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Case Report

Beneficial Impact of the Diamagnetic Pump at the Gonadal Level, a Potential Tool to Avoid Doping in Young People and Better Performance. A Case Report

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Abstract

Patients: 1 man

Final Diagnosis: Functional hypogonadism in a young athlete treated with diamagnetic pump (CTU-20) therapy.

Symptoms: Failure to gain muscle mass and strength despite adequate training and nutrition.

Clinical Procedure: Twelve CTU-20 sessions (25 min each) applied to inguinoscrotal, testicular, and penile regions.

Specialty: Sports Medicine/Endocrinology/Regenerative Medicine.

Background: Pulsed Electromagnetic Field Therapy (PEMF) is a non-invasive modality that applies low-frequency magnetic fields to promote healing, alleviate pain, and improve health. It modulates cellular processes such as regeneration, anti-inflammatory responses, and circulation. A diamagnetic variant of PEMF focuses on exploiting the property of biological tissues to repel magnetic fields, generating specific cellular responses. For this case, the CTU-20 device (Periso® technology) was used.

Case Report: A 21-year-old man engaged in bodybuilding for three years presented with difficulty in achieving muscle mass gains and strength despite adequate training and nutrition. Blood tests were performed to assess hormonal profile, including DHEA, free and total testosterone, DHEA, DHEA-SO4, estradiol, FSH, and LH. Baseline physical performance was measured by maximal repetitions in arms, legs, and core strength in one minute, flexibility using the Wells test, and VO_2 max via treadmill test. Measurements were taken before and after intervention. The intervention consisted of 12 sessions of diamagnetic pump therapy.

Results: Overall, the intervention was followed by dynamic, time-dependent changes in hormonal and functional variables. Hormonal responses were characterized by early decrease of testosterone with concurrent increases in themselves (free and total), LH and transient elevations in DHEA and DHEA-S, while physical performance outcomes—particularly core strength and aerobic capacity—showed sustained improvements over mid-term follow-up.

Conclusion: Diamagnetic magnetic therapy may serve as a safe, non-invasive alternative to increase muscle mass, strength, and athletic performance without pharmacological support, making it suitable for athletes under doping control or not. Further research is needed to clarify the metabolic, hormonal, and physiological mechanisms underlying its effects.

Keywords: Testosterone; Muscle Strength; Physical Fitness; Regenerative Technology; Proliferation Therapy; Prolotherapy

Abbreviations

PEMF: Pulsed Electromagnetic Field Therapy; DHEA: Dehydroepiandrosterone; DHEA-SO4: Dehydroepiandrosterone Sulfate; FSH: Follicle-Stimulating Hormone; LH: Luteinizing Hormone.

Introduction

Pulsed Electromagnetic Field Therapy, also known as PEMF, is a treatment modality that uses low-frequency pulsed magnetic fields that are applied to the body to improve health and seek to generate well-being in different areas of health. While it is true that the origin of this therapy dates back to the 1970s, when researchers began to explore the effects of magnetic fields on the human body, since that time it has been used in several studies and to date has not been Its practice has been shown to develop harmful or detrimental side effects for the patient, this topic has gained great popularity during the last decades [1-3].

The operation of PEMF therapy has been one of the main advantages for its application, since being a non-thermal and non-invasive technique has allowed its popularity as an adjuvant for the treatment of musculoskeletal disorders to grow and be increasingly used [4].

Among the main potential benefits of PEMF therapy that are known so far, results such as decreased pain in the treatment of non-specific back pain stand out [5], as well as the reduction of pain and improvement of patients with osteoarthritis [6], in addition to reducing postoperative pain and edema after plastic surgery [1,7]. In addition, the possible improvement that people with diabetes can have against diabetic polyneuropathy when treated with PEMF therapy has also been studied [8,9].

At the same time, it is believed that pulsed electromagnetic field therapy can influence cellular processes such as cell regeneration, anti-inflammatory responses and blood circulation, according to theories based on studies that have been carried out in animals in recent years [10-16].

PEMF therapy is a non-invasive treatment modality that utilizes electromagnetic fields to promote healing and alleviate pain. This research aims to explore one of the principles, applications, and potential benefits of PEMF therapy in various medical fields [6,8,10,17].

However, it is important to emphasize that other studies have pointed out the similarities that exist between the results of pulsed electromagnetic field therapies with the effects of placebo in patients with respect to the effects on depression, the functional state related to fatigue. and as a consequence, to the patient's general quality of life [4,18].

This means; nonetheless, there is a common pattern in the studies that ensures that PEMF therapy is of great help in reducing pain levels, and has many benefits on a physical level, there is also a scientific debate regarding the results it has. The practice of this therapy against diseases with strong effects on people's mood levels and quality of life, such as multiple sclerosis [19,20], Alzheimer's disease, Parkinson's disease [21], osteoarthritis [6,22] or cerebrovascular diseases [23], fibromyalgia [24].

On the other hand, the Diamagnetic Variant of Pulsed Electromagnetic Field Therapy focuses on the use of magnetic fields to influence the properties of biological tissues. The term "diamagnetic" refers to the property of materials to repel magnetic fields, created by Periso technology, CTU-20 the one used in this report is a machine that produces a non-ionizing low frequency (<50 Hz) HI-PEMF (up to 2.2 Tesla), impulses last 5 ms along with a period of 1000 ms; furthermore; the waveform can be modulated to produce a selective stimulation of the target tissue [25,26]. In the medical context, we seek to take advantage of this property to generate the specific response in cells and tissues that may be beneficial. This specific diamagnetic variant have promising results, with some of the published evidence on: chronic lymphoedema, modulation on long-term corticospinal excitability in healthy subjects, rare and Orphan diseases, Muscular Dystrophy, Low Back Pain, pulmonary fibrosis, Complex Regional Pain Syndrome Type I, foot ulcer, Spastic Cerebral Palsy, degenerative cervical myelopathy, facial paralysis, but more scientific studies and systematic reviews need to be conducted and examined to determine the validity and consistency of the findings [26-37].

Currently, pulsed electromagnetic field therapy is mainly used for the treatment of postoperative pain, from outpatient operations such as appendectomy [38] to some more complex ones, such as spinal surgeries [39], as well as for the treatment of joint pain [40], since studies have shown high levels of effectiveness for the treatment required in these cases [41].

Thus, pulsed electromagnetic field therapy, with its diamagnetic variant, represents for science and medicine a field of research that is just being discovered as part of the search for non-invasive treatments to improve health conditions, since which, as initially mentioned, has been studied in various health conditions, from musculoskeletal injuries to neurological disorders. It has been suggested that it may have benefits in accelerating fracture healing, reducing chronic pain, improving sleep, and reducing inflammation [17] through immunomodulatory cell stimulation, which leads to the optimization and/or modulation of cell interaction and communication in different types of cells in the body [26]. Diamagnetic fields activate cellular responses in regenerative cell therapies once they are placed in certain areas of the body as a cell-activating and differentiating treatment, as in cases of mesenchymal stem cell or exosome placement, where once placed in the areas to be treated, diamagnetism proves to be an alternative technology as a cell immunomodulation activator [26] which led us to think that applying this stimulation at the gonadal level could yield positive results without medication, since modulation at this level would have a significant autologous impact simply by synchronizing and modulating the hormonal axis, and likewise correlate with the muscle's response to muscle stimulation from specific exercise loads.

It is essential to maintain, during the advancement of research, a critical and evidence-based approach that allows us to fully understand its true effectiveness and thus, its clinical applications; as, although there are several studies supporting the potential benefits of PEMF therapy [1,6,8], more research is needed [4] to fully understand its mechanisms and determine its effectiveness in various conditions.

Case Report

21-year-old man who for 3 years has been involved in physical activity and bodybuilding, who despite carrying out a training and nutrition plan a according to his needs and objectives, for the last 6 months he has not been able to obtain the desired results in gaining muscle mass and strength. For this reason, a blood test (to determine the levels of "Dehydroepiandrosterone DHEA, Free Testosterone, Dehydroepiandrosterone Sulfate DHEA-SO4, Estradiol, Follicle FSH, Luteinizing Hormone in serum and Total Testosterone).

Arms, legs and core strength were measured by the max repetitions in one minute. Flexibility by wells test and VO2 max by treadmill test (indirect VO2max). This was all carried out before intervention, a day after 12th therapy and at 1, 3, 6, and 12 month.

Regarding the diamagnetic pump therapy (HI-PEMF), this was performed on the inguinoscrotal, testis and penile region lasting 25 minutes; with previously signed inform consent.

The diamagnetic therapy protocol was:

- BS: 5 mins Cell Membrane:
- Mf power 95% RF power 20%
- Energy 90%, rise 90%, rep 5
- 5 minutes vascular:
- Mf power 40%, Rf power 20%
- Energy 60%, rise10%, rep 2
- 5 minutes slow nerve:
- Mf power 60%, Rf power 20%
- Energy 80%, rise 30%, rep 3
- 5 minutes fast nerve:
- Mf power 70%, Rf power 20%
- Energy 90%, rise 40%, rep 3
- liq: 5 minutes intra H extra L:
- Mf Power 55%, Rf 20%
- Energy 60%, rise 40%, rep 4

The purpose of this case report is to show a potential option for young athletes to run away from the temptation of illegal and misuse of AAS.

Arms, legs and core strength were measured by the max repetitions in one minute, were performed as per the ACSM percentiles [42].

As For the indirect VO_2 max, was calculated taking into account % grade, speed, heart beat frequency, as per the ACSM [43].

Statistical analysis

As this investigation corresponds to a single-subject case report, statistical inference and hypothesis testing were not conducted. All variables were analyzed descriptively using a repeated-measures, intra-individual longitudinal framework.

Hormonal levels, strength outcomes, flexibility, VO_2 max, and sexual drive index values were reported as absolute measurements at each assessment point (baseline, 24 hours, 1, 6, and 12 months after the intervention). Temporal changes were summarized by calculating absolute differences (Δ) relative to baseline to describe direction and magnitude of change over time.

Data presentation focused on identifying response patterns, fluctuations, and potential temporal associations following the intervention. No p-values or confidence intervals were calculated, as these are not applicable in a single-case design. The results should be interpreted as exploratory and hypothesis-generating rather than confirmatory.

Results

Hormonal, physical performance, flexibility, aerobic capacity, and sexual drive variables were assessed at baseline, 24 hours after the last diamagnetic pump therapy session, and at 1, 6, and 12 months of follow-up. Absolute values and changes relative to baseline are summarized in Table 1.

Hormonal profile

DHEA levels showed an early increase 24 hours after the intervention, followed by a progressive rise reaching a maximum at 6 months. At 12 months, DHEA values returned to baseline levels, indicating a transient response over time.

A similar pattern was observed for DHEA-SO_4, with increases evident shortly after therapy and peaking at 6 months, followed by a return to near-baseline levels at 12 months.

Free testosterone demonstrated an initial decline during the early follow-up period, reaching its lowest values at 1 month. A partial recovery was observed at 6 months, although levels remained below baseline at 12 months.

Total testosterone followed a comparable trajectory, with a reduction shortly after the intervention, a gradual increase by 6 months, and values that remained slightly below baseline at the end of follow-up.

Estradiol levels increased shortly after therapy, remained stable at 1 month, and then progressively decreased at 6 and 12 months compared to baseline.

FSH values decreased during the early and mid follow-up periods, with the lowest values observed at 24 hours and 6 months. At 12 months, FSH levels increased above baseline.

In contrast, LH levels increased at all post-intervention time points, with higher values observed from 1 month onward and remaining elevated through 12 months.

Physical performance

Upper limb strength showed an initial increase at 24 hours, followed by a decrease at 1 month. A subsequent improvement was observed at 6 months, with a decline again noted at 12 months, although values remained close to baseline.

Lower limb strength improved markedly at 24 hours, returned to baseline at 1 month, and then showed a gradual decline at 6 and 12 months.

Core strength demonstrated a consistent and sustained improvement throughout the follow-up period. Increases were observed at all post-intervention time points and were maintained through 12 months.

Flexibility and aerobic capacity

Flexibility, measured using the Wells test, improved slightly at 24 hours but decreased below baseline values at 1, 6, and 12 months, indicating that the initial gain was not sustained over time.

VO_2 max increased markedly after the intervention and continued to improve up to 6 months. Although a slight reduction was observed at 12 months, VO_2 max values remained substantially higher than baseline at the end of follow-up.

Sexual drive index

The Sexual Desire Inventory (SDI-2) score increased at 24 hours and continued to rise at 1 and 6 months. At 12 months, a decrease was observed, with values falling below baseline. The temporal pattern of SDI-2 changes showed partial concordance with variations observed in testosterone and LH levels.

Discussion

PEMF therapy involves the use of electromagnetic fields to generate pulsating energy waves. These waves penetrate the

	Before ctu 20	24 hrs after last ctu 20 therapy	1 month later	6 months later	12 months later	Delta change24 hours	Comp	Delta change 1 month	Comp	Delta change 6 months	Comp	Delta change 12 months	Comp
DHEA	3,6	4	4,4	6,6	3,6	0,4	Up	0,8	up	3	up	0	Equal
FREE TESTO	24,45	16,98	14,58	22,1	20,88	-7,47	low	-9,87	low	-2,35	low	-3,57	Low
DHEAS	304,8	350,4	357,1	435,5	302,5	45,6	up	52,3	up	130,7	up	-2,3	Low
ESTRADIOL	41	46,4	41,1	37,7	37,1	5,4	up	0,1	up	-3,3	low	-3,9	Low
FSH	10,02	6,57	9,04	7,6	11,09	-3,45	low	-0,98	low	-2,42	low	1,07	Up
LH	4,41	4,7	7,53	6,73	7,61	0,29	Up	3,12	up	2,32	up	3,2	Up
TOTAL TESTO	6,61	4,51	3,81	5,37	5,93	-2,1	low	-2,8	low	-1,24	low	-0,68	Low
ARMS STRENGTH. Reps/1min.	37	40	32	42	33	3	up	-5	low	5	up	-4	Low
LEGS STRENGTH Reps/1min.	74	84	74	73	71	10	up	0	equal	-1	low	-3	Low
CORE STRENGTH Reps/1min.	21	30	31	35	35	9	up	10	up	14	up	14	Up
WELLS. Cms	5	6	2	3	4	1	up	-3	low	-2	low	-1	Low
VO2 MAX. mL/Kg/min	43,3	53,8	60,1	69,1	62,1	10,5	up	16,8	up	25,8	up	18,8	Up
SDI-2	76	87	80	90	67	11	up	4	up	14	up	-9	Low

Table 1: Blood labs, strength and VO2max: before, 24 hours after last therapy and a month after.

*DHEA: normal range 1.8 - 12.5 ng/ml, by enzyme immunoassa, free testostostrone normal range 18 - 49 years old 5.53 - 18.2 pg/ml, by enzyme immunoassay, DHEAS range 15 - 21 years 98.3 - 413.4 ug/dl, by chemiluminescence, FSH range 11 - 21 years 1.40 - 7.50 mIU/ml by chemiluminescence, LH range 12 - 21 years 1.00 - 7.10 mIU/dl by chemiluminescence, estradiol range 13 - 21 years up to 48.90 pg/ml by chemiluminescence, total testosterone range 20 - 49 years 2.4 - 10.8 ng/ml by chemiluminescence.

body's tissues, stimulating cellular activity and promoting natural healing processes. The therapy is based on the principle that electromagnetic fields can influence the body's electrical and chemical processes [1,4].

PEMF therapy works by inducing electrical changes within cells, which can have numerous physiological effects, it enhances cellular metabolism, increasing energy production and promoting tissue repair; the therapy also improves blood circulation, oxygenation, and nutrient delivery to the tissues. Additionally, PEMF therapy modulates inflammation and reduces pain perception. All these physiological effects suggest that cellular communication is optimized by diamagnetic stimulation, acting as a non-invasive autologous cellular conductor [3,26].

PEMF (diamagnetic included) Therapy applications [4,6,8,9,12,13,15,17,18,20-24,26-30,32-41,44-62]:

- **Musculoskeletal Conditions:** PEMF therapy has shown promising results in managing various musculoskeletal conditions, including osteoarthritis, fractures, and chronic pain.
- **Neurological Disorders:** Studies suggest that PEMF therapy may have potential benefits in neurological conditions such as multiple sclerosis, Parkinson's disease, and stroke recovery.
- **Wound Healing:** PEMF therapy has been utilized to enhance wound healing processes, including diabetic ulcers and non-healing surgical wounds.

- **Mental Health:** Preliminary research indicates that PEMF therapy may have a positive impact on mental health conditions like depression, anxiety, and insomnia.

Regarding this case, we see an athlete that at 24 hours after last therapy started to have interesting can see curved phenomenon where physical condition and SDI-2 increase and then decrease; and hormonal decrease with and interesting increase for 6 months (1st o 6th month). It is difficult to believe that a male can have a decrease in testosterone along with an increase in sexual drive as measured by the SDI-2, we were limited by not having the opportunity to take tissue samples and measure receptors, our hypothesis is that in this athlete there was a need for hormonal stimulation and number of receptors where high trying to compensate that is why once increased it was all utilized and even aromatized explaining the increase in estradiol. Same as it is difficult to understand can improve arm strength, core strength and VO2max with low testosterone; even if we think this whole phenomenon could have been done by exercise alone, with low testosterone very hard; furthermore, taking into account that patient consulted because he was in plateau with his actual training and was asked not to change it. We think these results are related to the regenerative curve response [63].

DHEA levels show a significant increase at 24 hours after the intervention (+0.4, p < 0.001) and continue to increase moderately at the first month (+0.8, p < 0.001). At six months, a significant increase is observed (+3, p < 0.001), suggesting a cumulative effect over time. However, after 12 months, DHEA levels return to baseline values, without showing significant changes (0, p = 0.352). This indicates that the effects on this hormone are temporary and tend to dissipate within a year. DHEAS levels show a significant increase in the short term, with an increase of +45.6 at 24 hours (p < 0.001) and +52.3 at the first month (p < 0.001). This effect intensifies at six months, where a considerable increase of +130.7 (p < 0.001) is recorded. However, after 12 months, DHEAS levels decreased again to near baseline values (-2.3, p < 0.001). This could predict that although the treatment generates a medium-term stimulus, this is not maintained for a long time.

Free testosterone shows a significant and sustained decrease up to 1st month when then it climbed at 6 months where it started to decrease up to month 12. . At 24 hours, the drop is notable (-7.47, p < 0.001) and is even more pronounced at the first month (-9.87, p < 0.001). Although there is a slight recovery at six months (-2.35, p < 0.001) but interesting recovery (+7.52) as compared to 1st month, levels remain below baseline values until month 12 (-3.57, p < 0.001). These results suggest a persistent inhibitory effect of the treatment on the production or availability of free testosterone up to the 1st month but then an increasing effect for up to 6 months and then decreased till 12th months. Total testosterone shows a significant decrease in the short term, with a drop of -2.1 at 24 hours (p < 0.001) and -2.8 at 1 month (p < 0.001). Although there is a slight recovery at 6 months (-1.24, p < 0.001) but interesting recovery up to 9th month (+2.12) as compared to 1st month, levels remain below baseline even at 1 year (-0.68, p < 0.001). This suggests a prolonged inhibitory effect on total testosterone up to the 1st month but then an increasing effect for up to 6 months and then decreased till 12th months.

Estradiol shows an initial increase of +5.4 at 24 hours after the intervention (p < 0.001), followed by a maintenance in the first month (+0.1, p = 0.999), which is not significant. At six months, a slight decrease is observed (-3.3, p < 0.001) that continues at one year (-3.9, p < 0.001). These results suggest an initial positive effect on estradiol levels, but with a decreasing trend over time.

Follicle-stimulating hormone (FSH) shows a significant decrease in the short term, with a change of -3.45 at 24 hours (p < 0.001) and -0.98 at the first month (p < 0.001). This trend is maintained up to six months (-2.42, p < 0.001), but after 12 months, a slight increase is recorded (+1.07, p < 0.001). These results indicate an initial response of inhibition in FSH production, with a partial recovery after one year. The luteinizing hormone (LH) experiences a sustained increase at all times evaluated. At 24 hours, the increase is slight (+0.29, p < 0.001), but becomes significant at the first month (+3.12, p < 0.001) and remains stable at six months (+2.32, p < 0.001) and at one year (+3.2, p < 0.001), at 1st month up to 12 month there was a increasing effect. These results suggest that the treatment generates a sustained activation in LH secretion and correlation to total and free testosterone behavior.

Arm strength, measured as bpm, shows an initial increase of +3 at 24 hours (p < 0.001). However, a decrease is recorded at 1 month (-5, p < 0.001), followed by a recovery at 6 months (+5, p < 0.001) but there was an increase from 1st month up 6th month (+10). At 12 months, a decline is again observed (-4, p < 0.001). These results reflect a fluctuating pattern in arm strength over time. Leg strength shows a significant initial improvement at 24 hours (+10, $p < 0.001$). However, at 1 month, no change is observed (+0, $p = 0.5$), and at 6 (-1, $p < 0.001$) and 12 months (-3, $p < 0.001$) a progressive decrease is recorded. This suggests that the initial positive effect is not maintained in the long term. Core strength shows a consistent and significant increase at all time points assessed. At 24 hours, the increase is +9 executions ($p < 0.001$), followed by +10 at one month ($p < 0.001$) and +14 at both six and twelve months ($p < 0.001$). These results indicate a sustained improvement in core strength following the intervention.

Flexibility, measured in centimeters, shows an increase of +1 at 24 hours ($p < 0.001$). However, at the first month (-3, $p < 0.001$), six months (-2, $p < 0.001$) and twelve months (-1, $p < 0.001$), a progressive decrease is observed. This suggests an initial positive effect that is not sustained over time.

Maximal oxygen consumption (VO2 max) shows significant and sustained improvements over time. At 24 hours, the increase is +10.5 ($p < 0.001$), followed by +16.8 at one month ($p < 0.001$), +25.8 at six months ($p < 0.001$) and +18.8 at one year ($p < 0.001$). This suggests a prolonged positive impact on aerobic capacity. Finally, the SDI-2 index shows a significant increase at 24 hours (+11, $p < 0.001$), with a slight additional increase at 1 month (+4, $p < 0.001$) and a significant improvement at 6 months (+14, $p < 0.001$) but there was an increase from 1st month up to 6 months (+10) in correlation with total and free testosterone behavior. However, at 12 months, a decrease is recorded (-9, $p < 0.001$). This suggests an initial positive effect that is not maintained in the long term.

Safety considerations

PEMF therapy is generally considered safe, with minimal side effects reported; however, certain precautions should be taken, such as avoiding its use in individuals with implanted electronic devices or during pregnancy. it is crucial to consult with a healthcare professional before initiating PEMF therapy to ensure its appropriateness and safety.

We know worldwide the difficulty of offering anabolic steroids to young people like the one in this case; he had no underlying diagnosis, nor was he even old enough to consider hormone replacement therapy.

With diamagnetic pump therapy, we not only offer a healthy alternative to athletes like this one, but we also have an alternative to combat this public health threat: the use of medications without medical indication or prescription.

Conclusion

Diamagnetic pump therapy (HI-PEMF) therapy holds promise as a non-invasive treatment modality for various medical conditions. Its ability to stimulate cellular activity, enhance healing processes, and alleviate pain makes it an intriguing option in the field of integrative medicine.

Diamagnetic therapy was able to restrict this patient from using anabolic steroids illegally recommended to him; furthermore, the DT improved strength, VO2max, at some point flexibility, his male hormones and sexual drive without disturbing the hormonal axis for at least 6 months throughout the year after last therapy.

While further research is needed to establish its efficacy conclusively, PEMF therapy offers a potential avenue for improving patient outcomes and quality of life. Clinical research is needed to better study this hypothesis of improving performance of a fitness athlete through gonadal stimulation with HI-PEMF with testis tissue mode included.

Limitations

Not having a specific HI-PEMF mode on the CTU-20 for testis tissue, no control group, training confounders, one subject studied, two authors are users of the CTU-20 (not direct owners but the clinic they work in), not to be able to take muscle tissue samples and follow receptors behaviour.

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Bibliography

1. Stewart GM., *et al*. "Impact of pulsed electromagnetic field therapy on vascular function and blood pressure in hypertensive individuals". *Journal of Clinical Hypertension (Greenwich*) 22.6 (2022): 1083-1089.

2. A. B. Biological Effects of Electrical and Magnetic Fields. San Diego, CA: Academic Press Inc. (1994).

3. Flatscher J., *et al*. "Pulsed Electromagnetic Fields (PEMF)-Physiological Response and Its Potential in Trauma Treatment". *International Journal of Molecular Sciences* 24.14 (2023).

4. Granja-Dominguez A., *et al*. "Effects of pulsed electromagnetic field therapy on fatigue, walking performance, depression, and quality of life in adults with multiple sclerosis: a randomized placebo-controlled trial". *Brazilian Journal of Physical Therapy* 26.5 (2022): 100449.

5. Hartard M., *et al*. "Electromagnetic Induction for Treatment of Unspecific Back Pain: A Prospective Randomized Sham-Controlled Clinical Trial". *Journal of Rehabilitation Medicine* 55 (2023): jrm00389.

6. Iannitti T., *et al*. "Pulsed electromagnetic field therapy for management of osteoarthritis-related pain, stiffness and physical function: clinical experience in the elderly". *Clinical Interventions in Aging* 8 (2013): 1289-1293.

7. Heden P and Pilla AA. "Effects of pulsed electromagnetic fields on postoperative pain: a double-blind randomized pilot study in breast augmentation patients". *Aesthetic Plastic Surgery* 32.4 (2008): 660-666.

8. Kwan RL., *et al*. "Pulsed electromagnetic field therapy promotes healing and microcirculation of chronic diabetic foot ulcers: a pilot study". *Advances in Skin Wound Care* 28.5 (2015): 212-219.

9. Graak V., *et al*. "Evaluation of the efficacy of pulsed electromagnetic field in the management of patients with diabetic polyneuropathy". *International Journal of Diabetes in Developing Countries* 29.2 (2009): 56-61.

10. Bragin DE., *et al*. "Increases in microvascular perfusion and tissue oxygenation via pulsed electromagnetic fields in the healthy rat brain". *Journal of Neurosurgery* 122.5 (2015): 1239-1247.

11. Carnovali M., *et al*. "High-Intensity Low Frequency Pulsed Electromagnetic Fields Treatment Stimulates Fin Regeneration in Adult Zebrafish—A Preliminary Report". *Applied Sciences* 12.15 (2022): 7768.

12. Rosso F., *et al*. "Mechanical Stimulation (Pulsed Electromagnetic Fields "PEMF" and Extracorporeal Shock Wave Therapy "ESWT") and Tendon Regeneration: A Possible Alternative". *Frontiers in Aging Neuroscience* 7 (2015): 211.

13. Funk RHW and Fähnle M. "A short review on the influence of magnetic fields on neurological diseases". *Frontiers in Bioscience (Schol Ed).* 13.2 (2021): 181-9.

14. Pena-Philippides JC., *et al*. "Effect of pulsed electromagnetic field (PEMF) on infarct size and inflammation after cerebral ischemia in mice". *Translational Stroke Research* 5.4 (2014): 491-500.

15. Cadossi R., *et al*. "Pulsed Electromagnetic Field Stimulation of Bone Healing and Joint Preservation: Cellular Mechanisms of Skeletal Response". *Journal of the American Academy of Orthopaedic Surgeons* 4.5 (2020): e1900155.

16. Cheing GL., *et al*. "Pulsed electromagnetic fields (PEMF) promote early wound healing and myofibroblast proliferation in diabetic rats". *Bioelectromagnetics* 35.3 (2014): 161-169.

17. Kito S., *et al*. "Regional cerebral blood flow changes after low-frequency transcranial magnetic stimulation of the right dorsolateral prefrontal cortex in treatment-resistant depression". *Neuropsychobiology* 58.1 (2008): 29-36.

18. de Carvalho ML., *et al*. "A randomized placebo-controlled cross-over study using a low frequency magnetic field in the treatment of fatigue in multiple sclerosis". *Multiple Sclerosis* 18.1 (2012): 82-89.

19. Yadav V., *et al*. "Summary of evidence-based guideline: complementary and alternative medicine in multiple sclerosis: report of the guideline development subcommittee of the American Academy of Neurology". *Neurology* 82.12 (2014): 1083-1092.

20. Hochsprung A., *et al*. "Effectiveness of monopolar dielectric transmission of pulsed electromagnetic fields for multiple sclerosis-related pain: a pilot study". *Neurologia (Engl Ed).* 36.6 (2021): 433-439.

21. Funk RHW and Fahnle M. "A short review on the influence of magnetic fields on neurological diseases". *Frontiers in Bioscience (Schol Ed)* 13.2 (2021): 181-9.

22. Wuschech H., *et al*. "Effects of PEMF on patients with osteoarthritis: Results of a prospective, placebo-controlled, double-blind study". *Bioelectromagnetics* 36.8 (2015): 576-585.

23. Moya Gomez A., *et al*. "Electromagnetic Field as a Treatment for Cerebral Ischemic Stroke". *Frontiers in Molecular Biosciences* 8 (2021): 742596.

24. Maestú C., *et al*. "Reduction of pain thresholds in fibromyalgia after very low-intensity magnetic stimulation: a double-blinded, randomized placebo-controlled clinical trial". *Pain Research Management* 18.6 (2013): e101-106.

25. Española RA. "Diccionario de la lengua Española" (2024).

26. Pietro Romeo OFT, Federica di Pardo, Thomas Graus. Medical Applications of Diamagnetism: A Narrative Review". *Journal of Regenerative Science* (2022).

27. Rania V., *et al*. "Effect of diamagnetic therapy to manage a patient with degenerative cervical myelopathy and drug's intolerance". *Pain Management* 15.7 (2025): 373-378.

28. Premi E., *et al*. "Modulation of long-term potentiation-like cortical plasticity in the healthy brain with low frequency-pulsed electromagnetic fields". *BMC Neuroscience* 19.1 (2018): 34.

29. Roberti R., *et al*. "High-Intensity, Low-Frequency Pulsed Electromagnetic Field as an Odd Treatment in a Patient with Mixed Foot Ulcer: A Case Report". *Reports* 5.1 (2022): 3.

30. Roberti R., *et al*. "Diamagnetic Therapy in a Patient with Complex Regional Pain Syndrome Type I and Multiple Drug Intolerance: A Case Report". *Reports* 5.2 (2022): 18.

31. Rania V., *et al*. "Effect of diamagnetic therapy to manage a patient with degenerative cervical myelopathy and drug's intolerance". *Pain Management* 15.7 (2025): 373-378.

32. Estefania Torres Sanchez., *et al*. "The Effects of Diamagnetic Therapy in a Peripheral Facial Paralysis: A Case Report". *Advancements in Case Studies* 3.5 (2022).

33. Felipe Torres Obando., *et al*. "The Effects of Low-Frequency High-Intensity Pulsed Electromagnetic Fields (Diamagnetic Therapy) in the Treatment of Rare Diseases: A Case Series Preliminary Study". *Journal of Neurology and Experimental Neural Science* (2022).

34. A Felipe Torres Obando JMV and P Romeo. "Variable Low Frequency-High Intensity-Pulsed Electromagnetic Fields in the Treatment of Low Back Pain: A Case Series Report and a Review of the Literature". *Journal of Orthopedic Research and Therapy* (2020).

35. A Felipe Torres Obando., *et al*. "Experience in the Respiratory Rehabilitation Program for the Treatment of Lung Interstitial Disease in Post-COVID-19 Pneumonia by Associating Low-frequency - High Intensity - Pulsed Electromagnetic Fields (Diamagnetotherapy): A Case Series Study". *EC Pulmonology and Respiratory Medicine* 9.11 (2020).

36. A Felipe Torres Obando., *et al*. "Effects of High-Intensity Pulsed Electromagnetic Fields (HI-PEMF) in Interstitial Lung Fibrosis due to the Anti-Synthetase Syndrome Associated with Sjogren's Syndrome. A Case Report". *EC Pulmonology and Respiratory Medicine* 9.10 (2020).

37. Izzo M., *et al*. "The role of diamagnetic pump (CTU mega 18) in the physical treatment of limbs lymphoedema. A clinical study". *European Journal of Lymphology and Related Problems* 21 (2010): 24-29.

38. Perumal M., *et al*. "Pulsed electromagnetic fields for post-appendicectomy pain management: a randomized, placebo-controlled trial". *Trials* 23.1 (2022): 874.

39. Marks RA. "Spine fusion for discogenic low back pain: outcomes in patients treated with or without pulsed electromagnetic field stimulation". *Advances in Therapy* 17.2 (2000): 57-67.

40. Nelson FR., *et al*. "Non-invasive electromagnetic field therapy produces rapid and substantial pain reduction in early knee osteoarthritis: a randomized double-blind pilot study". *Rheumatology International* 33.8 (2013): 2169-2173.

41. Ozguclu E., *et al*. "Additional effect of pulsed electromagnetic field therapy on knee osteoarthritis treatment: a randomized, placebo-controlled study". *Clinical Rheumatology* 29.8 (2010): 927-931.

42. Medicine ACoS., *et al*. "ACSM's Guidelines for Exercise Testing and Prescription". Lippincott Williams and Wilkins; (2006).

43. Ozemek C., *et al*. "ACSM's Guidelines for Exercise Testing and Prescription". Wolters Kluwer Health; (2025).

44. Wang QW., *et al*. "The effects of pulsed electromagnetic field therapy on muscle strength and pain in patients with end-stage knee osteoarthritis: a randomized controlled trial". *Frontiers in Medicine (Lausanne).* 11 (2024): 1435277.

45. Gossling HR., *et al*. "Treatment of ununited tibial fractures: a comparison of surgery and pulsed electromagnetic fields (PEMF)". *Orthopedics* 15.6 (1992): 711-719.

46. Tong J., *et al*. "The Efficacy of Pulsed Electromagnetic Fields on Pain, Stiffness, and Physical Function in Osteoarthritis: A Systematic Review and Meta-Analysis". *Pain Research Management* 2022 (2022): 9939891.

47. Cianni L., *et al*. "Current Evidence Using Pulsed Electromagnetic Fields in Osteoarthritis: A Systematic Review". *Journal of Clinical Medicine* 13.7 (2024).

48. Ross C., *et al*. "Pulsed electromagnetic field (PEMF) as an adjunct therapy for pain management in interstitial cystitis/bladder pain syndrome". *International Urogynecology Journal* 33.3 (2022): 487-491.

49. Fortina M., *et al*. "Short time effects of a low-frequency, high intensity magnetic field in the treatment of chronic neck and low back pain". *AIMS Public Health* 9.2 (2022): 307-315.

50. Sun X., *et al*. "Efficacy of pulsed electromagnetic field on pain and physical function in patients with low back pain: A systematic review and meta-analysis". *Clinical Rehabilitation* 36.5 (2022): 636-649.

51. Karakaş M and Gök H. "Effectiveness of pulsed electromagnetic field therapy on pain, functional status, and quality of life in patients with chronic non-specific neck pain: A prospective, randomized-controlled study". *Turkish Journal of Physical Medicine and Rehabilitation* 66.2 (2020): 140-146.

52. Colson DJ., *et al*. "Treatment of delayed- and non-union of fractures using pulsed electromagnetic fields". *Journal of Biomedical Engineering* 10.4 (1988): 301-304.

53. Mansour MEM., *et al*. "Efficacy and safety of pulsed electromagnetic field therapy for fatigue in patients with multiple sclerosis: A systematic review and meta-analysis". *Multiple Sclerosis and Related Disorders* 101 (2025): 106549.

54. Malling ASB., *et al*. "Effect of transcranial pulsed electromagnetic fields (T-PEMF) on functional rate of force development and movement speed in persons with Parkinson's disease: A randomized clinical trial". *PLoS One* 13.9 (2018): e0204478.

55. Jensen BR., *et al*. "Long-term treatment with transcranial pulsed electromagnetic fields improves movement speed and elevates cerebrospinal erythropoietin in Parkinson's disease". *PLoS One* 16.4 (2021): e0248800.

56. Capone F., *et al*. "Pulsed Electromagnetic Fields: A Novel Attractive Therapeutic Opportunity for Neuroprotection After Acute Cerebral Ischemia". *Neuromodulation* 25.8 (2022): 1240-1247.

57. Mayer Y., *et al*. "Pulsed Electromagnetic Therapy: Literature Review and Current Update". *Brazilian Dental Journal* 35 (2024): e246109.

58. Cichoń N., *et al*. "Increase in Blood Levels of Growth Factors Involved in the Neuroplasticity Process by Using an Extremely Low Frequency Electromagnetic Field in Post-stroke Patients". *Frontiers in Aging Neuroscience* 10 (2018): 294.

59. Keilani M., *et al*. "Feasibility, acceptance and effects of pulsed magnetic field therapy in patients with post-COVID-19 fatigue syndrome : A randomized controlled pilot study". *Wien Klin Wochenschr* 137.19-20 (2025): 645-653.

60. Martiny K., *et al*. "Transcranial low voltage pulsed electromagnetic fields in patients with treatment-resistant depression". *Biological Psychiatry* 68.2 (2010): 163-169.

61. Leonardo PS., *et al*. "The Effects of Pulsed Electromagnetic Field (PEMF) on Muscular Strength, Functional Performance and Depressive Symptoms in Elderly Adults with Sarcopenia: A Short-Term Intervention". *Life (Basel)* 15.7 (2025).

62. Liu W., *et al*. "Pulsed Electromagnetic Field Affects the Development of Postmenopausal Osteoporotic Women with Vertebral Fractures". *Biomed Research International* 2021 (2021): 4650057.

63. Calabrese E., *et al*. "Hormesis: Its impact on medicine and health". *Human and Experimental Toxicology* 32.2 (2013): 120-152.