure 02: Schematic representation of the effects of PEMF on skeletal muscle contraction. The illustration shows the PEMF acting deeply on the muscle, due to its 3D effect, causing a supramaximal muscle contraction.

The pulsed electromagnetic field (PEMF) uses alternating magnetic fields, based on the law of electromagnetic induction, promotes electrical currents that depolarize the neuromuscular tissue may resulting in supramaximal contractions[3,4]. Motor neurons are activated due to their large diameter and therefore less resistance compared to other types of neurons. Since nociceptors are not activated, the application of magnetic stimulation is not painful[5]. This is an important point since the classic discomfort of therapeutic electrical currents does not exist with PEMF.

The new PEMF equipment normally comprises a circular coil located in the applicator, which is placed over the treatment area. Starting a treatment, an alternating electric current run into the circular coil and the alternations in the electric current induce rapidly changing magnetic waves which propagate into the underlying tissue, inducing consequently a secondary electric current that will depolarize the muscle-innervating motor neurons and induce muscle contractions.

Under normal conditions, the greatest amount of tension that could be developed and performed physiologically is called maximal voluntary contraction (MVC)[5]. It usually only lasts for a fraction of a second. Contractions with tension greater than MVC are defined as supramaximal contractions[6]. PEMF possesses the ability to generate sustained supramaximal contractions for several seconds, which significantly increases stress/workload, if muscle adaptation takes place. In supramaximal contraction, proteins are degraded, but amino acids are reused in the synthesis process at the expense of intense energy expenditure[7].

However, the evolution of research has demonstrated that besides the muscle stimulations, PEMF are able to interact with different structures of the locomotor system, including tendons, cartilage and bones. The purpose of the present work was to carry out a narrative review with a systematic methodology of bibliographic search, about the applications of PEMF technology in the musculoskeletal system.

Search Strategy

Five databases including Medline, Pubmed Central, Scopus, Lilacs and PEDro were searched for studies from 2001 to September 2022.

Keywords and MeSH terms were used and combined by Boolean operators as follows: (PEMF OR HIFEM AND Skeletal muscle OR muscle OR bone OR tendon; Pulsed Electromagnetic Field AND Skeletal muscle OR muscle OR bone OR tendon; The results were analyzed by the team of researchers and clinical professionals for the elaboration of the theoretical review on the effects of electromagnetic field stimulation on skeletal muscles, tendon or bones.

Pulsed Electromagnetic Field (PEMF) and Tendon Diseases

Tendinopathies are part of the so-called group of the most common musculoskeletal diseases in modern society. There are several causes, whether due to daily activities, work-related or even repetitive movements or overcharge in sports. Chronic pain in the tendons is relatively common, especially considering the Achilles, patellar and elbow tendons[8]. Tendinopathies are changes in the health of the tendon, which are generally frequent and difficult to treat, disabling professional and recreational athletes as well as ordinary people in their workplaces[9]. The high prevalence, along with the fact that they often become chronic, make these diseases a major socio-economic problem where medical interventions and therapies for rehabilitation are limited[10].

The PEMF technology has attracted increasing interest since consistent evidence of its therapeutic properties has been demonstrated to treat musculoskeletal conditions. Concerning on tendon disorders, some scientific studies have investigated the efficacy of PEMF in tendon healing. In vivo studies showed that PEMFs was able to improve tendon healing through a reduction of inflammation, improvement of mechanical properties and an induction of faster collagen alignment. Taken together, these results suggest a reparative role PEMFs in tendinopathies[11].

De Girolamo et al[12,13] demonstrated as cytokines (interleukin (IL)-6 and IL-10) and growth factor (TGF-β) release and up-regulation of tenogenic gene transcription (scleraxis and type I collagen) in response to PEMF. A dose-dependent response of human TCs to PEMFs (1.5 mT, 75Hz) was observed.

Rosso et al[14] also demonstrated with in vitro studies on human tendon cells an increased cell proliferation after PEMF stimulation. According to Randelli et al[15], the possibility of activating tendon healing through electromagnetic stimulation has become increasingly popular. However, the mechanisms of beneficial effects are not elucidated. The authors suggest the possibility of stem cells involvement in the healing process. The effects of electromagnetic fields were analyzed in human tendon stem cells isolated from patients undergoing surgeries and the treatment presented positive effects on stem cell marker expression, as treated cells maintained a higher expression of these markers during culturing.

Kamel et al[16] compared the effects of Pulsed Electromagnetic Field with traditional Ultrasound in the treatment of postnatal carpal tunnel syndrome in a randomized controlled clinical trial in egyptian women. In this study, one of the groups was treated with pulsed electromagnetic field, with nerve and tendon gliding exercises for the wrist, three times per week for four weeks. The second group was treated with pulsed ultrasound and wrist exercises. The authors evaluated pain level, sensory and motor distal latencies and conduction velocities of the median nerve, functional status scale and hand grip strength pre- and post-treatment. The authors observed a significant reduction of pain levels and sensory and motor distal latencies of the median nerve. Besides, they also observed an increase in sensory and motor conduction velocities of the median nerve as well as in the hand grip strength in both groups. However, a significant difference between the two groups in favor of pulsed electromagnetic field treatment was reported. The symptoms were alleviated in both groups, but significantly more effective for PEMF than for pulsed ultrasound, at least in treating postnatal carpal tunnel syndrome.

Tucker et al[17] showed that PEMF positively affected the biomechanical properties and tendon healing and does not alter joint function in a rat rotator cuff repair model (rotator cuff tendons). This is a very important study considering that Rotator cuff tears are common musculoskeletal injuries which often require surgical intervention and post-repair prognosis is poor, with surgical repairs that fail in up to 94% of cases.

Liu et al[18] studied the effects of PEMF on tenocytes and muscle cells to define the role of a commercially available PEMF on tenocytes and myoblasts growth and differentiation in vitro. The authors demonstrated that 2 weeks treatment of PEMF enhanced gene expressions of growth factors in human rotator cuff tenocytes under inflammatory conditions. PEMF significantly enhanced C2C12 myotube formation under normal and inflammatory conditions. This study suggest PEMF seems to have a positive activity inducing tenocyte gene expression and myoblast differentiation thus potentially serving as a non-surgical treatment to improve rotator cuff tendon lesions.

Huegel et al[19] demonstrated that PEMF improved the rotator cuff tendon-to bone healing. These findings suggest that PEMF can serve as an adjuvant therapy to improve rotator cuff tendinitis. In 2015, Osti et al[20] in a randomized clinical trial demonstrated that PEMF therapy is effective in reducing inflammation, swelling and pain after rotator cuff arthroscopic repair.

In rats, Gehwolf et al[21] recently demonstrated that the exposure to high energy PEMF treatment in inflamed condition affected different biological mechanisms such as extracellular matrix remodeling, inflammation and negative regulation of apoptosis.

Vinhas et al[22] investigated the modulatory effect of pulsed electromagnetic field (PEMF) on the inflammatory profile of human tendon-derived cells after stimulation with interleukin-1β. The PEMF technology was investigated varying the frequency, intensity (1.5, 4, or 5 mT), and duty-cycle (10% or 50%) in cell cutures of Human tendon cells. The authors reported that PEMF was effective in reducing IL-6 and TNF-α production besides the gene expression of TNFα, IL-6, IL-8, COX-2, and metaloproteinases MMP-1, MMP-2, and MMP-3. On the other hand, anti-inflammatory mediators IL-4, IL-10, and TIMP-1 expression were increased. The in vitro results reinforce the hypothesis of anti-inflammatory action of PEMF in tendon tissues.

Colombini et al,[23] investigated the anabolic and anti-inflammatory PEMF-mediated response on Tendon cells in an in vitro model of inflammation. Besides, the authors also investigated the possible role of Adenosine receptors on the anti-inflammatory effect of PEMF in tendon cells. They concluded that Adenosine receptors (A2AARs) have a role in the promotion of the Tendon cells anabolic/reparative response to PEMFs.

Recently, Dolkart et al[24] also studied the effects of the continuous pulsed electromagnetic feld (PEMF) on rotator cuff (RC) healing using a rat model. In their study, the authors hypothesized that PEMF application after rotator cuff detachment and repair could produce beneficial effects on biomechanical properties, tissue morphology and bone density. The authors concluded that PEMF was able to enhance early postoperative tendon-to-bone healing in an acute rat supraspinatus detachment and repair model besides an increased biomechanical elasticity and better collagen organization, suggesting an improvement of the rotator cuff healing.

Pulsed Electromagnetic Field (PEMF) and Joint Diseases

Osteoarthritis (OA) is a burden to the modern society. A common and disabling condition that represents a challenge to the public and private health systems representing significant socioeconomic costs and complex implications for the patients[25,26]. Osteoarthritis is highly prevalent in elderly population. According to Iwasa and Reddi[27], more than 30 million are currently affected with increasing tendencies.

Together with orthopaedical trauma, tendon and ligament lesions, ageing and increasing obesity in the world population, OA is becoming more prevalent, with worldwide estimates suggesting that 250 million suffers with this painful condition. According to the scientific literature, the majority of OA patients do not receive appropriate management therapies. Management therapy is characterized as mainly by rest, exercise and NSAID`s. However, moderate evidence for electrophysical agents, such as photobiomodulation[28-31] has been demonstrated.

The medical cost of osteoarthritis in developed countries has been estimated to account for between 1% and 2·5% of the gross internal product (GIP) with hip and knee joint replacements representing the major proportion of these costs. Besides the direct costs, the indirect costs represented by work loss and premature retirement are also substantial and frequently underestimated or even forgotten[32].

Pulsed Electromagnetic Field therapy has also been suggested as an alternative treatment for OA[33]. According to Shupak et al[34], PEMF promotes joint benefits based on basic principles of physics: Wolff's law, the piezoelectric properties of collagens, and the concept of streaming potentials. Although the effects of PEMF have previously been reported to increase morphogens and promote osteogenesis[35,36], the real therapeutic effects of PEMF on osteoarthritis still on debate.

Osteoarthritis is a whole joint disease, involving structural alterations in the hyaline articular cartilage, subchondral bone, ligaments, capsule, synovium, and periarticular muscles[37]. The complex pathogenesis of osteoarthritis involves mechanical, inflammatory, and metabolic factors, which ultimately lead to structural destruction and failure of the synovial joint. The disease is an active dynamic alteration arising from an imbalance between the repair and destruction of joint tissues, and not a passive degenerative disease or so-called wear-and-tear disease as commonly described. In this context the needing for cartilage stimulating therapies is highly necessary.

During the osteoarthritis process, cartilage composition changes and the cartilage loses its integrity[38]. Proliferating synoviocytes also release proinflammatory products which are accompanied by tissue hypertrophy and increased vascularity. In the subchondral bone, bone turnover is increased, and vascular invasion takes place, going from the subchondral bone, through the tidemark, and into the cartilage. One of the main goals of OA treatment is to regenerate a native articular cartilage, including a low friction coefficient.

Pulsed Electromagnetic Field (PEMF) and Cartilage

The use of PEMF as an adjunctive therapy for joint diseases is not exactly new. PEMF has been studied for at least 20 years for Muscle-skeletal and joint disorders. In 2005, the first clinical trial that we were able to identify[39] enrolled 83 patients in a placebo-controlled study. The authors reported that they were unable to demonstrate a beneficial symptomatic effect of PEMF in the treatment of knee OA in all patients. However, in patients younger than 65 years old, there were significant and beneficial effect of treatment related to stiffness.

Fini et al[40], studied the pulsed electromagnetic field stimulation on knee cartilage, subchondral and epyphiseal trabecular bone of aged Dunkin Hartley guinea pigs. PEMF stimulation significantly changed the progression of OA lesions in all examined knee areas, even in the presence of severe OA lesions.

van Bergen et al[41] published a clinical trial protocol consisting of prospective, double-blind, randomized, placebo-controlled trial (RCT) to be conducted in five centers throughout the Netherlands and Belgium. 68 patients woud be randomized to either active PEMF-treatment or sham-treatment for 60 days, four hours daily. However, only in 2016 the results of the Clinical Trial were published[42]. PEMF does not lead to a higher percentage of patients who resume sports or to earlier resumption of sports after arthroscopic debridement and microfracture of talar OCDs. Furthermore, no differences were found in bone repair between groups.

In 2013, Chen et al[43] studied the effects of electromagnetic fields on adipose-derived (ADSC) stem cells in a chondrogenic microenvironment in vitro. Interestingly, PEMF treatment increased mineralization of ADSC and enhanced chondrogenic differentiation of ADSCs cultured in a chondrogenic microenvironment. PEMF enhanced both osteogenesis and chondrogenesis under the same conditions.

Veronesi et al[44] demonstrated that that PEMF stimulation can be used as adjuvant therapy to preserve cartilage from detrimental effects of high inflammatory cytokine levels during OA. PEMFs were able to counteract the progression of OA acting on both cartilage cellularity and ECM in cartilage previously treated with IL1β. The experimental model consisted of culturing bovine cartilage explants with a high dose of interleukin 1β (IL1β, 50 ng/ml) at different experimental times (24 h, and 7 and 21 days). The effects of PEMFs (75 Hz, 1.5 mT) were evaluated in cartilage explants treated with IL1β or not (control), in terms of cartilage structure, cellularity and proteoglycans, glycosaminoglycans, collagen II and transforming growth factor β1 synthesis by using histology, histomorphometry and immunohistochemistry.

Bagnato et al[10] performed an important randomized, double-blinded and placebo-controlled clinical trial with sixty-six OA patients. In this study, patients with radiographic evidence of knee OA and persistent pain higher than 40 mm (VAS) were recruited. The clinical trial consisted of 1 month treatment in 60 knee OA patients. The primary outcome was the reduction in pain intensity and the secondary outcomes included quality of life assessment (SF-36 v2), pressure pain threshold (PPT) and changes in intake of NSAIDs/analgesics. The authors reported that PEMF was effective to reduce pain in knee OA patients and also improved pain threshold and physical functioning. Besides, twenty-six per cent of patients in the PEMF group stopped taking NSAIDs or any other analgesic drug, and no adverse events were detected.

Yang et al[45] investigated the efficacy of pulsed electromagnetic field (PEMF) treatment on cartilage and subchondral trabecular bone in knee osteoarthritis (OA) using and experimental model induced by low-dose monosodium iodoacetate in rats. The authors observed that PEMF treatment increased bone and cartilage formation, and decreased bone and cartilage resorption, suggesting that PEMF might become a potential biophysical treatment modality for osteoarthritis.

Zhou et al[46] investigated the effects of pulsed electromagnetic field on cartilage degeneration, and expression of mitogen-activated protein kinases (MAPKs) and matrix metalloproteinases (MMPs), in an experimental rat model of osteoarthritis induced by anterior cruciate ligament transection. The authors performed histological examination, enzyme-linked immunosorbent assay, quantitative real-time polymerase chain reaction, to assess cartilage degeneration, urine C-terminal cross-linking telopeptide of type II collagen (CTX-II), and mRNA expression of extracellular signal-regulated kinase (ERK), c-Jun N-terminal kinase (c-Jun), p38, and MMPs and the conclusions were that PEMF may regulate the catabolic factor, MMP13, and inhibit cartilage destruction, at least partially, by inhibiting MAPKs signaling pathway.

Recently Parate et al[47] demonstrated that PEMF stimulation was able to modulate paracrine function of mesenchymal stem cells (MSCs) for the enhancement and re-establishment of cartilage regeneration in states of cellular stress.

According to Varani et al[48], the application of PEMFs in tissue repair is indicated to improve the functional and mechanical properties of the engineered construct and to favor graft integration in bones. Besides, PEMF is indicated to control the local inflammatory response, and to foster tissue repair from both implanted and resident MSCs cells. Vinod et al[49] demonstrated in vitro that PEMF was able to induce chondrogenesis.

Yang et al[50] recently showed that PEMF attenuates structural and functional progression of OA through inhibition of TNF-α and IL-6 signaling. These results are significant since chondrocyte death is regulated by TNF-α and IL-6 signaling.

According to Li Y et al[51], PEMF treatment was proven to enhance the quality of engineered chondrogenic constructs in vitro and facilitate chondrogenesis and cartilage repair in vivo. Liu J et al[52] demonstrated that PEMF alleviated the degree of inflammation and degeneration of cartilage in rats with OA, based on the histopathological changes and decline of the expression of IL-1β and MMP-13. The authors suggest that PEMF could be a highly promising noninvasive strategy to slow down the progression of OA.

PEMF and Muscle Hypertrophy

According to Duncan et al[53], in an in vivo study carried out in a porcine experimental model, PEMF was capable of inducing hypertrophic muscle alterations after 2 weeks of treatment. The authors report an increase in muscle mass density of 20.56%. In the same study, an increase in muscle fiber density (hyperplasia) of 8.0% was observed. Mean individual muscle fiber size increased by 12.15% 2 weeks after treatment, while the control group showed no significant changes in fiber density or hyperplasia. The authors suggest that PEMF can be used for non-invasive induction of muscle growth.

The exact mechanism of muscular contraction by the electromagnetic field remains unknown. The classic hypothesis is that of depolarization of peripheral motor neurons, with release of acetylcholine in the myoneural plate. Acetylcholine binds to receptors on the membrane of skeletal muscle cells (Sodium Receptor Channels), changing the membrane voltage and inducing the opening of voltage-gated calcium channels, resulting in a massive influx of calcium and inducing muscle contraction. However, there are evidence that PEMF is able to stimulate at least two molecular mechanisms related to the expression of Voltage-dependent Calcium Channels and increase of intracellular calcium concentrations in bone tissue. However, the effect observed in bone cells may be repeating itself in muscle tissue, which would explain the greater effectiveness of PEMF in relation to electrical currents. This is because, the effect of muscle contraction, in fact, can be triggered by a direct change in voltage of the membrane of the skeletal muscle cell, leading to the opening of voltage-gated calcium channels and consequent muscle contraction, however without depending on neuronal depolarization, that is, a direct effect on the muscle. Obviously, this hypothesis would greatly reduce the muscle fatigue factor resulting from the inhibition of nerve transmission in the myoneural plate caused by acidification in this region.

Petecchia et al(54) also demonstrate increased expression of voltage-dependent calcium channels in cultured cells. If the effect is reproducible in skeletal musculature, an avenue of possibilities opens for the effective gain in force generation and muscular efficiency, both in sports and aesthetics.

PEMF and postpartum abdominal diastasis

During pregnancy, the abdominal muscles are stretched and separated extensively to accommodate the growing fetus. However, the abdominal muscles often do not fully return to their original position and may remain separated after delivery. In severe cases, the separation of muscles can exceed 2.7 cm, characterizing a condition of abdominal diastasis. Jacob and Rank(55) in a pilot study with 10 patients used the PEMF protocol twice a week for 30 minutes for 2 weeks. Patients were followed up 1, 3 and 6 months after the end of PEMF treatment.

Results obtained from magnetic resonance imaging showed an average fat reduction of 17% at one month and 20% after 3 months. The authors also reported a mean increase in muscle thickness of 20.5% after 1 month and 21.3% after 3 months. Especially, regarding the distance between the rectus abdominis muscles, a reduction of 16.7% in 01 month and 22.7% after 3 months. After six months, the authors report that 9 patients returned for evaluation, and showed, on average, a 17.6% fat reduction, a 21.7% increase in muscle, and a reduction in 23.2% of the distance between the abdominal muscles. The patients' weight did not change significantly. That study did not have a control group, but the initial results suggest a beneficial effect on fat reduction and muscle strengthening.

PEMF and Urinary Incontinence

Urinary incontinence (UI) is usually defined as the involuntary loss of urine. It is a chronic problem that negatively and significantly affects the quality of life(56). Urinary incontinence is classified as a) stress incontinence (SUI); b) urgent (IUU); c) Mixed (IUM).

The prevalence of urinary incontinence can vary between 25 and 45%, but can reach 69% in some populations, and the symptoms seem to worsen with advancing age, body mass index and some other factors(57-61). In general, the mechanism of urinary incontinence is often associated with failure of the pelvic floor muscle apparatus.

Recently, Samuels et al(62) carried out a study with 75 patients with urinary incontinence and muscle strengthening using the PEMF technology. Of all 75 patients, 61 showed significant improvement of 49.93% of symptoms after 6 weeks of treatment and 64.4% after 3 months. The authors concluded that the PEMF technology was able to induce a significant improvement in the symptoms of urinary incontinence, especially mixed. In the 06-month follow-up after treatment, an improvement in the patients' quality of life was observed in relation to the problem.

On this same topic, Elena et al(63) investigated the efficiency of PEMF technology compared to classical electrical stimulation. The study was carried out with 95 women in the postpartum period who complained of urinary incontinence. Symptomatic patients received treatment with PEMF or electrostimulation in 10 sessions with a frequency of 2 to 3 times a week (PEMF – 28 minutes/session) or on alternate days (electrostimulation). In this study, 50 patients were treated with PEMF, 25 were treated with electrostimulation and 20 were considered as a healthy control group for comparison purposes. The authors report that the PEMF technology was able to significantly improve the biometric indices of pelvic floor integrity and symptoms of urinary incontinence, and that such results are due to the strengthening of the pelvic floor musculature. Interestingly, the patients also reported less discomfort with the use of PEMF, when compared to the electric current.

CONCLUSION

Pulsed electromagnetic fields (PEMF) present relevant clinical and experimental evidence of beneficial effects in the treatment of several musculoskeletal inflammatory disorders, such as tendinopathies and osteoarthritis, in addition to the treatment of urinary incontinence and abdominal diastasis. The evidence found goes beyond the described muscle-building effects. Placebo-controlled randomized clinical trials are needed to improve the power of evidence of current data. However, PEMF can be considered as the evolution of electrical currents for the treatment of musculoskeletal disorders, mainly due to its better tolerance by patients.

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Critical reviewer of the selected studies. Rodrigo Alvaro B. Lopes-Martins – General Coordinator and Chief of the Research Group.

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