

Radio Frequency
Applications: Scientific
Evidence & Clinical Findings
In Medical Aesthetics,
Intimate Health And
Rehabilitation Treatments.

Content

Basic Research

Molecular Bases

Cell Lines Safety Studies

Clinical Bases

Clinical Research Rehabilitation

Physiotherapy

Clinical Research Intimate Health

Clinical Research Aesthetics



Basic Research





Molecular Bases

Antiadipogenic Effects Of Subthermal Electric Stimulation At 448 kHz On Differentiating Human Mesenchymal Stem Cells.

Hernández-Bule ML, Martínez-Botas J, Trillo MA, Paino CL, Ubeda A. Mol Med Rep, 2016 ; 13, (5): 3895-903.

Objectives:

To study the effects of exposure to subtherapeutic doses of the capacitive electric transfer at 448 kHz (CRET) on early adipogenic processes in adipose-derived stem cells (ADSCs) from human donors.

Materials And Methods:

ADSCs were incubated for 2 or 9 days in the presence of an adipogenic medium and exposed to 5-minute pulses of 448 kHz electric signal at 50 microA/mm² during the last 48 hours of incubation. Colorimetric, immunofluorescence, Western blotting, and quantitative reverse transcription-polymerase chain reaction assays were performed to evaluate ADSC adipogenic differentiation.

Results:

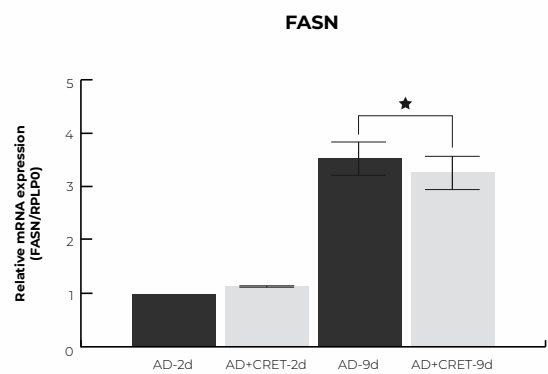
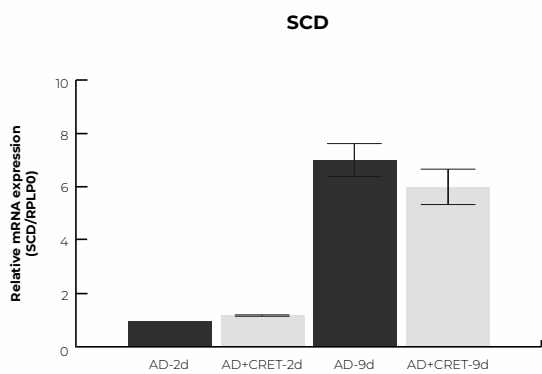
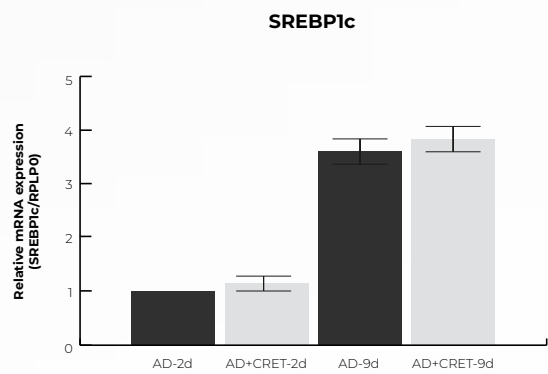
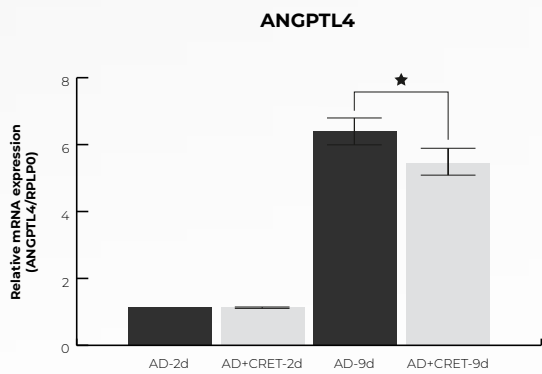
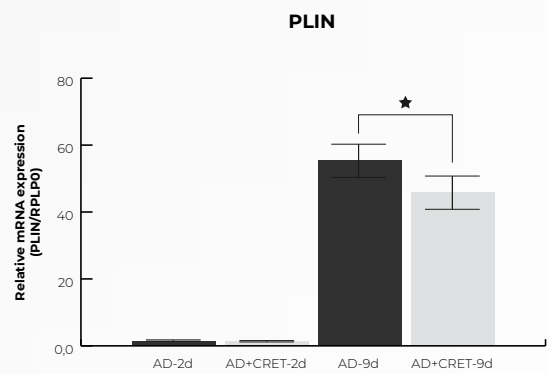
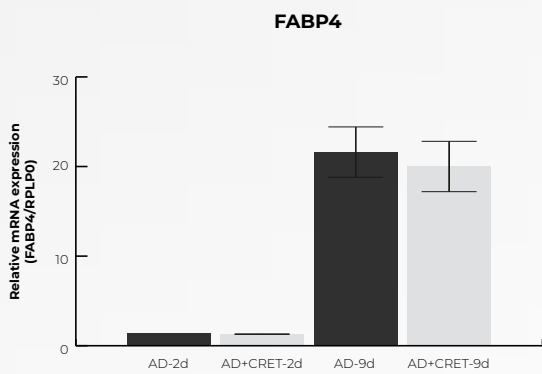
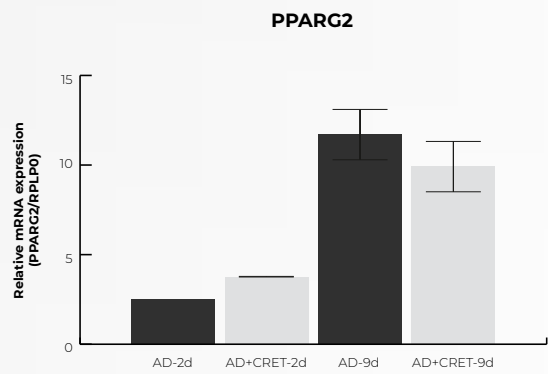
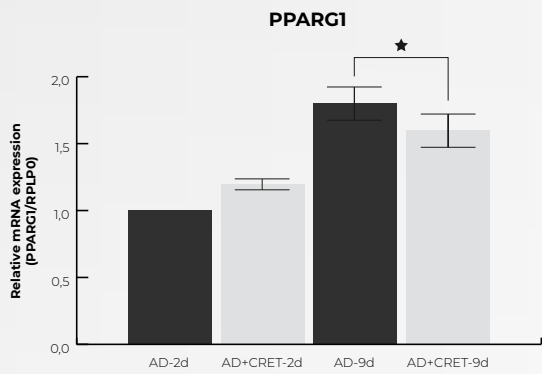
Electrical stimulation significantly reduced cytoplasmic lipid content after 2 and 9 days of differentiation. The anti-adipogenic response in 9-day samples was accompanied by activation of mitogen-activated protein kinase 1/2, decreased expression and partial inactivation of peroxisome proliferator-activated receptor (PPAR) gamma receptor, which was translocated from the nucleus to the cytoplasm, and a significant decrease in the expression levels of PPARG1 gene, perilipin, angiopoietin 4 protein, and fatty acid synthase.

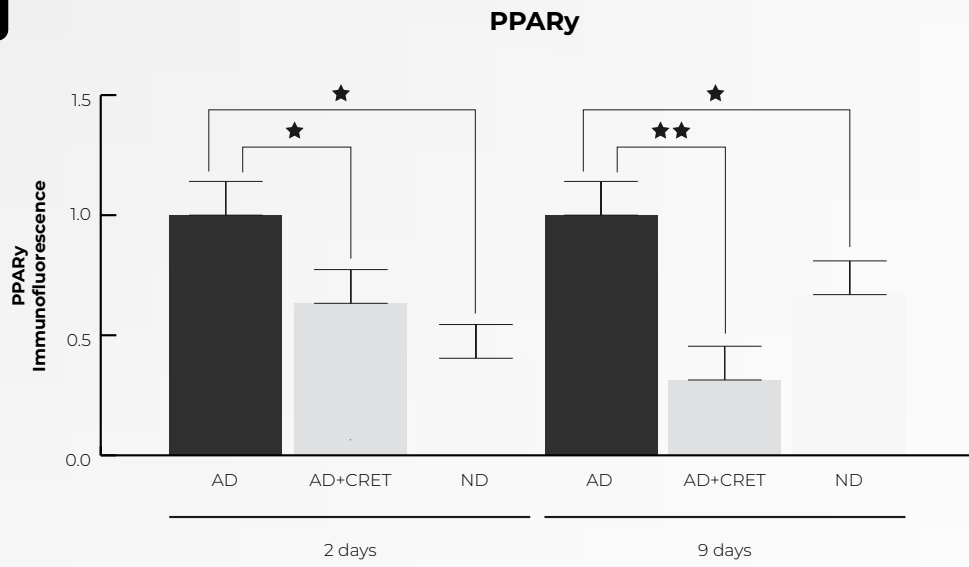
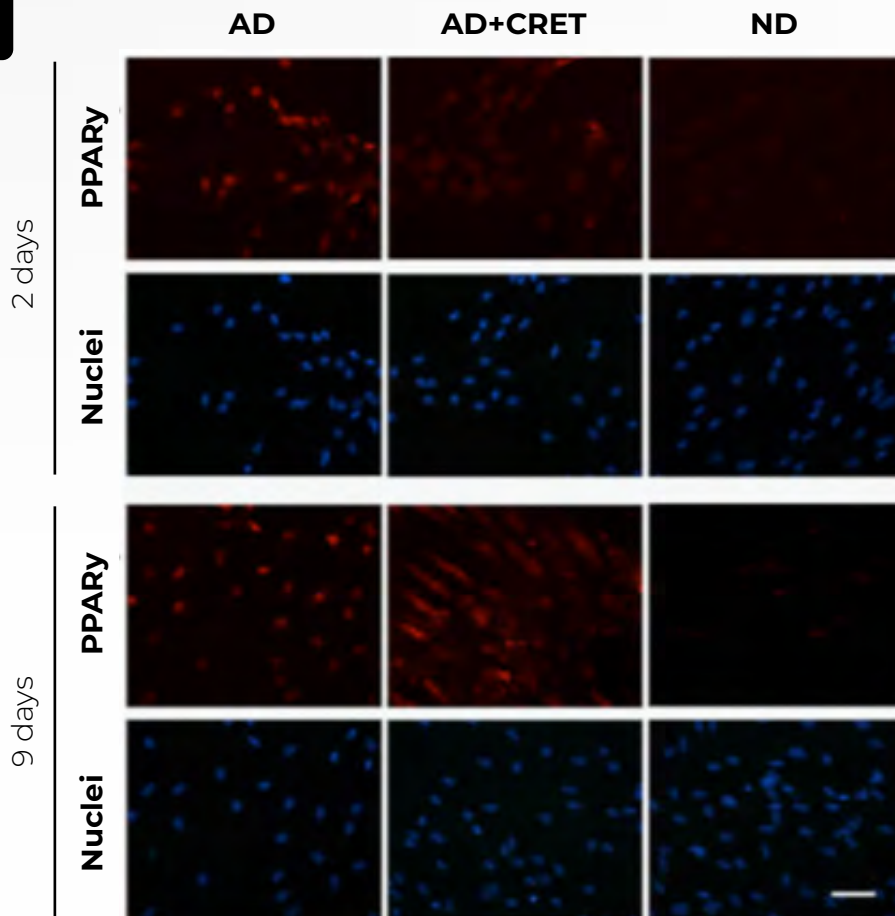
Conclusions:

The results demonstrated that subtherapeutic stimulation with CRET interferes with early adipogenic differentiation in ADSCs, indicating that the electric stimulus itself can modulate the processes controlling fat synthesis and mobilization, even in the absence of concomitant thermal and mechanical components of thermo-electric CRET therapy.



<https://www.ncbi.nlm.nih.gov/pubmed/?term=Antiadipogenic+effects+of+subthermal+electric+stimulation+at+448+kHz+on+differentiating+human+mesenchymal+stem+cells>



A**B**

Chondrogenic Differentiation Of Adipose- Derived Stem Cells By Radiofrequency Electric Stimulation.

Hernández-Bule ML, Trillo, Martínez-García MA, Abilahoud C, Úbeda A. Journal of Stem Cell Research & Therapy. 2017;7(12): 10.

Objectives:

Although capacitive-resistive electrical transfer therapies (CRET), based on the transdermal application of electrothermal radiofrequency currents, have demonstrated promising therapeutic efficacy in the regeneration of traumatic or degenerative tissue injuries, their potential effects on tissues such as cartilage, which have low regenerative capacity, have not been sufficiently studied. Here, we investigate the effects of exposure to a 448 kHz current commonly used in CRET therapy on the early chondrogenic differentiation of human adipose-derived stem cells (ADSCs).

Materials And Methods:

Stem cells obtained from healthy donors were differentiated in chondrogenic medium for 16 days. During the last two days of incubation, cultures were intermittently or fictitiously exposed to a 448 kHz sinusoidal current, administered at a subthermal density of

50 $\mu\text{A}/\text{mm}^2$. Cell response was evaluated by XTT, glycosaminoglycans (GAG) and collagen quantification (image analysis, Blyscan assay and immunoblot), and the analysis of chondrogenic factors Sox5 and Sox6 expression, as well as ERK1/2 transcription factor and its active form p-ERK1/2 (immunofluorescence, immunoblot and RT-PCR).

Results:

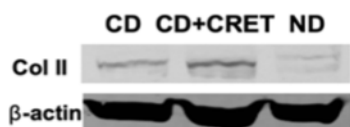
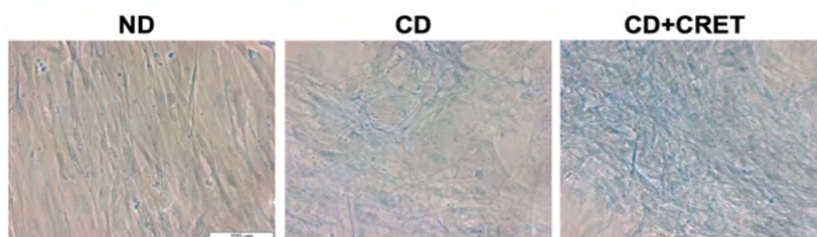
Electrical stimulus significantly increased the levels of type II collagen and GAGs in the extracellular matrix of differentiating cultures. Although no changes were observed in SOX gene expression at the end of the 48-hour treatment, the stimulus induced significant overexpression of transcription factors L-Sox5, Sox6, and p-ERK1/2. As these proteins are crucial regulators of extracellular matrix synthesis during chondrogenic differentiation, their overexpression is likely involved in the observed increases in extracellular collagen content and GAGs.



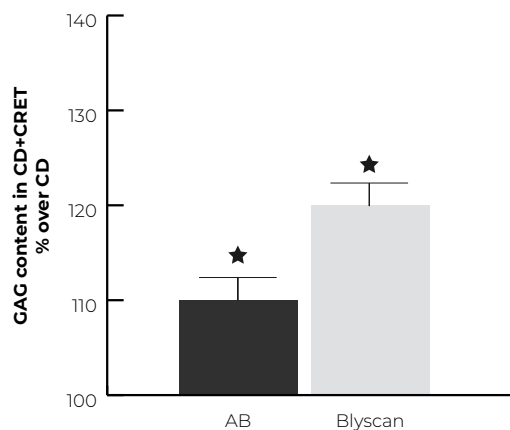
<https://www.walshmedicalmedia.com/open-access/chondrogenic-differentiation-of-adipose-derived-stem-cells-by-radiofrequency-electric-stimulation-2157-7633-1000407.pdf>

Conclusions:

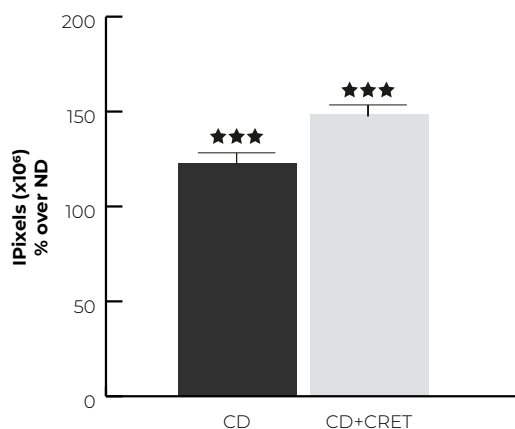
This dataset supports the hypothesis that the electrical component of the electrothermal treatment applied in CRET therapies could stimulate cartilage repair by promoting chondrogenic differentiation. Combined with previously reported results indicating that in vitro treatment with the same type of subthermal electrical signal promotes the proliferation of undifferentiated ADSCs, these data identify the molecular phenomena underlying the potential reparative and regenerative effects of these radiofrequency currents.



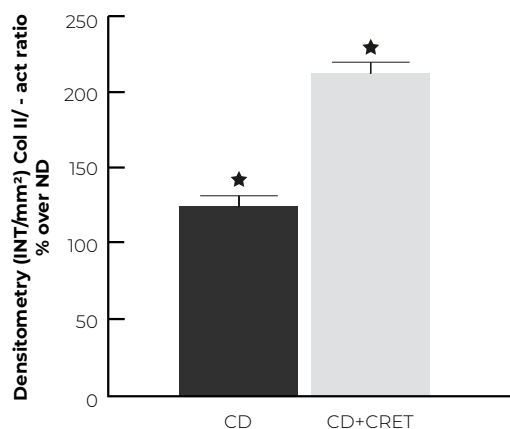
Glycosaminoglycan



Collagen



Collagen type II



Electric Stimulation At 448 kHz Promotes Proliferation Of Human Mesenchymal Stem Cells.

Hernández-Bule ML, Paino CL, Trillo MA, Ubeda A. Cell Physiol Biochem. 2014;34(5): 1741-55.

Objectives:

Capacitive-resistive electrical transfer (CRET) is a non-invasive electrothermal therapy that applies electrical currents in the frequency range of 400 kHz - 450 kHz for the treatment of musculoskeletal injuries. It is known that electrical currents and electrical or magnetic fields can influence proliferative and/or differentiation processes involved in tissue regeneration. This study investigates proliferative responses that could be responsible for the effects of CRET on tissue repair.

Materials And Methods:

XTT assay, flow cytometry, immunofluorescence, and Western Blot analyses were performed to evaluate viability, proliferation, and differentiation of adipose-derived stem cells (ADSC) from healthy donors, after short and repeated in vitro stimulation (5 min On/4 h Off), with a 448 kHz electrical signal currently used in CRET therapy, applied at a subthermal dose of 50 $\mu\text{A}/\text{mm}^2$.

Results:

The treatment induced an upregulation of PCNA and ERK1/2, as well as a significant increase in the fractions of ADSC undergoing the S, G2, and M phases of the cell cycle, and an increased rate of cellular proliferation. This proliferative effect did not compromise the multipotential capacity of the ADSC for subsequent adipogenic, chondrogenic, or osteogenic differentiation.

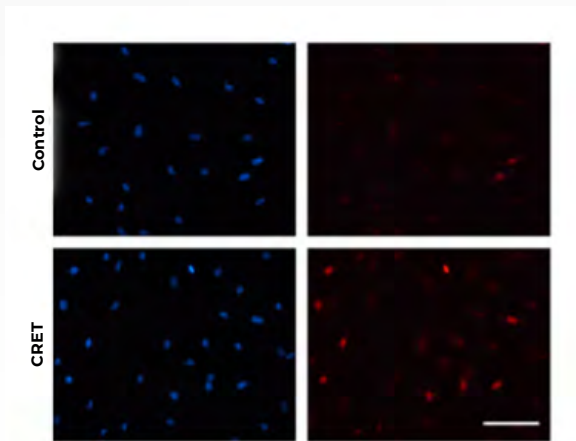
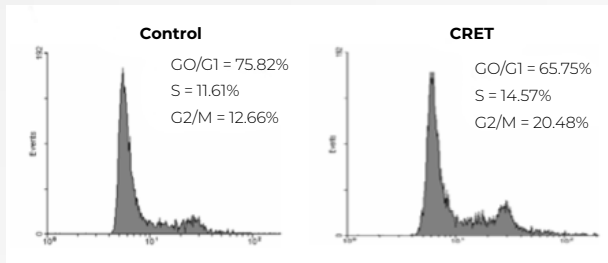
Conclusions:

These data identify the cellular and molecular phenomena that may underlie the response to CRET and indicate that repair of CRET-induced injuries may be induced by the stimulation of stem cell proliferation present in injured tissues.



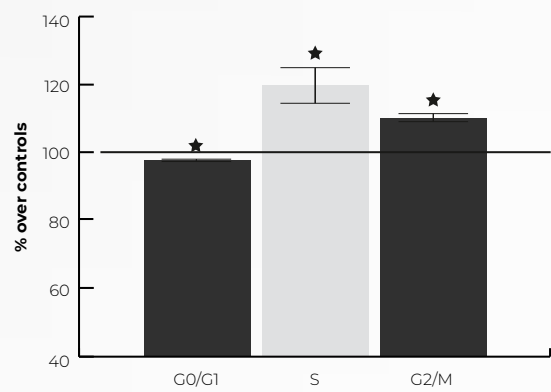
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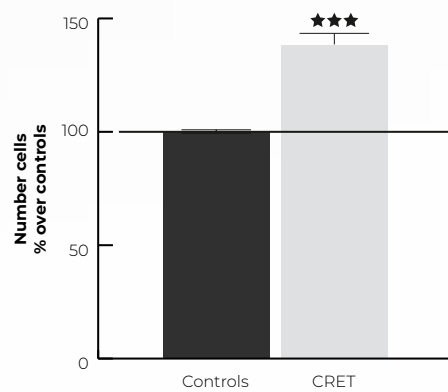


B

Cell Cycle Phases



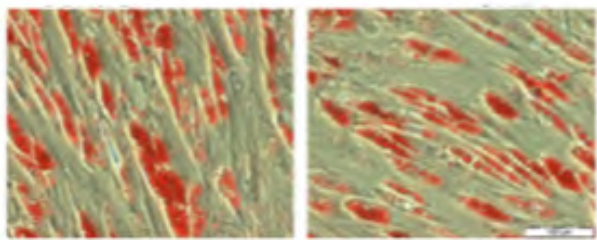
BrdU Immunofluorescence



A

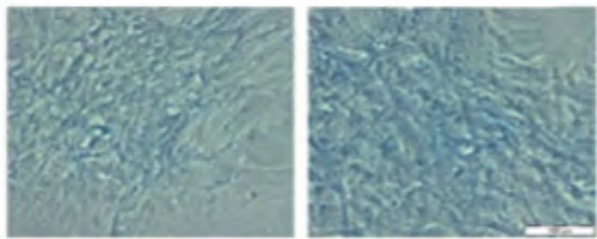
Adipogenic differentiation

Control CRET



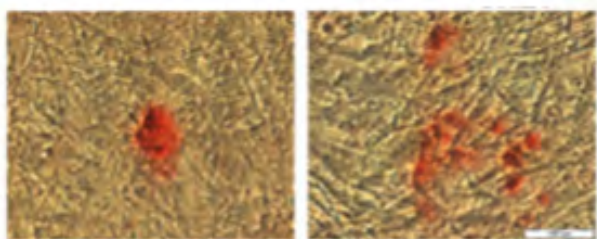
Chondrogenic differentiation

Control CRET



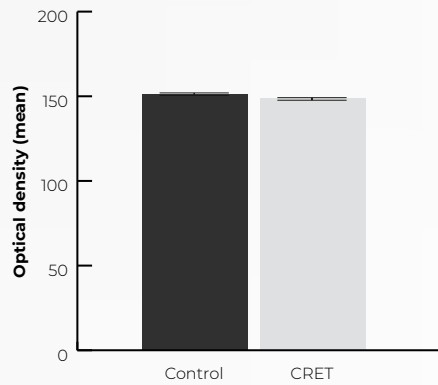
Osteogenic differentiation

Control CRET

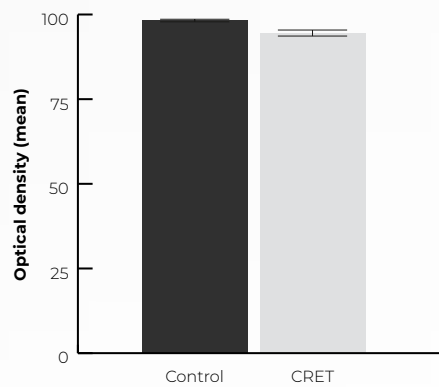


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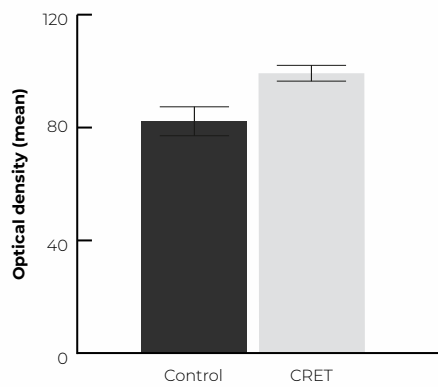
Adipogenic differentiation



Chondrogenic differentiation



Osteogenic differentiation



Repressive Effects Of A Capacitive-Resistive Electric Transfer (CRET) Hyperthermic Apparatus Combined With Provitamin C On Intracellular Lipid-Droplets Formation In Adipocytes.

Kato, S., et al. (2013). *Int J Hyperthermia* 29(1): 30-37.

Objectives:

The aim of this study was to evaluate the inhibitory effects of L-ascorbic acid-2-O-phosphate-Na(2) (APS), a pro-vitamin C, combined with hyperthermia on the adipogenic differentiation of mouse stromal cells, OP9.

Materials And Methods:

OP9 preadipocytes were differentiated by serum replacement, administered with APS and simultaneously treated with hyperthermia using a capacitance-resistance electric transfer (CRET) device, which was performed twice a day. After 2 days, intracellular lipid droplets were stained with Oil Red O, observed under a microscope, and evaluated by spectrophotometry.

Results:

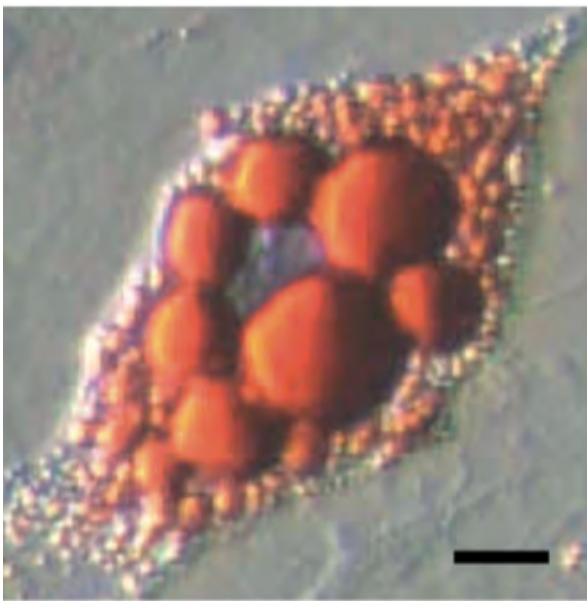
After stimulation with serum replacement for 2 days, lipid droplets accumulated around the nuclei of OP9 cells. When APS was administered without hyperthermia at concentrations of 0.15-0.6 mM, the amount of lipid droplets was significantly reduced to 50.5%, or about -11.3% compared to undifferentiated control, and decreased the large aggregates of lipid droplets. In OP9 cells treated with hyperthermia at 42°C for 0.5 min, 1 min, or 3 min in the absence of APS, adipogenesis was abruptly and time-dependently suppressed by 95.4%, 18.7%, or -5.5%, respectively. In contrast, the percentage of adipogenesis was 96.8% in OP9 cells treated with mild hyperthermia alone at 41°C for 1 minute. Simultaneous application of APS and hyperthermia at 41°C for 1 minute significantly reduced the accumulation of lipid droplets to 25.7%, or about -66.2%. By observation under scanning electron microscopy (SEM), the surface of APS- and hyperthermia-treated OP9 cells appeared to have the morphological property of undifferentiated OP9 cells.



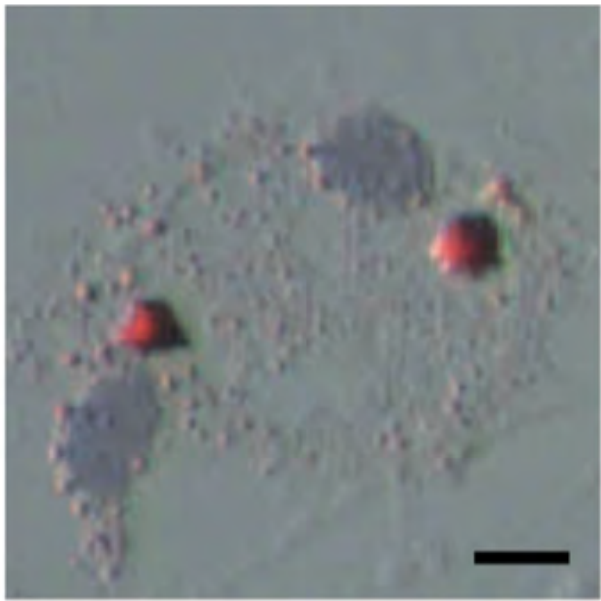
<https://www.tandfonline.com/doi/full/10.3109/02656736.2012.750016>

Conclusions:

The combined treatment of APS and mild hyperthermia suppresses adipogenesis in OP9 cells, particularly the accumulation of lipid droplets during spontaneous differentiation of OP9 preadipocytes.



Differentiated control of CRET (-)



CRET (+) in the presence of 0.6 mM APS

Influence Of Electrodes On The 448 kHz Electric Currents Created By Radiofrequency: A Finite Element Study.

Spottorno J, González de Vega C, Buenaventura M, Hernando A. (2017). Electromagn Biol Med 36(3): 306- 314.

Objectives:

This study aims to evaluate the effectiveness of the INDIBA radiofrequency current in physical rehabilitation by examining the effect of different electrodes on the current density inside the body.

Materials And Methods:

Finite element calculations were performed to study the effect of capacitive and resistive active electrodes on the current density inside the body.

Results:

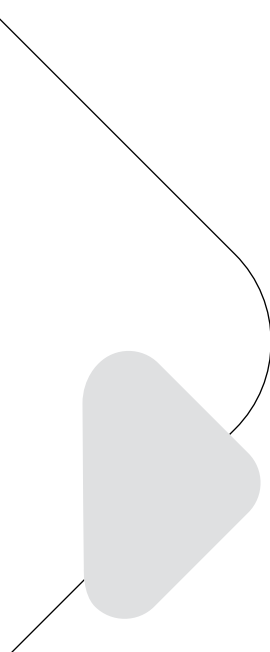
The results showed that capacitive active electrodes were more effective in increasing the current density inside the body compared to resistive electrodes.

Conclusions:


This study suggests that the use of capacitive active electrodes can improve the effectiveness of the INDIBA radiofrequency current in physical rehabilitation. Finite element calculations can help doctors better understand the behavior of the technology and improve treatments.



<https://pubmed.ncbi.nlm.nih.gov/28759286/>



Cell Lines Safety Studies



Carcinostatic Effects Of Diverse Ascorbate Derivatives In Comparison With Aliphatic Chain Moiety Structures: Promotion By Combined Hyperthermia And Reduced Cytotoxicity To Normal Cells.

Asada R, Kageyama K, Tanaka H, Kimura M, Saitoh Y, Miwa N. *Oncology letters*. 2012;3(5):1042-6.

Objectives:

The objective of this study was to compare the carcinostatic activity of various L-ascorbic acid (Asc) derivatives using human epidermoid carcinoma cells of the tongue (HSC-4).

Materials And Methods:

The study used HSC-4 cells to compare the carcinostatic activity of different Asc derivatives, including linear C(16) chain types such as 6-O-palmitoyl-Asc (A6-P) and Asc-2-phosphate-6-O-palmitate sodium salt (APPS), and branched C(16) chain types, such as Asc-2-phosphate-6-O-(2'-hexyl)decanoate (APHD), isomer of APPS, and Asc-2,3,5,6-O-tetra-(2'-hexyl)decanoate (VCIP). The effects of these derivatives were compared at 37°C and 42°C.

Results:

The order of carcinostatic effects at 37°C was APPS>A6-P=APHD>VCIP, and at 42°C was APPS=A6-P>APHD>VCIP. Thus, the two right

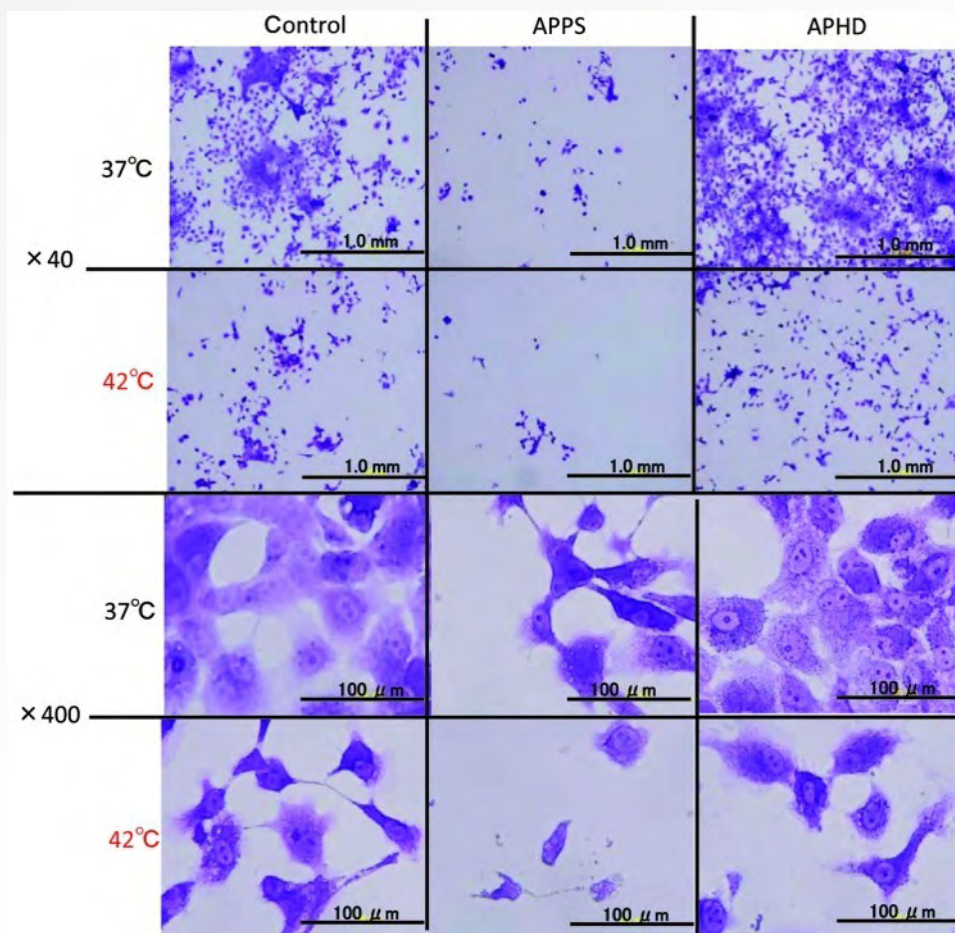
chain C(16) derivatives, APPS and A6-P, had a greater effect than the two branched C(16) chain Asc derivatives, which are considered to have more difficulty "orienting themselves in the cell-membrane-glycerolipid direction". HSC-4 cells treated with APPS showed a decrease in cell number, cell shrinkage, pycnosis indicating apoptosis, and cell deformation. The order of cytotoxicity of normal human dermal fibroblasts (OUMS-36) at 37°C was A6-P (50% inhibitory concentration: 150-300 µM)>APHD (450-600 µM)>>Asc=APPS (800-1000 µM).

Conclusions:

The study found that APPS had a greater advantage than APHD, A6-P, and VCIP in terms of carcinostatic effects at 37°C, promotion of carcinostasis at 42°C, and a decrease in cytotoxicity for normal cells. This observation suggests a marked potential for partial aliphatic chain structures as anticancer agents due to their selective cancer carcinostasis and combined efficacy with hyperthermia without causing side effects.



<https://www.ncbi.nlm.nih.gov/pubmed/22783388>



Cytostatic Response Of HepG2 To 0.57 MHz Electric Currents Mediated By Changes In Cell Cycle Control Proteins.

Hernández-Bule ML, Cid MA, Trillo MA, Leal J, Úbeda A.
International Journal of Oncology. 2010;37(6).

Objectives:

The objective of this study was to investigate the antiproliferative response of HepG2 cells to capacitive-resistive electric transfer therapy (CRET) and to understand the underlying cellular mechanisms.

Material and Methods:

CRET is a non-invasive therapy that applies electrical currents of 0.4-0.6 MHz to musculoskeletal lesions. In this study, the antiproliferative effects of CRET were investigated in HepG2 cells. The cells were treated intermittently for 24 hours with a current density of 50 $\mu\text{A}/\text{mm}^2$. Changes in the expression and activation of proteins involved in cell cycle control were measured using Western blot analysis.

Results:

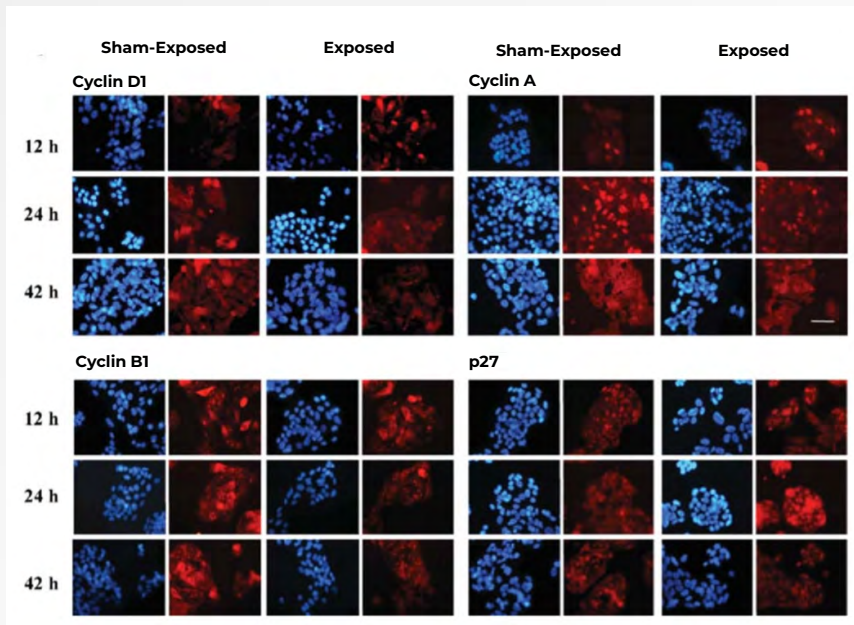
The results showed that the treatment with CRET induced statistically significant changes in the expression and activation of p27Kip1 and cyclins D1, A, and B1, which are key regulators of the cell cycle in HepG2 cells. These changes were consistent with alterations reported in the cell cycle of HepG2 cells following exposure to the same electrical treatment. The study proposes that the antiproliferative effect of CRET is mainly mediated by changes in the expression and activation of proteins involved in the regulation of the cell cycle, which are targets of new chemical therapies.

Conclusions:

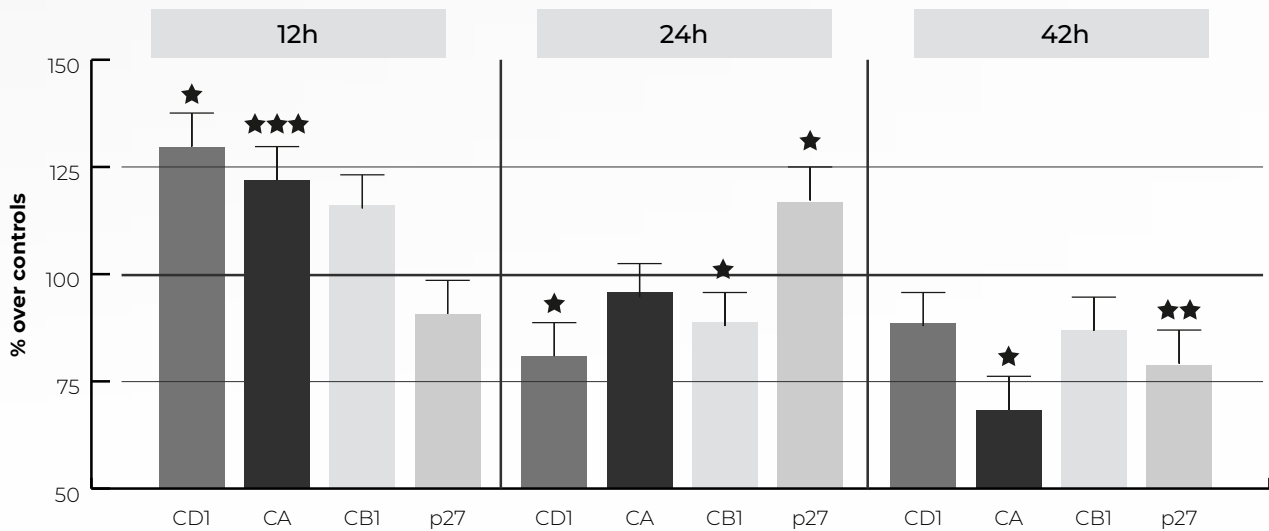
The ability to stop the cell cycle by electrically induced changes in cell cycle control proteins could open up new possibilities in the field of oncology. Although CRET has been shown to be effective in clinical studies, further research is needed to fully understand its mechanisms of interaction at the cellular level.



<https://pubmed.ncbi.nlm.nih.gov/21042707/>

A**B**

Quantification through immunofluorescence



(A) Representative immunofluorescent photomicrographs showing nuclear and cytoplasmic cyclins D1, A and B1 and protein p27Kip1 expression after 12 or 24 h of exposure or sham-exposure and after 18 h of post-incubation in the absence of the electric stimulus (42 h). Revealed with Alexa Red. The DNA was stained with Hoechst 33342. Bar, 50 μm.

(B) Quantification through immunofluorescence; means ± SEM of a minimum of three experimental replicates per protein and time interval. Data normalised over the respective controls. Student's t-test; *0.01 ≤ p ≤ 0.05; **0.001 ≤ p ≤ 0.01; *** < 0.001.

Nonthermal Levels Of Electric Currents Applied In Capacitive Electric Transfer Therapy Provoke Partial Cytotoxic Effects In Human Neuroblastoma Cultures.

Hernandez-Bule, M. L., et al. (2004). Neurocirugia (Astur) 15(4): 366-371; discussion 371. (Article in Spanish)

Objectives:

The objective of this study is to investigate the cellular response to low-frequency sinusoidal electrical currents of 0.5 MHz.

Materials And Methods:

Experimental exposure to signals identical to those used in clinical thermotherapy using capacitive transfer electrical therapy (CTET) at an intensity sufficient to significantly increase tissue temperature in target areas was used. The study was conducted in vitro using human neuroblastoma cells. The doses of electrical signals applied were sub-thermal.

Results:

The results of the study indicate that in vitro exposure to sub-thermal CTET signals induces cytotoxic effects in human neuroblastoma cells. The response is likely due to alterations in the cell cycle induced by the electrical signal. Overall, the study suggests that the potential therapeutic effects of CTET strategy may be due to both the thermal response of tissues to the electrical currents and the athermal response of cells to the electrical signal itself.

Conclusions:

The results of this study highlight the potential of CTET as a therapeutic strategy for tumors. The athermal effects of the electrical signals on cells may provide an additional mechanism for the efficacy of CTET in addition to the thermal effects on tissues.



<https://pubmed.ncbi.nlm.nih.gov/15368027/>

In Vitro Exposure To 0,57MHz Electric Currents Exerts Cytostatic Effects In HepG2 Human Hepatocarcinoma Cells.

Hernández-Bule ML, Trillo MA, Cid MA, Leal J, Úbeda A.
Int J Oncol. 2007; 30:583-92.

Objectives:

The objective of this study was to investigate the response of human HepG2 cells to CRET currents of 0.57 MHz at subthermal densities.

Materials And Methods:

The non-invasive technique of capacitive-resistive electrical transfer therapy (CRET) was used to apply electrical currents of 0.45 to 6 MHz to increase the internal temperature of targeted tissues transdermally and focally. Previous studies have shown that the electrical stimulus could induce cooperative or synergistic responses in exposed tissues, which are more effective than other thermal therapies. Short and repeated stimuli with currents of 0.57 MHz at subthermal levels have been demonstrated to cause partial cytotoxic effects on human neuroblastoma cells in vitro. In this study, the response of human HepG2 cells to CRET currents was investigated during and after exposure to 0.57 MHz currents at subthermal densities.

Results:

The electrical stimuli caused a decrease in the proliferation rate of the cultures, probably due to an electrical block of the cell cycle in a fraction of the cell population.

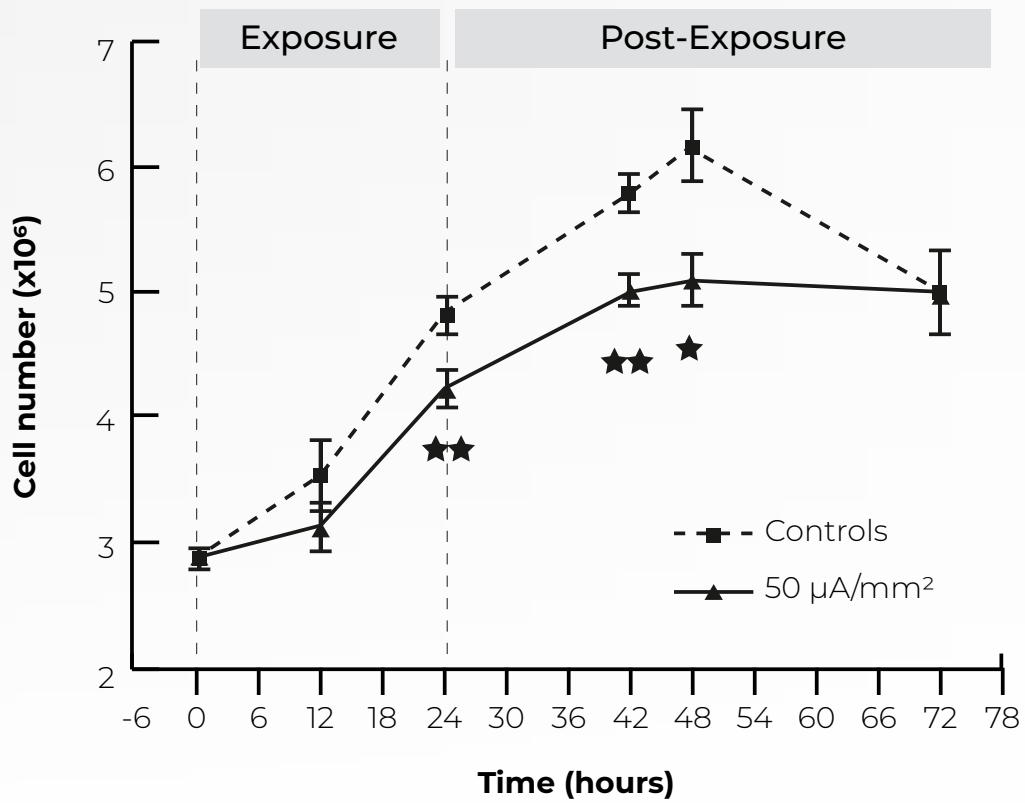
Conclusions:

The study shows that CRET currents at subthermal densities can induce cytotoxic effects on human HepG2 cells. The electrical block of the cell cycle in a fraction of the cell population may be the cause of this effect. These findings suggest that CRET may have potential as a novel therapy for the treatment of human hepatocarcinoma.



<https://pubmed.ncbi.nlm.nih.gov/17273759/>

Hepatocarcinoma Cells



Response Of Neuroblastoma Cells To RF Currents As A Function Of The Signal Frequency.

Hernandez-Bule ML, Medel E, Colastra C, Roldan R, Úbeda A. BMC cancer. 2019 ; 19 (1): 889.

Objectives:

The objective of this study is to analyze the relevance of frequency signal in the response to the human NB69 cell line during subthermal electrical treatment with four distinct frequencies located between 350 and 650 kHz.

Materials And Methods:

Trypan blue test, flow cytometry, immunofluorescence, and immunotransfer were used to study the effects of subthermal CRET waves on cell viability, cell cycle progression, and the expression of several protein markers involved in cell death and proliferation of NB69 cells.

Results:

Among the tested frequencies, only a 448 kHz wave induced a statistically significant pro-apoptotic and anti-proliferative response. The apoptotic effect is due, at least in part, to the

significant changes induced by the 448 kHz wave in the expression of p53, Bax, and caspase-3. The cytostatic response was preceded by changes in cell cycle kinetics and the expression of p-ERK1/2, cyclin D1, and p27 proteins, which corresponds to the potential involvement of the EGF receptor in the changes generated by the wave in the ERK1/2 pathway. This element supports the results showing that pro-apoptotic and anti-proliferative responses to CRET can be transiently blocked when the electrical signal is applied in the presence of PD98059, a chemical inhibitor of the ERK1/2 pathway.

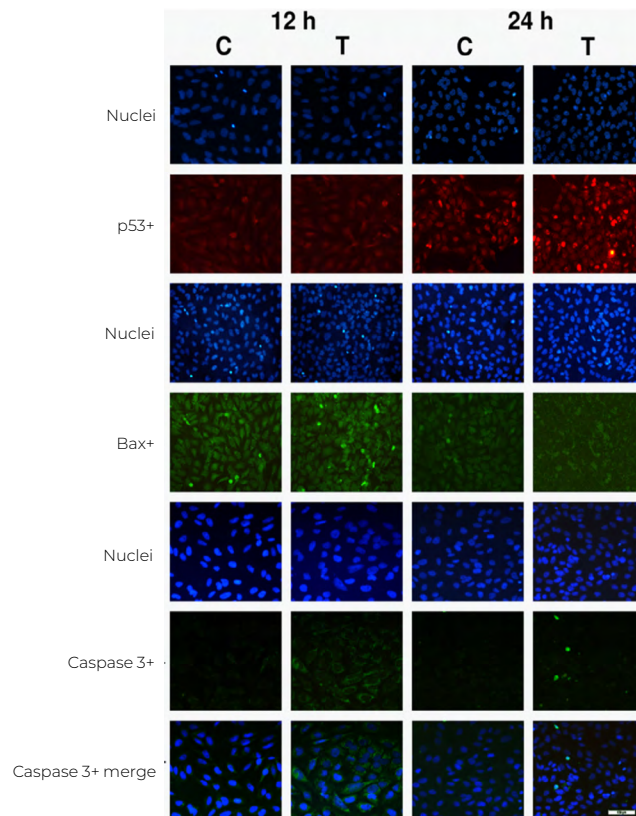
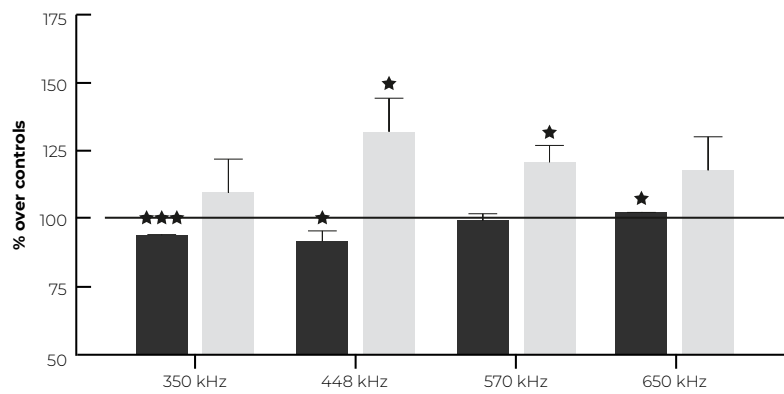
Conclusions:

The understanding of mechanisms that slow down cancer cell growth by inducing changes in the expression of proteins involved in cell proliferation control and apoptosis through an electric wave presents new perspectives in oncology.



<https://www.ncbi.nlm.nih.gov/pubmed/?term=hern%C3%A1ndez-bule+2019>
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6728948/>

Neuroblastoma Cells



Radiofrequency Currents Exert Cytotoxic Effects in Nb69 Human Neuroblastoma Cells But Not In Peripheral Blood Mononuclear Cells.

Hernández-Bule ML, Roldan E, Matilla J, Trillo MA, Ubeda A.
Int J Oncol. 2012;41(4): 1251-9.

Objectives:

The objective of this study was to expand the knowledge of the cellular and molecular mechanisms involved in the response to subthermic electrical stimulation in cancer treatment, specifically in neuroblastoma cells, by comparing the response of these cells to that of primary cultures of human peripheral blood mononuclear cells (PBMC) exposed to the same treatment.

Materials And Methods:

The study utilized the capacitive-resistive electric transfer therapy (CRET) which involves applying electric currents at frequencies ranging from 0.45 to 0.6 MHz to induce hyperthermia in target tissues. The study compared the response of NB69 human neuroblastoma cells to that of PBMCs exposed to subthermic electrical stimulation at a frequency of 0.57 MHz.

Results:

The results showed that PBMCs were not sensitive to the subthermic electrical currents of 0.57 MHz, confirming the cytotoxic effects of the treatment on NB69 cells. The study also revealed a cytostatic response of the neuroblastoma cell line, which was previously undetected. The CRET currents significantly reduced the fraction of cells in the G2/M phase of the cell cycle at 12 hours of exposure, affecting the proliferation of NB69 cells.

Conclusions:

This study provides new insights into the mechanisms of response to CRET treatment, indicating the cytotoxic and/or cytostatic effects of electrical stimulation on human tumor cells, while sparing normal cells with a low rate of proliferation. The findings suggest that CRET therapy may be a promising treatment for specific types of cancer.



<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3583634/>

Molecular Mechanisms Underlying Antiproliferative And Differentiating Responses Of Hepatocarcinoma Cells To Subthermal Electric Stimulation.

Hernández-Bule ML, Trillo MA, Ubeda A.
PLoS One. 2014;9(1):e84636.

Objectives:

The objective of this study was to investigate the molecular mechanisms involved in cryostasis induced by resistive capacitively coupled electrical transfer therapy (CRET) and to examine the possibility that the cellular response to treatment extends to other phenomena, such as the induction of apoptosis and/or changes in the differentiation stage of hepatocarcinoma cells.

Materials And Methods:

Currents of 0.4-0.6 MHz were applied at subthermal doses to treat inflammatory and musculoskeletal lesions. Previous studies have shown that intermittent exposure to these currents exerts cytotoxic or antiproliferative effects on human neuroblastoma or hepatocarcinoma cells. In this study, intermittent stimulation (5 m On/4 h Off) with 0.57 MHz, sinusoidal signal at a current density of 50 microA/mm² was used to evaluate its effects on hepatocarcinoma cells. Tests were performed to study changes in the expression

of p53 and Bcl-2 proteins, apoptotic rate, alpha-fetoprotein expression, and albumin concentration released in the medium.

Results:

The results show that intermittent stimulation with 0.57 MHz can be mediated by a significant increase in apoptotic rate as well as significant changes in the expression of p53 and Bcl-2 proteins. The results also revealed a significant decrease in alpha-fetoprotein expression in treated samples, combined with an increased concentration of albumin released in the medium by stimulated cells, which may be interpreted as evidence of a transient cytodifferentiation response induced by the current.

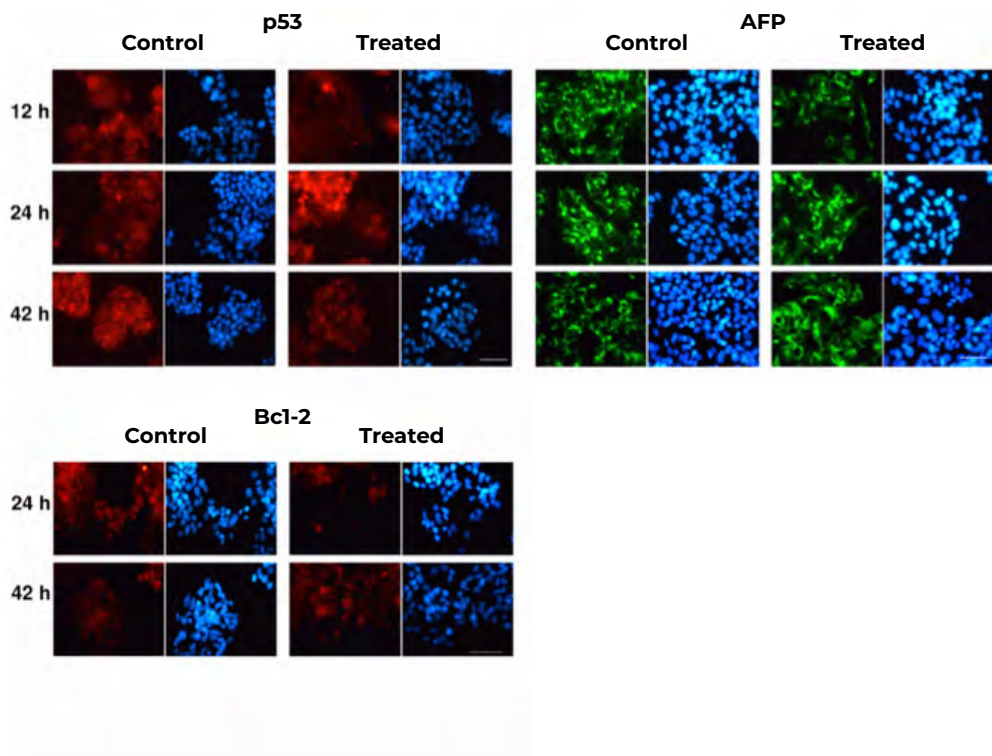
Conclusions:

Resistive capacitively coupled electrical transfer therapy (CRET) can promote both differentiation and cell cycle arrest in human cancer cells. The results of this study present a potential interest for the possible extension of CRET therapy applications to the field of oncology.

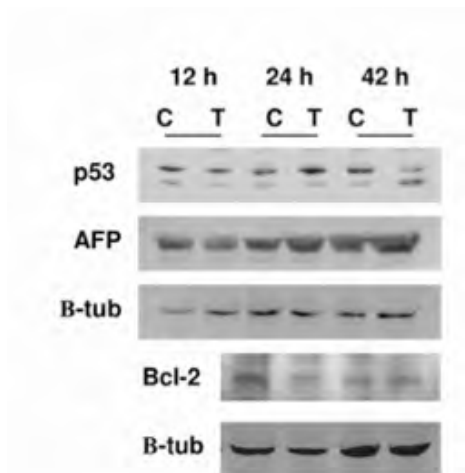


<https://pubmed.ncbi.nlm.nih.gov/24416255/>

A



B



Anticancer Effects Of 6-O-Palmitoyl-Ascorbate Combined With A Capacitive-Resistive Electric Transfer Hyperthermic Apparatus As Compared With Ascorbate In Relation To Ascorbyl Radical Generation.

Kato S, Asada S, Kageyama K, Saitoh Y, Miwa N. *Cytotechnology*. 2011;63(4): 425- 35.

Objectives:

The objective of this study is to determine the antiproliferative activity of 6-O-palmitoyl-L-ascorbic acid (Asc6Palm), a lipophilic derivative of L-ascorbic acid (Asc), on HSC-4 human squamous tongue carcinoma cells using combined hyperthermia in comparison to Asc.

Materials And Methods:

Asc6Palm or Asc was administered to HSC-4 cells for 1 hour, after which hyperthermia at 42°C was applied for 15 minutes. Following additional incubation for 1 to 72 hours at 37°C, cell proliferation was determined by Crystal Violet staining. The ascorbyl radical (AscR) in the HSC-4 cell suspension was measured by electron spin resonance (ESR), and cellular morphology was observed by scanning electron microscopy (SEM).

Results:

At 37°C, 4 mM Asc or 0.35 mM Asc6Palm were sufficient to suppress HSC-4 cell proliferation. Through the combined use of hyperthermia at 42°C, cell proliferation decreased compared to 37°C. After incubation with 4 mM Asc in HSC-4 cell suspensions at 37°C or 42°C for 0-180 minutes, the intensity of the AscR signal by ESR did not vary regardless of the presence of cells at 37°C, while AscR increased in the presence of HSC-4 cells at 42°C. It was suggested that Asc oxidation occurred rapidly in HSC-4 cells due to hyperthermia, which increased antiproliferative activity. By SEM observation, the surface of HSC-4 cells treated with Asc6Palm revealed distinct morphological changes. Therefore, the combined treatment of Asc6Palm and hyperthermia should exert marked antitumor activity.

Conclusions:

Asc6Palm, a lipophilic derivative of Asc, combined with hyperthermia has potent antitumor activity on HSC-4 cells. The results suggest that Asc6Palm may be a useful candidate for cancer therapy.



<https://pubmed.ncbi.nlm.nih.gov/21667158/>

Synergic Carcinostatic Effects Of Ascorbic Acid And Hyperthermia On Ehrlich Ascites Tumor Cell.

Saitoh Y, Yoshimoto T, Kato S, Miwa N.
Exp Oncol. 2015;37(2): 94-9.

Objectives:

In this study, we evaluated the anticarcinogenic effects of combined ascorbic acid (AsA) and capacitively-resistively coupled hyperthermia (CRET) treatment induced by the device on Ehrlich ascites tumor (EAT) cells.

Materials And Methods:

EAT cells were exposed to various concentrations of AsA (0-10 mM) for 1 hour, followed by CRET treatment for 15 minutes at 42 degrees Celsius. Cell viability was evaluated by the WST-8 assay 24 hours after the combined treatment. The involvement of reactive oxygen species was evaluated using catalase and tempol; caspase-3/7 activation was determined by their fluorescent substrates; cell proliferation was estimated by time-lapse observation. The effect on the cell cycle was analyzed by flow cytometry.

Results:

The combined AsA and CRET treatment synergistically suppressed cell viability compared to either treatment alone, and these synergistic anticarcinogenic effects were evident even at non-cytotoxic concentrations of AsA alone (≤ 2 mM). The anticarcinogenic effects of the combined AsA and CRET treatment were dose-dependently attenuated by the addition of catalase, but not by the superoxide anion scavenger radical tempol. Time-lapse observation revealed that the combined AsA and CRET treatment activated caspase-3/7 from 10 to 24 hours after treatment, accompanied by a significant suppression of cell growth. Cell cycle analysis showed that the rate of cells in sub-G1 phase (apoptotic) was significantly increased at 12 and 24 hours, and cells in G2/M phase increased gradually between 6 and 24 hours after treatment.

Conclusions:

These results indicate that the combined AsA and CRET treatment synergistically inhibits the growth of EAT cells by G2/M arrest and induction of apoptosis through H₂O₂ generation at lower concentrations of AsA, and this anticarcinogenic effect cannot be exerted by AsA alone.



<https://pubmed.ncbi.nlm.nih.gov/26112934/>



Clinical Bases



Posterior Thigh Thermal Skin Adaptation To Radiofrequency Treatment At 448 kHz Applied With or Without Fascia Treatment Tools.

Fousekis K, Chrysanthopoulos G, Tsekoura M, Madalidis D, Mylonas K, Angelopoulos P, et al. Journal of Physical Therapy Science. 2020.

Objectives:

The objective of this study was to observe the cutaneous thermal responses of the posterior thigh during radiofrequency therapy at 448 kHz applied in a conventional manner (INDIBA Rehabilitation) or combined with soft tissue treatment (Fascia).

Participants and Methods:

Ten men (aged 22 years \pm 3 years, weighing 75.2 kg \pm 4.9 kg, measuring 1.785 m \pm 4.7 cm) received four different treatments: a) INDIBA Rehabilitation radiofrequency treatment (IA), b) Fascia treatment (IF), c) placebo INDIBA Activ treatment (IAP), and d) placebo Fascia treatment (IFP), applied to the posterior surface of the supporting thigh, while the other thigh served as the control measurement. Skin temperature was recorded using a wireless infrared thermometer before and after treatment, every minute until the skin surface returned to pre-treatment values.

Results:

The two groups that received IA and IF treatments showed an increase in skin temperature, unlike the two groups that received the placebo. IF resulted in an average temperature increase lasting for 164.2 minutes, compared to 54.8 minutes for IA, 23.17 minutes for placebo IF, and 17.6 minutes for placebo IA.

Conclusions:

These observations demonstrate that radiofrequency therapy at 448 kHz can induce and sustain an increase in cutaneous temperature, improved blood circulation, and enhanced metabolism of underlying tissues. Keywords: Hamstrings, cutaneous temperature, radiofrequency therapy.



<https://pubmed.ncbi.nlm.nih.gov/32273653/>
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7113424/>

Descriptive data of the average posterior thigh skin temperatures before and after treatment interventions

| | | Temperature (°C) | Temperature (°C) | % variation of | Duration of elevated |
|------------------|-------------------------------|------------------|------------------------|----------------|----------------------|
| | | before treatment | 15 min after treatment | temperature | temperature (min) |
| | | Mean | Mean | Mean | Mean |
| Treated side | Fascia | 36.0 | 39.7 | +10.6 | 164.2 |
| | INDIBA Rehabilitation | 36.0 | 39.9 | +10.7 | 54.8 |
| | Fascia placebo | 35.6 | 35.7 | +0.04 | 23.7 |
| | INDIBA Rehabilitation placebo | 35.5 | 34.9 | -1.8 | 17.6 |
| Non-treated side | Fascia | 35.5 | 35.4 | -0.3 | |
| | INDIBA Rehabilitation | 35.6 | 35.5 | -0.1 | |
| | Fascia placebo | 35.6 | 41.7 | +0.2 | |
| | INDIBA Rehabilitation placebo | 35.4 | 35.3 | -0.4 | |

The percentage change in the mean temperature after the 15 min treatment and the duration of elevated temperature (in minutes) for the treated side.

Thermal Build-Up, Decay And Retention Responses To Local Therapeutic Application Of 448 kHz Capacitive Resistive Monopolar Radiofrequency: A Prospective Randomised Crossover Study In Healthy Adults.

Kumaran B, Watson T. Int J Hyperthermie. 2015 ; 31(8): 883-895.

Objectives:

Radiofrequency-based electrophysical agents are widely used in clinical practice for their thermal effects, primarily to alleviate pain and inflammation and improve tissue extensibility. The most commonly used and studied therapies are shortwave therapies that operate at 27.12 MHz. Although relatively new, electrophysical agents employing much lower frequencies have also emerged. Capacitive resistive monopolar radiofrequency at 448 kHz is one such therapy. This laboratory study aimed to investigate the skin's thermal responses to 448 kHz radiofrequency therapy in healthy adults.

Methods:

In a randomized crossover study involving two groups, 15 volunteers underwent two modes (capacitive and resistive) of 448 kHz radiofrequency therapy (using the INDIBA Rehabilitation 902 device) administered locally in the lower thigh region. Starting at the

minimum, the intensity was gradually increased until thermal discomfort was felt. Participants reported three time points: onset of warmth, defined thermal sensation, and onset of thermal discomfort. Local skin temperature was measured before, immediately after, and up to 45 minutes after treatment.

Results:

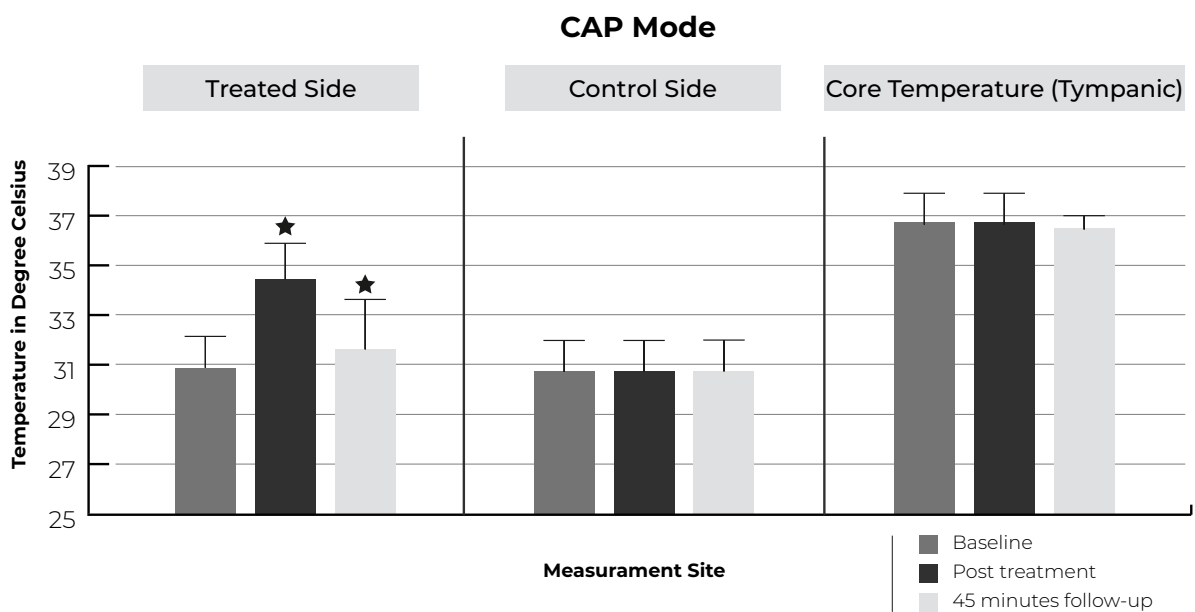
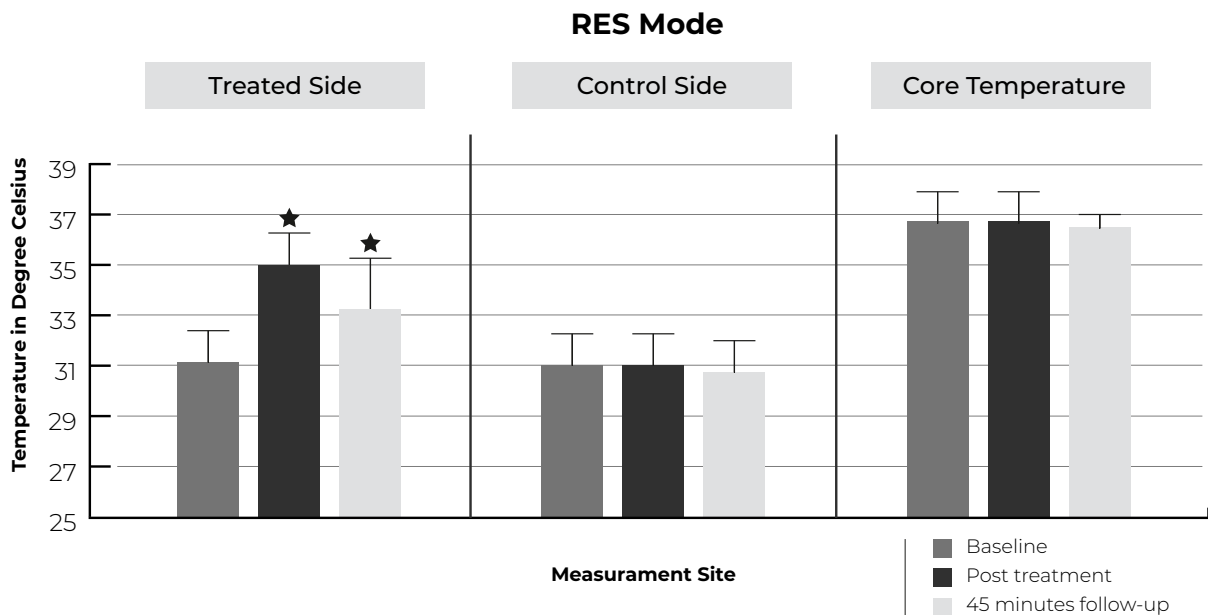
Both capacitive and resistive treatment modes significantly increased skin temperature and maintained it for the 45-minute follow-up. There was a statistically significant difference between the thermal response patterns produced by the two modes. The maximum temperatures reached after treatment were not significantly different between the two; however, the retention rate during follow-up was significantly higher for the resistive mode.



<https://www.ncbi.nlm.nih.gov/pubmed/?term=Thermal+build-up%2C+decay+and+retention+responses+to+local+therapeutic+application+of+of+448+kHz+capacitive+resistive+monopolar+radiofrequency%3A+A+prospective+randomised+crossover+study+in+healthy+adults>

Conclusions:

This study confirms that 448 kHz radiofrequency treatment can significantly increase and maintain skin temperature. The study also provides useful baseline data for further research in the low-frequency ranges of radiofrequency therapy that remain largely unexplored.



Skin Thermophysiological Effects Of 448 kHz Capacitive Resistive Monopolar Radiofrequency In Healthy Adults: A Randomised Crossover Study And Comparison With Pulsed Shortwave Therapy.

Kumaran B, Watson T. Electromagn Biol Med. 2018: 1-12.

Objectives:

Electrophysical agents based on radiofrequency (RF) have been used in therapeutic practice for several decades (e.g., shortwave therapies). Currently, there is insufficient evidence supporting such devices operating under shortwave frequencies. This laboratory study investigated the physiological effects on the skin of 448 kHz capacitive resistive monopolar radiofrequency (CRMRF) and compared them to pulsed shortwave therapy (PSWT).

Materials And Methods:

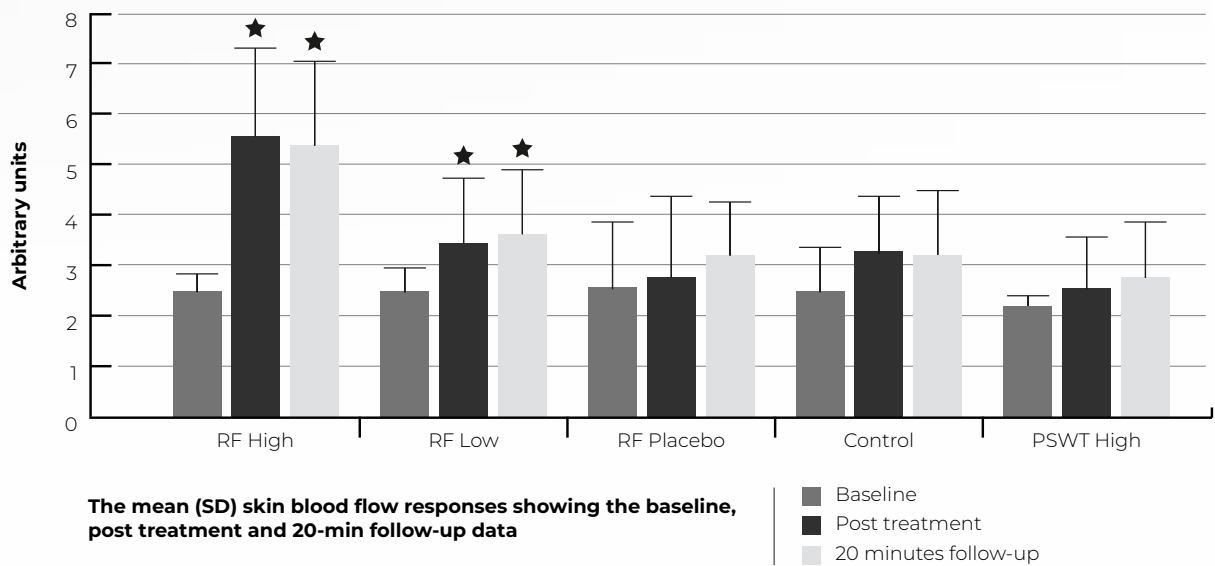
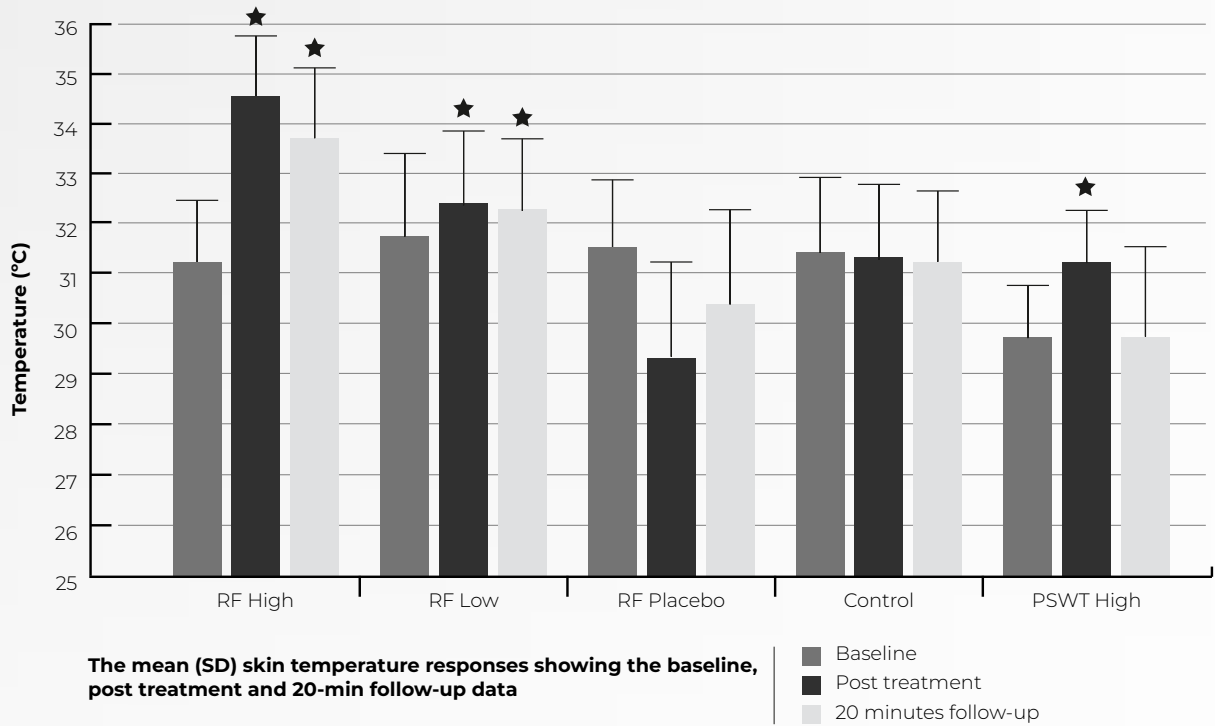
In a randomized crossover study, seventeen healthy volunteers received four treatment conditions - high dose, low dose, placebo (receiving no CRMRF treatment), and a control condition receiving no intervention. Additionally, fifteen participants received a high dose of PSWT for comparison. The treatment was applied to the lower right medial thigh. Measurements of skin temperature (SKT), cutaneous blood flow (SBF), and nerve conduction velocity (NCV) were obtained before, immediately after, and 20 minutes post-treatment using the Biopac MP150 system. Group data were compared using ANOVA. Statistical significance was set at $p \leq 0.05$ (0.8P, 95% CI).

Results:

Significant and sustained increases in SKT with both high and low dose CRMRF were demonstrated compared to the other groups ($p < 0.001$). PSWT significantly increased SKT ($p < 0.001$) but failed to sustain it during follow-up. However, among the five conditions evaluated, only high-dose CRMRF significantly and sustainably increased SBF ($p < 0.001$). Overall, the physiological responses of CRMRF were significantly more pronounced than those of PSWT. No significant changes were noted in NCV for any condition. The physiological changes associated with CRMRF were more pronounced than those associated with PSWT, placebo, or the control group. Any potentially greater therapeutic benefit of CRMRF needs to be confirmed through comparative clinical studies.

Conclusions:

This laboratory study demonstrated that CRMRF, compared to PSWT, resulted in significant and sustained increases in skin temperature and cutaneous blood flow. These findings support the potential efficacy of CRMRF as a therapeutic agent in the treatment of skin-related conditions. However, further clinical studies are required to confirm and compare the therapeutic benefits of CRMRF in a clinical setting.



Continuous-Mode 448 kHz Capacitive Resistive Monopolar Radiofrequency Induce Greater Deep Blood Flow Changes Compared To Pulsed Mode Shortwave: A Crossover Study In Healthy Adults.

Kumaran B, Herbland A, Watson T.
European Journal of Physiotherapy. 2017;19(3): 137-46.

Objectives:

The objective of this laboratory study was to investigate the profound physiological effects of monopolar capacitive resistive radiofrequency (CRMRF) at 448 kHz compared to pulsed shortwave therapy (PSWT). The aim was to assess the therapeutic potential of CRMRF and compare it to the commonly used PSWT, as there is a lack of sufficient evidence supporting the efficacy of radiofrequency electrophysical agents (AEP) operating at shortwave frequencies.

Materials And Methods:

In a randomized crossover study, 17 healthy volunteers received four treatment conditions: high dose, low dose, placebo CRMRF treatment for 15 minutes, and a control condition with no intervention. Additionally, 15 participants received a high dose of PSWT as a fifth condition for comparison. Pre- and post-treatment measurements of deep blood flow and tissue extensibility were obtained using Doppler ultrasound and sonoelastography. Group data were compared using an analysis of variance (ANOVA) model, with statistical significance set at $p < 0.05$, power of 0.8, and a 95% confidence interval.

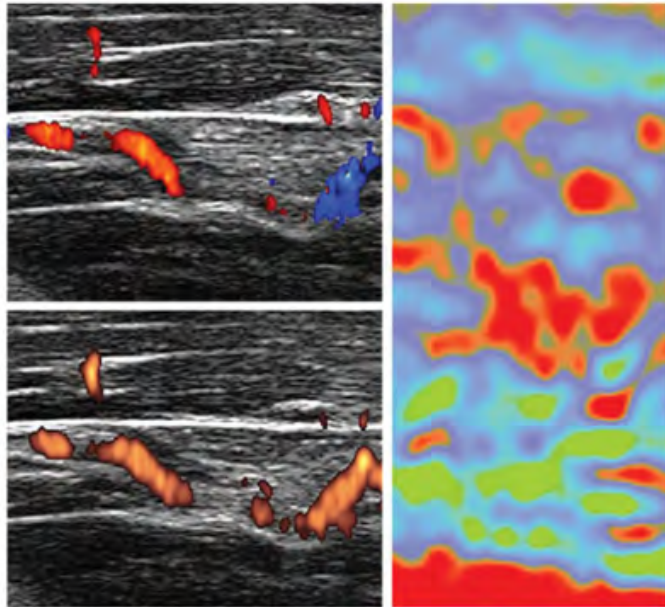
Results:

Significant increases in volume and intensity of deep blood flow were observed with CRMRF compared to the placebo, control ($p = 0.003$), and PSWT ($p < 0.001$). No significant changes in blood flow velocity or tissue extensibility were noted for any condition.

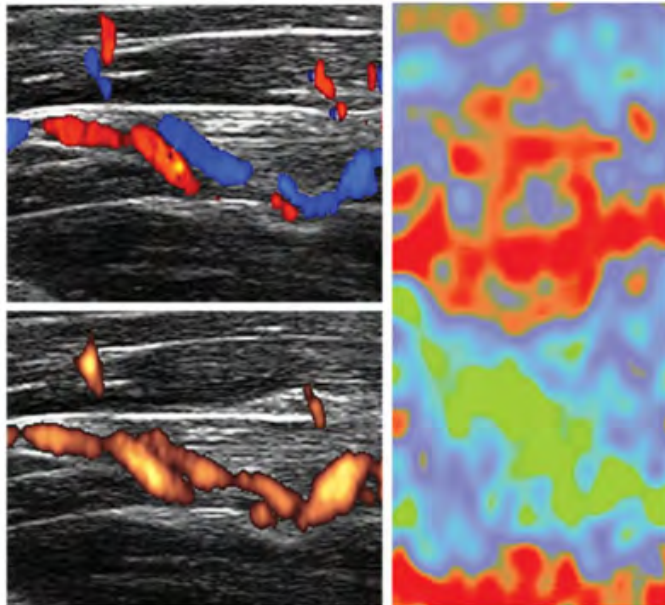
Conclusions:

The profound changes in deep blood flow observed with CRMRF were more pronounced than with PSWT, placebo, or control. These findings suggest that CRMRF may have greater therapeutic potential. However, further comparative clinical studies are needed to confirm these potential benefits.

Pre-intervention



Post intervention



Non Invasive Intracranial Hyperthermia With Electric Capacitive Transference -Ect- Intratumoral And Cerebral Thermometry Results.

Ley-Valle A. Neurocirugía. 2003;14:5.

Objectives:

The objective of this study is to evaluate the effect of external capacitive and resistive therapy (TEC-TER) on malignant gliomas, focusing on intracranial temperature changes in tumor and healthy tissues.

Materials And Methods:

TEC-TER, a technique developed by INDIBA, is used for external applications. It generates an increase in temperature internally through the transformation of "Cold Energy" (electrons) into power (Watts) when passing through certain semiconductors (living tissues), resulting in thermal elevation. A thermal probe is used for measurement.

Results:

The study presents intracranial isotherms obtained using a thermal probe, comparing the temperature changes in tumor and healthy tissues with the application of TEC-TER. The results demonstrate that TEC-TER induces a significant increase in temperature specifically in malignant gliomas, while having no effect on healthy tissues. This differential effect is attributed to the absence of vascular autoregulation and the unique metabolic characteristics of tumor tissue. The intracranial temperature elevation achieved with TEC-TER supports its potential as a therapeutic approach for malignant gliomas.

Conclusions:

The findings of this study highlight the efficacy of TEC-TER, an external capacitive and resistive therapy, in inducing localized hyperthermia in malignant gliomas. The ability of TEC-TER to selectively target tumor tissue and generate temperature elevation holds promise for its application in neurosurgery. Further research and clinical trials are warranted to evaluate the full therapeutic potential of TEC-TER in the treatment of malignant gliomas and other tumor types.

Effect Of Capacitive And Resistive Electric Transfer On Haemoglobin Saturation And Tissue Temperature.

Tashiro Y, Hasegawa S, Yokota Y, Nishiguchi S, Fukutani N, Shirooka H, Tasaka S, Matsushita T, Matsubara K, Nakayama Y, Sonoda T, Tsuboyama T, Aoyama T.

Int J Hyperthermie. 2017: 1-7.

Objectives:

This study aims to evaluate the effects of capacitive and resistive electric transfer (CRET) and hot compression (HP) on hemoglobin saturation and tissue temperature.

Materials And Methods:

The participants were 13 healthy men (mean age 24.5 years +/- 3.0 years). They underwent three interventions on different days: (1) CRET (CRET group), (2) HP (HP group), and (3) CRET without power (sham group). The intervention and measurement were applied at the level of the lower paraspinal muscle. The active ProRecovery HCR902 INDIBA(R) was used in the CRET group, and the wet heat method was used in the HP group. Oxygenated, deoxygenated, and total hemoglobin levels (oxy-Hb, deoxy-Hb, total-Hb) were measured before and after the 15-minute interventions, as well as the temperature on the skin surface and at depths of 10 mm and 20 mm (ST, 10mmDT, and 20mmDT, respectively). Hemoglobin saturation and tissue temperature were measured up to 30 minutes after the

intervention and collected every 5 minutes. Statistical analysis was performed for each index using the Mann-Whitney U test to compare all groups at each time point.

Results:

Total Hb and oxy-Hb were significantly higher in the CRET group than in the HP group for 30 minutes uninterrupted after the intervention. The 10mmDT and 20mmDT were significantly higher in the CRET group than in the HP group from 10 to 30 minutes after the intervention.

Conclusions:

The effect on hemoglobin saturation was higher in the CRET group than in the HP group. Additionally, the CRET intervention effectively warmed the deep tissues more than the HP intervention.

Total Hb

| CRET | HP | Sham |
|---------------------|--------------------|-------------------|
| 86.4 (73.8-100.4) | 86.4 (62.1-100.8) | 90.5 (76.5-104.9) |
| 96.8 (80.8-107.1)*§ | 93.2 (71.1-105.2)† | 88.7 (76.0-100.8) |
| 97.2 (79.8-107.6)*§ | 93.6 (72.5-104.9)† | 90.3 (78.2-105.3) |
| 99.0 (80.4-105.3)*§ | 92.3 (71.1-103.8)† | 89.2 (77.4-101.3) |
| 98.0 (80.6-109.1)*§ | 93.6 (71.1-104.0)† | 89.9 (77.0-100.3) |
| 98.2 (80.4-108.4)*§ | 92.7 (69.3-104.1)† | 90.6 (77.4-100.4) |
| 98.1 (79.8-108.9)*§ | 92.3 (69.8-103.8)† | 92.6 (78.3-99.5) |

Oxy-Hb

| CRET | HP | Sham |
|--------------------|-------------------|------------------|
| 86.4 (73.8-100.4) | 53.6 (39.2-67.1) | 58.5 (45.5-65.7) |
| 65.8 (58.5-76.1)*§ | 60.0 (48.2-75.2)† | 56.3 (45.0-69.0) |
| 66.6 (59.9-76.1)*§ | 61.3 (49.1-75.1)† | 55.8 (47.3-69.5) |
| 65.4 (59.9-74.7)*§ | 60.2 (48.6-74.3)† | 56.3 (46.4-68.5) |
| 64.8 (56.3-77.9)*§ | 60.5 (49.1-74.3)† | 55.8 (46.4-69.0) |
| 64.8 (57.2-77.4)*§ | 60.0 (47.7-74.1)† | 55.8 (47.3-68.4) |
| 64.8 (56.3-77.9)*§ | 59.4 (48.2-74.0)† | 56.3 (46.8-69.0) |

Deoxy-Hb

| CRET | HP | Sham |
|------------------|------------------|------------------|
| 32.9 (16.7-36.0) | 30.2 (22.1-39.6) | 33.8 (28.8-40.1) |
| 30.6 (15.0-35.6) | 30.2 (19.8-38.0) | 32.4 (29.0-39.6) |
| 30.6 (14.8-34.7) | 30.6 (18.9-38.1) | 32.0 (28.8-39.2) |
| 31.4 (15.0-34.7) | 30.2 (19.0-37.9) | 31.9 (28.4-39.6) |
| 31.2 (15.3-35.1) | 29.7 (19.8-38.0) | 32.0 (28.8-39.2) |
| 31.1 (15.4-35.6) | 30.0 (19.5-37.8) | 32.0 (28.0-39.2) |
| 32.0 (15.0-36.0) | 30.2 (19.4-38.0) | 32.0 (27.9-39.0) |

Effect Of Capacitive And Resistive Electric Transfer On Tissue Temperature, Muscle Flexibility, And Blood Circulation.

Yokota Y, Tashiro Y, Suzuki Y, Tasaka S, Matsushita T, Matsubara K, Kawagoe M, Sonoda T, Nakayama Y, Hasegawa S, Aoyama T. J Nov Physiother. 2017;07(01).

Objectives:

The differences between capacitive and resistive electric transfer (CRET) and hot pack (HP) in their effects on tissue temperature, muscle flexibility, and blood circulation are unknown. This study aimed to clarify the effect of CRET and HP on tissue temperature, muscle flexibility, and blood circulation.

Methods:

Participants were 13 healthy adults. They randomly underwent three 15-minute interventions: (1) CRET, (2) HP, and (3) motorized CRET-free (trial). The intervention and measurement were applied to the right hamstring muscle. The INDIBA Rehabilitation HCR902 device was used in the CRET study. The moist heat method was used in the HP trial. Measurement indices were surface temperature (ST), temperature at 10 mm depth (DT), and 20 mm DT temperature; passive straight leg raise (SLR) test; and concentrations of oxygenated (oxy), deoxygenated (deoxy),

and total (Hb) hemoglobin. Each index was measured for 30 minutes after the intervention, and the amount of variation (Δ) from the pre-intervention value was calculated.

Results:

Δ ST, Δ 10 mm DT, Δ 20 mm DT, Δ oxy-Hb, and Δ total-Hb were significantly higher in both CRET and HP trials compared to the simulated trial for 30 minutes after the intervention ($p < 0.05$). Δ SLR was significantly higher in the CRET study than in the HP study from 15 to 30 minutes after the intervention ($p < 0.01$).

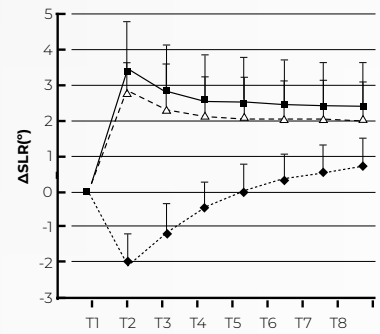
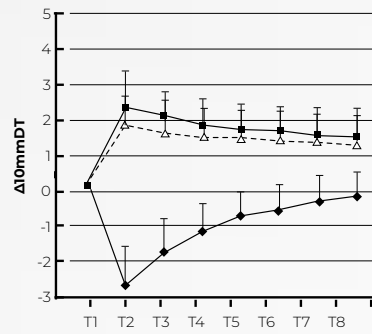
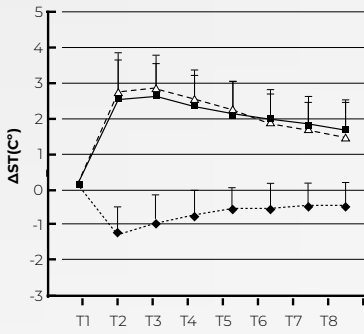
Conclusions:

Our results indicate that CRET is an effective method for preventing and treating musculoskeletal injuries and improving muscle flexibility. Furthermore, it can improve blood circulation as well as HP can.

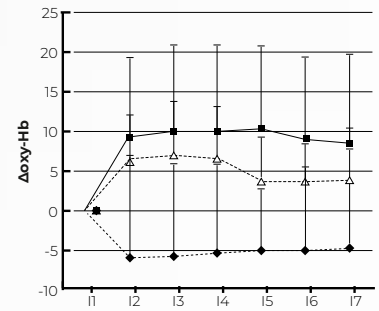
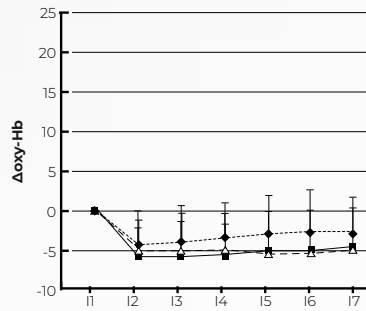
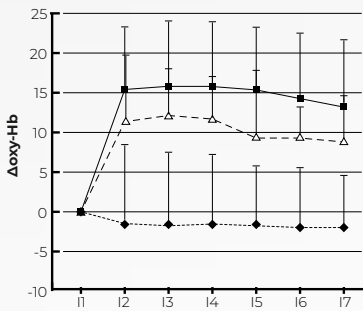


<https://www.omicsonline.org/open-access-pdfs/effect-of-capacitive-and-resistive-electric-transfer-on-tissue-temperature-muscle-flexibility-and-blood-circulation-2165-7025-1000325.pdf>

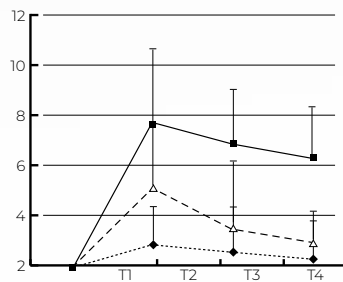
Changes in Tissue Temperature



Changes in Blood Circulation



Changes in Tissue Flexibility





Clinical Research Rehabilitation





Physiotherapy



Structural Changes In Refractory Epitrochlear Tendinopathy After The Combined Application Of Percutaneous Needle Electrolysis, PRP And Active Biological Stimulus In A Professional Tennis Player.

Fernández-Galiano B, Gómez-Domínguez S.
J Invasive Tech Phys Ther. 2016;1(2):2.

Objectives:

The objective of this communication was to describe the case of a professional tennis player with chronic epicondylitis treated with percutaneous needle electrolysis (PNE), PRP, and active biological stimulus.

Materials And Methods:

A 34-year-old professional tennis player with a 7-month history of left epicondylitis was unable to continue his sports activity due to functional impairment secondary to the injury. Imaging studies (MRI and ultrasound) confirmed the presence of epicondylar tendinosis with intrasubstance rupture of the epicondylar tendon. The patient received 2 Celestone + Scandinebsa infiltrations in the 5 months prior to treatment. A conservative, minimally invasive 8-week treatment program was planned, in which invasive physiotherapy techniques were combined with active loading exercises. The aim was to restore tendon functionality, avoid surgery, and re-adapt the tendon to support the necessary loads for professional tennis. An external physiotherapist performed an initial and final evaluation of the case. Invasive physiotherapy interventions were performed by a second physiotherapist, while active rehabilitation work was planned and

supervised by a third physiotherapist. The materials used were GE Logiq S7 and S8, INDIBA Rehabilitation 902, Physio Invasiva®, Kit Orthopass 20 ml by Proteal, Agu-punt 25 mm needles, and the sports facilities of the Chamartín Tennis Club.

Results:

The ultrasound examination by the physiotherapist blinded to the treatment process revealed structural changes in the tendon, with an absence of neovascularization and increased tissue resistance, evaluated by elastography. At the same time, the patient's symptoms improved, and functionality was restored.

Conclusions:

After 8 weeks of treatment, and considering the visible structural changes on the ultrasound images, we can conclude that the combination of PNE + PRP + active biological stimulus is an effective therapeutic option in cases of refractory epicondylitis. The patient's functionality is optimal, and they are able to return to training before the competition.

Acute Effects Of Capacitive And Resistive Electric Transfer On The Achilles Tendon.

Bito T, Tashiro Y, Suzuki Y, Kajiwara Y, Zeidan H, Kawagoe M, et al.
Biologie électromagnétique et médecine. 2018

Objectives:

The objective of this study was to investigate the acute effects of Capacitive-Resistive Electric Transfer (CRET) on Achilles tendon elongation during muscle contraction and circulation in the peritendinous region.

Materials And Methods:

Sixteen healthy male participants were included in this study. Each participant underwent two interventions: (1) CRET and (2) CRET without power (sham trial). Tendon elongation was measured four times. Near-infrared spectroscopy was used to measure blood circulation (total hemoglobin volume, oxygenated hemoglobin, and deoxygenated hemoglobin) for 5 minutes before and 30 minutes after the intervention. Differences between measurements before and after the intervention were compared between the two interventions.

Results:

There were no significant differences in tendon elongation and deoxygenated hemoglobin between the two interventions. However, total hemoglobin and oxygenated hemoglobin increased significantly in the CRET trial compared to the sham trial. Moreover, the increases in total hemoglobin and oxygenated hemoglobin lasted for 30 minutes after the CRET intervention (CRET vs. sham: oxy-Hb: $F = 8.063$, $p = 0.001$, total Hb: $F = 4.564$, $p = 0.011$).

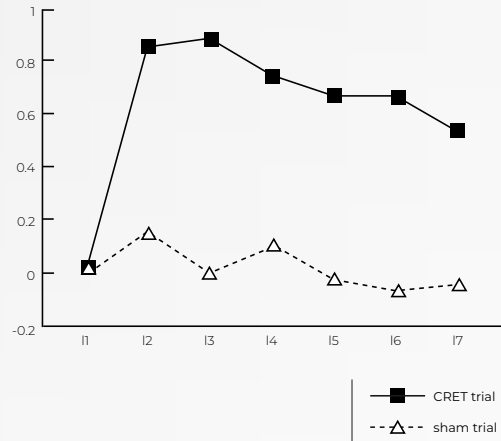
Conclusions:

The CRET current significantly improved blood circulation in the peritendinous region.

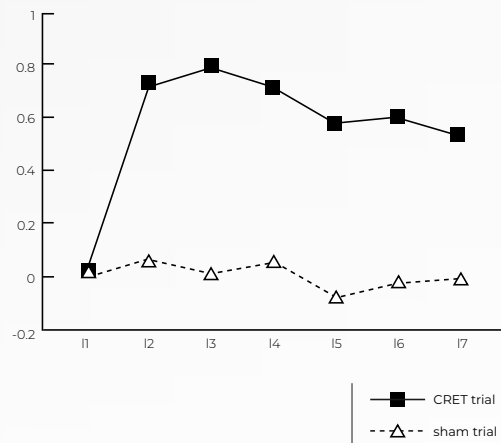


<https://pubmed.ncbi.nlm.nih.gov/30663425/>

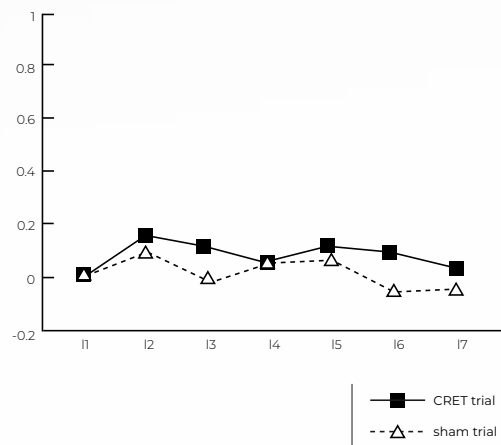
Total-Hb $\mu\text{mol/L}$



Oxy-Hb $\mu\text{mol/L}$



Deoxy-Hb $\mu\text{mol/L}$



Clinical Effects Of Capacitive Electric Transfer Hyperthermia Therapy For Cervico- Omo-Brachial Pain.

Takahashi K, Suyama T, Onodera M, Hirabayashi S, Tsuzuki N, Zhong-Shi L. J. Phys. Ther. Sci. 2000;12: 43-48.

Objectives:

This article assesses to investigate the effects of high-frequency hyperthermia in patients with cervicobrachial pain treatment.

Results:

An elevation of skin temperature was observed even 15 minutes after treatment, without any adverse effects. This therapy was very effective in relieving pain, with an effectiveness rate of 81.8%.

Materials And Methods:

Physiotherapy was conducted on 22 patients with cervicobrachial pain using the MD-303 (0.65 ± 0.05 MHz) hyperthermia equipment with a capacitive electric transfer method. The 22 patients included 6 with cervical spondylosis, 6 with cervicobrachial pain, 4 with scapulohumeral periartthritis, 3 with a cervical sprain, 2 with tennis elbow, and 1 with rheumatoid arthritis of the hand. The treatment was performed a total of 10 times, for 20 minutes each time.

Conclusions:

The high-frequency hyperthermia with a capacitive electric transfer method was effective in relieving cervico-brachial pain and had no adverse effects.

Clinical Effects Of Capacitive Electric Transfer Hyperthermia Therapy For Lumbago.

Takahashi K, Suyama T, Onodera M, Hirabayashi S, Tsuzuki N, Zhong-Shi L. J. Phys. Ther. Sci. 1999;11: 45-51.

Objectives:

This study aims to understand the effect of using high-frequency hyperthermia with a capacitive electric transfer therapy in patients with lower back pain.

Results:

An elevation of skin temperature was observed even 15 minutes after treatment, without any adverse effects. This therapy was very effective in relieving pain, with an effectiveness rate of 81.1%.

Materials And Methods:

Physiotherapy was conducted on 37 patients with lower back pain using the MD-303 (0.65 ± 0.05 MHz) hyperthermia equipment with a capacitive electric transfer method. The 37 patients included 13 with lumbar spondylosis, 7 with lumbar spinal canal stenosis, 5 with lumbar disc herniation, 4 with lumbar spondylolysis/spondylolisthesis, 4 with lumbar discopathy, and 4 with other conditions accompanied by lower back pain. The therapy was performed a total of 10 times, for 20 minutes each time.

Conclusions:

High-frequency hyperthermia with a capacitive electric transfer method was effective in relieving lower back pain and had no adverse effects.

Treatment Using 448kHz Capacitive Resistive Capacitive Monopolar Radiofrequency Improves Pain And Function In Patients With Osteoarthritis Of The Knee Joint: A Randomized Controlled Trial.

Kumaran B, Watson T.
Physiothérapie. 2019;105(1):98-107.

Objectives:

To evaluate the effectiveness of a monopolar resistive capacitive radiofrequency treatment (CRMRF) in improving pain and function in patients with knee osteoarthritis.

Materials And Methods:

A randomized controlled trial was conducted with three groups and concealed allocation, blinded participant analysis, and intention-to-treat analysis. Forty-five patients with osteoarthritis who were on the waiting list for physiotherapy in a local hospital were enrolled. Participants in the active and sham groups received eight sessions of CRMRF and sham CRMRF over four weeks, respectively, in addition to standard care. The control group received only standard care.

Pain and function were measured at four-time points: baseline (week 0), week 4 (after intervention), week 8, and week 16 (two follow-ups), using a visual analog scale (VAS), the Western Ontario and McMaster Universities

Osteoarthritis Index (WOMAC), the Timed Up and Go (TUG) test, and knee range of motion (ROM).

Results:

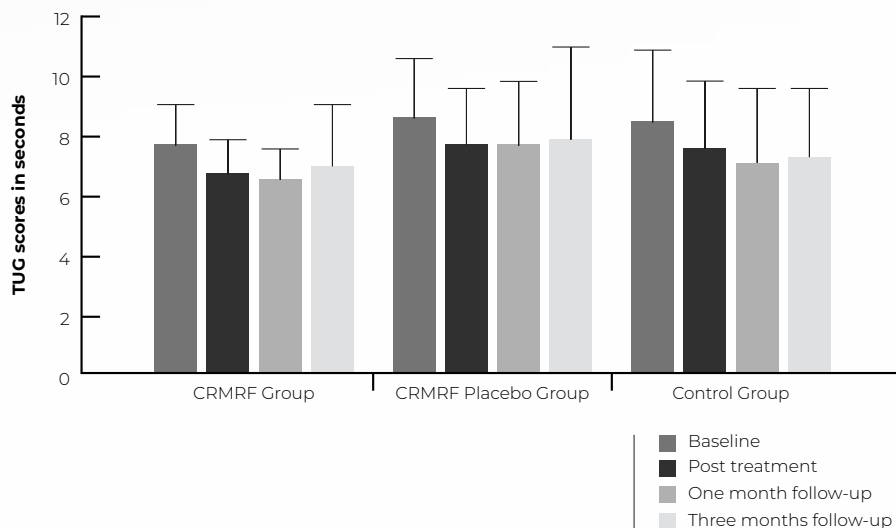
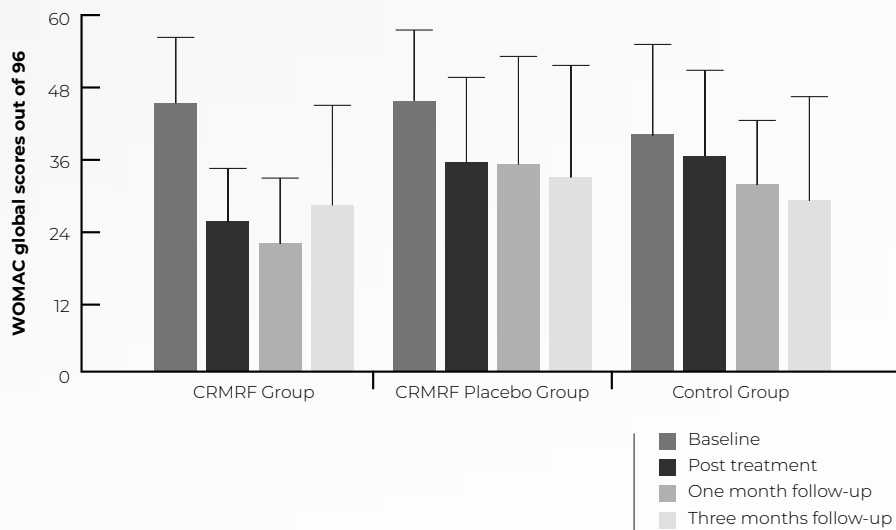
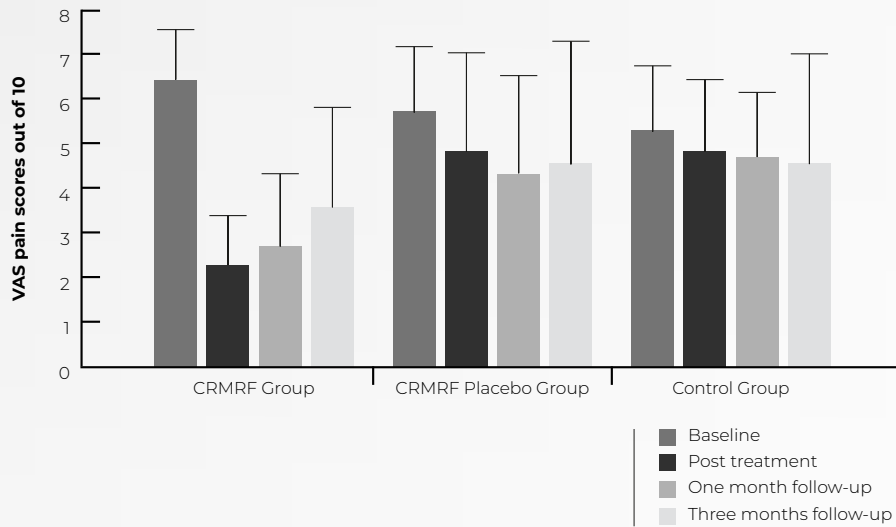
Clinically significant changes in pain (VAS) were observed in the active group after treatment compared to the sham (mean difference: 0.79 (95% CI: 0.29 to 1.3), effect size: 1.3) and control (mean difference: 0.82 (95% CI: 0.32 to 1.3), effect size: 1.5) groups, and at one-month follow-up compared to the control group (mean difference: 0.68 (95% CI: 0.10 to 1.3), effect size: 1.1). With regard to function (WOMAC), a clinically significant change was observed in the active group after treatment compared to the control group (mean difference: 1.3 (95% CI: 0.02 to 2.6), effect size: 0.94), but not compared to sham. No significant differences were noted for TUG or knee ROM. No differences were noted at the three-month follow-up for any of the outcomes.

Conclusions:

CRMRF treatment can improve pain and function in patients with knee osteoarthritis in the short term.



<https://pubmed.ncbi.nlm.nih.gov/30269963/>



The Effectiveness Of 448 kHz Capacitive Resistive Monopoles Radio Frequency in Acute Ankle Sprain: A Case Report.

Piponas K, Stasinopoulos D.
J Altern Complement Integr Med. 2021 ; 7.

Objectives:

The objective of this report was to investigate the effects of 448 kHz monopolar capacitive and resistive radiofrequency (RFMCR) on severe ankle sprains.

Materials And Methods:

A patient with a severe right ankle sprain participated in the case study. The patient received RFMCR treatment at 448 kHz, twice a day for seven consecutive days. Evaluations included self-reported pain using a visual analogue scale, and ankle edema and mobility using goniometry before and after treatment.

| | Pain (cm) | Edema (cm) | Range of motion - dorsiflexion (degrees) | Range of motion - plantar flexion (degrees) |
|------------------|-----------|------------|--|---|
| Before treatment | 8 | 57 | 10 | 14 |
| After treatment | 0 | 53.5 | 18 | 41 |

Results:

In all evaluations, a decrease in pain and an increase in functionality were recorded. The results of this trial indicate that RFMCR treatment at 448 kHz, as described above, can lead to significant improvements in pain and disability in cases of severe ankle sprain. However, further studies are needed to confirm these observations.

Conclusions:

In conclusion, the use of RFMCR at 448 kHz may be a promising treatment for severe ankle sprains, as it demonstrated significant improvements in pain and functionality. Future studies should investigate the efficacy and safety of this treatment in larger populations.



https://www.heraldopenaccess.us/article_pdf/9/the-effectiveness-of-448-kHz-capacitive-resistive-monopoles-radio-frequency-in-acute-ankle-sprain-a-case-report.pdf

448 kHz Monopolar Capacitive Resistive Radiofrequency In Chronic Rotator Cuff Tendinopathy.

Stasinopoulos D.

Annal of Clinical Case Reports. 2021 ; 8 (10): 1-5

Objectives:

The objective of the present study was to discover the effects of different modes of capacitive and resistive monopolar radiofrequency (RFMCR) at 448 kHz on chronic tendinopathies of the rotator cuff.

Results:

At the end of the treatment and during follow-ups at 3 and 6 months for all modes of application of RFMCR at 448 kHz, pain decreased, and mobility and strength increased. The thermal effect (thermal or hyperthermal) in a continuous wave was the most notable at the end of the treatment and during the follow-ups.

Materials And Methods:

Three groups were formed, the first group received a continuous subthermal wave (without heat effect), the second group received a continuous subthermal wave in continuous modulation, and the third group received thermotherapy (thermal or hyperthermal) in a continuous wave. All patients followed an exercise program. Pain, mobility, and strength were measured.

Conclusions:

Further randomized and controlled clinical trials are necessary to establish the efficacy of RFMCR at 448 kHz on the treatment of chronic tendinopathies of the rotator cuff.

| | Pain (cm) | Function (cm) | Pain-free Grip Strength(lb) | PRTEE questionnaire |
|------------------|-----------|---------------|-----------------------------|---------------------|
| Before treatment | 9 | 1 | 15 | 96 |
| After treatment | 2 | 7 | 52 | 18 |

448 kHz Capacitive Resistive Monopolar Radiofrequency And A Supervised Exercise Programme In Chronic Patellar Tendinopathy: A Case Report.

Stasinopoulos D.

Annal of Clinical Case Reports. 2021 ; 8 (10) : 1-5.

Objectives:

The objective of this case study is to analyze the effects of eccentric-concentric combined with isometric contraction, lumbopelvic control exercises, and monopolar capacitive and resistive radiofrequency (RFMCR) thermotherapy (thermie or hyperthermie) at 448 kHz in continuous wave on pain and disability in a patient with chronic patellar tendinopathy (CPT).

Materials And Methods:

A patient with unilateral CPT for 9 months was included in the study. The patient followed a supervised program, three times a week for six weeks, including isometric exercises for the quadriceps, progressive eccentric-concentric quadriceps work, and simple lumbopelvic control exercises. This program was personalized according to the patient's pain description during the interview. In addition, the patient received RFMCR treatment three times a week, for a total of 18 applications. The patient was evaluated using the VISA-P self-questionnaire, a pressure algometer to determine pain

threshold (PPT), and a handheld dynamometer to measure knee extension strength at the beginning, end of treatment (week 6), one month after the end of treatment (week 10), and three months (week 18) after the end of treatment.

Results:

At the end of treatment and during follow-up, a decrease in pain was observed, as well as an increase in mobility and strength.

Conclusions:

The results of this case study indicate that the combination of isometric quadriceps exercises, progressive eccentric-concentric quadriceps work, lumbopelvic control exercises, and monopolar capacitive and resistive radiofrequency thermotherapy at 448 kHz in continuous wave can lead to significant improvements in pain and disability in cases of CPT. Further studies with larger sample sizes and controlled designs are necessary to confirm these findings.



<https://austinpublishinggroup.com/clinical-case-reports/fulltext/ajccr-v8-id1236.pdf>

| | Pre | Post | 1-month follow-up |
|---------------------|-----------------|------------------|-------------------|
| VAS (E+ CRET Group) | 39.6 (9.0-74.0) | 10.1 (0-35.0)*§ | 10.3 (0-37.0)† |
| VAS (E group) | 35.7 (5.0-83.0) | 23.0 (0-52.0)*§ | 15.6 (0-60.0)† |
| ODI(E+ CRETGroup) | 21.2 (4.0-42.0) | 10.3 (4.0-16.0)* | 10.1 (0-16.0)† |
| ODI (E group) | 18.9 (4.0-34.0) | 14.3 (2.0-20.0) | 15.2 (0-20.0) |
| KW (E+ CRET group) | 18.3 | 23.6 | 23.0 (15.0-37.0) |
| KW (E group) | (11.0-30.0) | (12.0-37.0) | 24.2 (14.0-34.0) |
| | 20.4 | 24.5 | |
| | (11.0-33.0) | (14.0-34.0) | |

*p < 0.016 pre vs post (Wilcoxon signed-rank test).

†p < 0.016 pre vs follow up (Wilcoxon signed-rank test).

§p < 0.05 E+CRET group vs E group (Mann-Whitney U test).

448 kHz Capacitive Resistive Monopolar Radiofrequency In Patients With Rotator Cuff Tendinopathy. A Pilot Study.

Stasinopoulos D, Constantinou A, Lamnisis D.
Acta Scientific Orthopaedics. 2020 ; 3(4).

Objectives:

The objective of this study was to discover the effects of different modes of capacitive and resistive monopolar radiofrequency (CRMR) at 448 kHz on chronic rotator cuff tendinopathies.

Results:

At the end of the treatment and during follow-ups at 3 and 6 months, pain decreased, mobility and strength increased for all modes of CRMR application at 448 kHz. The thermal effect (heating) with continuous wave was the most notable at the end of treatment and during follow-ups.

Materials And Methods:

Three groups of patients were studied: the first group received a subthermal (non-heating) wave continuously; the second group received a subthermal wave with continuous modulation, and the third group received thermotherapy (heating) with continuous wave. All patients followed an exercise program. Pain, mobility, and strength were measured.

Conclusions:

Randomized and controlled clinical trials are necessary to establish the effectiveness of CRMR at 448 kHz in the treatment of chronic rotator cuff tendinopathies.



<https://www.anncaserep.com/abstract.php?aid=4504>

The Effectiveness Of 448 kHz Capacitive Resistive Monopoles Radiofrequency In Acute Lateral Elbow Tendinopathy: A Case Report.

Stasinopoulos D.

Annal of Clinical Case Reports. 2019; 4: Article 1613

Objectives:

To discover the effects of capacitive and resistive monopolar radiofrequency (CRMR) at 448 kHz on severe lateral epicondylitis (LET), as no study has demonstrated the effectiveness of physiotherapy in the treatment of severe LET.

Materials And Methods:

A patient with severe LET was treated with CRMR at 448 kHz twice a day for five consecutive days. Pain and functionality were measured using a visual analog scale, the PRTEE self-assessment questionnaire, and the painless handgrip test. The patient was evaluated before and after the treatment

Results:

In all evaluations, a decrease in pain and an increase in functionality were observed after treatment with CRMR at 448 kHz for severe LET.

Conclusions:

The results of this trial indicate that treatment with CRMR at 448 kHz as described above can lead to significant improvements in pain and disability in cases of severe LET, suggesting it may be a useful treatment. However, further studies are needed to confirm its effectiveness.

Asthma Treatment Using Capacitive Resistive Electric Transfer (CRET).

Martínez Rubio A, Bordas JR.
Rehab Fis. 1992;3(13):18-9.

Objectives:

The objective of this clinical study was to evaluate the effectiveness of Capacitive Resistive Electric Transfer (CRET) treatment on patients suffering from bronchial asthma for more than six months.

Materials And Methods:

Fifty-two patients suffering from bronchial asthma were treated with CRET. The study evaluated the reduction in bronchial spasms, dyspnea, and dependence on pharmacological devices. The study also assessed the reduction in relapses after the CRET treatment.

Results:

60% of the patients treated with CRET showed a notable improvement in bronchial spasms, with a decrease in dyspnea and a reduction in dependence on pharmacological devices. The study found that CRET treatment reduced the number of relapses in patients suffering from bronchial asthma.

Conclusions:

The study concludes that CRET treatment can effectively reduce the symptoms of bronchial asthma without the need for medication. This treatment can help patients suffering from severe asthma and reduce the frequency of relapses. The study highlights the need for further research into non-pharmacological treatments for asthma.

Effects Of Capacitive And Resistive Electric Transfer Therapy In Patients With Knee Osteoarthritis: A Randomized Controlled Trial.

Cocchetta CA, Sale P, Ferrara PE, Specchia A, Maccauro G, Ferriero G, et al. International journal of rehabilitation research Internationale Zeitschrift fur Rehabilitationsforschung Revue internationale de recherches de readaptation. 2019; 42 (2): 106-11.

Objectives:

The objective of this randomized controlled trial was to determine whether a two-week CRET treatment program can reduce pain, stiffness, and functional limitations in patients with knee osteoarthritis compared to a placebo treatment.

Materials And Methods:

Thirty-three patients with knee osteoarthritis were assigned to the experimental group, while 22 patients were assigned to the control group. The experimental group received six intermittent applications of CRET, while the control group received a placebo treatment without energy transfer. The Western Ontario and McMaster University Osteoarthritis Index (WOMAC) and the Visual Analog Scale (VAS) for pain were used to measure the results. All patients were evaluated before treatment (T0), after treatment (T1), and at one month (T2) and three months (T3) after treatment.

Results:

The results showed that CRET significantly improves strength, physical function, and pain reduction in patients with knee osteoarthritis. In the experimental group, a decrease in WOMAC and VAS scores was observed at T1, T2, and T3 compared to T0. No significant changes in WOMAC and VAS scores were reported for the control group at all measurement points.

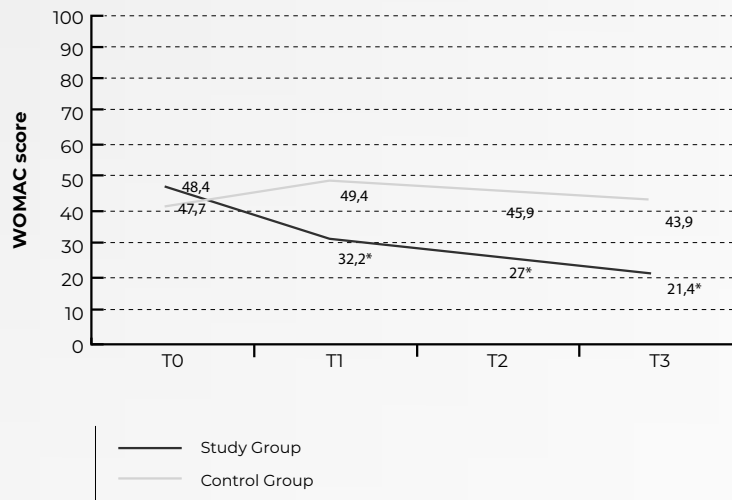
Conclusions:

Given the low number of required sessions, cost-effectiveness, and long-term benefits, CRET appears to be an effective therapeutic option for managing knee osteoarthritis to reduce pain, stiffness, and functional limitations.

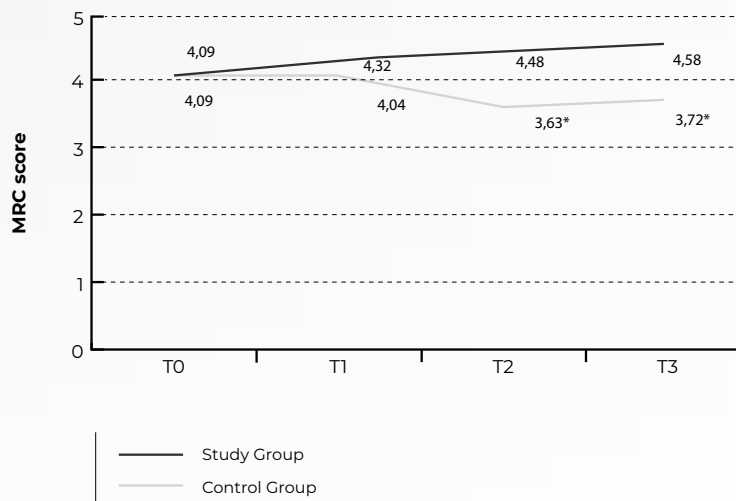


<https://pubmed.ncbi.nlm.nih.gov/30362981/>

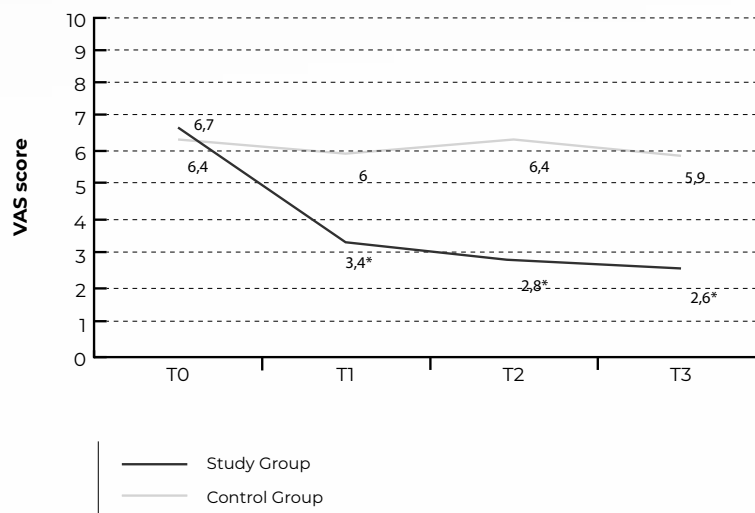
WOMAC



MRC



VAS



Osteoarticular Pain In Geriatric Patients: Capacitive Electric Transfer Treatment (PhD Thesis).

Bordas JR, Martínez D. Physiotherapy Unit.
“Fabra i Puig” Medical Centre.
Paseo Fabra, Barcelona, 2009.

Objectives:

The objective of this study was to evaluate the effectiveness of capacitive and resistive electric transfer (CRET) in treating joint pain, motor disabilities, and muscle stiffness in patients.

Methods:

The study was conducted on 214 patients who were treated with CRET. The evaluation was done by the patients and verified by the physiotherapist and the physician.

Results:

The results showed a notable improvement in 62% of cases, which was maintained over time.

Conclusions:

The use of CRET in the treatment of joint pain, motor disabilities, and muscle stiffness appears to be effective and promising. Further studies could help to establish its full potential in the management of these conditions.

Clinical Effects Of Capacitive Electric Transfer Hyperthermia Therapy For Cervico-Omo-Brachial Pain.

Takahashi K, Suyama T, Onodera M, Hirabayashi S, Tsuzuki N, Zhong-Shi L. J. Phys. Ther. Sci. 2000 ; 12: 43-48.

Objectives:

To evaluate the effectiveness of the electric transfer method using a high-frequency hyperthermia device, MD 303, in reducing cervicothoracobrachial pain in patients.

Results:

The skin temperature of the patients increased 15 minutes after the treatment, and no adverse effects were observed. The therapy was highly effective in relieving pain, with an efficacy rate of 81.8%.

Materials And Methods:

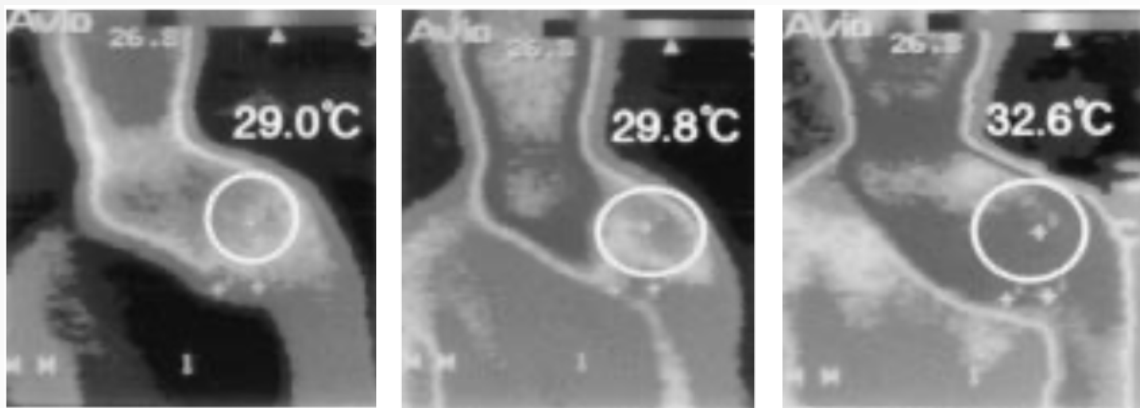
A total of 22 patients with cervicothoracobrachial pain were treated with ten sessions of electric therapy using the MD 303 device, which has a frequency of 0.65 ± 0.05 MHz. Among the patients, six had cervical spondylosis, six had thoracic outlet syndrome, four had scapulohumeral periartthritis, three had cervical sprains, two had shoulder tendinitis, and one had rheumatoid arthritis of the hands. Each session lasted for 20 minutes.

Conclusions:

The electric transfer method using the MD 303 device is a safe and effective therapy for reducing cervicothoracobrachial pain in patients. Further studies with larger sample sizes are recommended to confirm these findings.

| | N.O | % | |
|----------------------|-----------|--------------|-------|
| Very Effective | 0 | 0.0 | |
| Effective | 11 | 50.0 | 81.8% |
| Slightly Effective | 7 | 31.8 | |
| Ineffective | 2 | 9.1 | |
| Slightly Exacerbated | 2 | 9.1 | |
| Exacerbated | 0 | 0.0 | |
| Markedly Exacerbated | 0 | 0.0 | |
| Total | 22 | 100.0 | |

“Slightly Effective” and better patients were treated as effective cases



Before Treatment

Immediately After Treatment

15 Minutes After Treatment

The Effect Of Capacitive And Resistive Electric Transfer Intervention On Delayed-Onset Muscle Soreness Induced By Eccentric Exercise.

Nakamura M, Sato S, Kiyono R, Yahata K, Yoshida R, Kasahara K, et al.

International Journal of environmental research and public health. 2022; 19 (9).

Objectives:

The objective of this study was to investigate the acute effect of capacitive and resistive electric transfer (CRET) intervention on eccentrically damaged muscle.

Materials And Methods:

A total of 28 healthy and sedentary male volunteers were randomly assigned to either the CRET intervention or control groups. The participants performed a bout of eccentric exercise of the knee extensors with the dominant leg and received 30 minutes of CRET intervention of the quadriceps 48 hours after the exercise. Knee flexion range of motion (ROM), muscle soreness, and maximum voluntary isometric (MVC-ISO) and concentric contraction (MVC-CON) torque of the knee extensors were measured before the exercise (baseline) and before and after the CRET intervention.

Results:

The results of the study showed that CRET intervention significantly improved knee flexion ROM, muscle strength (MVC-ISO and MVC-CON), and muscle soreness. These findings suggest that CRET intervention may be an effective method for improving muscle soreness and loss of muscle function in an eccentrically damaged muscle.

Conclusions:

In conclusion, the findings of this study demonstrate that CRET intervention may be a promising therapeutic approach for improving muscle function following eccentric exercise. Further research is needed to investigate the long-term effects of CRET intervention and its potential application in clinical settings.



<https://pubmed.ncbi.nlm.nih.gov/35565117/>

| | | Baseline | Pre-Intervention | Post-Intervention | Interaction Effect |
|----------------------|---------------|--------------|------------------|-------------------|-------------------------|
| MVC-ISO (Nm) | CRET Group | 154.3 ± 23.1 | 112.1 ± 34.1 * | 132.0 ± 34.8 # | F = 5.44, p < 0.01 |
| | Control Group | 162.1 ± 22.9 | 98.8 ± 43.7 * | 100.0 ± 34.5 * | ηp ² =0.179 |
| MVC-CON (Nm) | CRET Group | 164.9 ± 26.7 | 103.6 ± 34.5 * | 141.5 ± 44.7# | F = 4.70, p = 0.014 |
| | Control Group | 154.0 ± 19.8 | 82.3 ± 34.3 * | 91.8 ± 34.7*,# | ηp ² = 0.158 |
| Knee flexion ROM (°) | CRET Group | 138.0 ± 9.6 | 126.7 ± 8.3* | 135.7 ± 6.3# | F = 4.21, p = 0.02 |
| | Control Group | 143.2 ± 8.5 | 136.8 ± 10.9 * | 138.3 ± 10.8 * | ηp ² =0.144 |
| Muscle soreness | | | | | |
| At contraction (mm) | CRET Group | 2.2±5.4 | 27.4 ± 15.3 | 17.2 ± 13.4 | F = 1.69, p = 0.195 |
| | Control Group | 4.9 ± 4.2 | 24.4 ± 12.8 | 23.0 ± 11.5 | ηp ² =0.063 |
| At stretching (mm) | CRET Group | 25.9 ± 9.1 | 39.4 ± 15.1 | 27.5 ± 13.0 | F = 1.86, p = 0.17 |
| | Control Group | 34.8 ± 25.0 | 49.8 ± 25.2 | 44.3 ± 26.6 | ηp ² =0.069 |
| At palpation (mm) | CRET Group | 14.7 ± 10.3 | 45.7 ± 17.3 * | 21.5 ± 14.6 # | F = 5.71, p < 0.01 |
| | Control Group | 14.7 ± 10.3 | 45.7 ± 17.3 * | 40.4 ± 11.7 * | ηp ² = 0.186 |

*: significant difference from baseline value; #: significant difference from pre-intervention value. Statistical differences fixed at p < 0.05.

Clinical Effects Of Capacitive Electric Transfer Hyperthermia Therapy For Lumbago.

Takahashi K, Suyama T, Onodera M, Hirabayashi S, Tsuzuki N, Zhong-Shi L. J. Phys. Ther. Sci. 1999; 11: 45-51.

Objectives:

To evaluate the effectiveness of electric transfer method using a high-frequency hyperthermia device, MD 303, in reducing low back pain in patients.

Results:

The skin temperature of the patients increased 15 minutes after the treatment, and no adverse effects were observed. The therapy was highly effective in relieving pain, with an efficacy rate of 81.1%.

Materials And Methods:

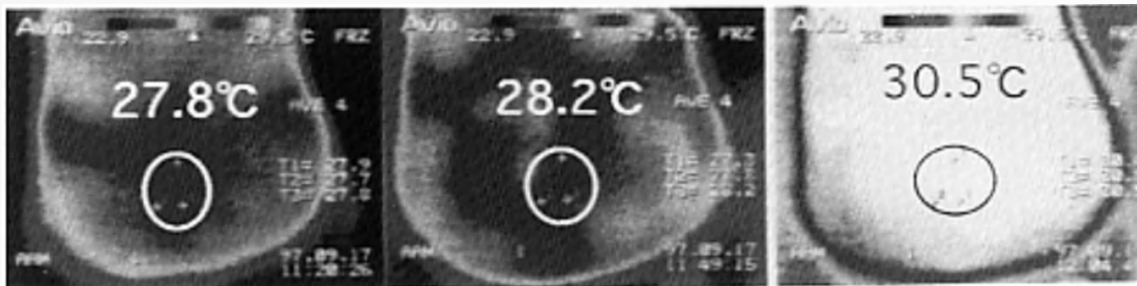
A total of 37 patients with low back pain were treated with ten sessions of electric therapy using the MD 303 device, which has a frequency of 0.65 ± 0.05 MHz. Among the patients, 13 had lumbar spondylosis, 7 had lumbar spinal stenosis, 5 had lumbar disc herniation, 4 had lumbar spondylosis/spondylolisthesis, 4 had lumbar discopathy, and 4 had other conditions accompanied by low back pain. Each session lasted for 20 minutes.

Conclusions:

The electric transfer method using the MD 303 device is a safe and effective therapy for reducing low back pain in patients. The findings of this study support the use of this therapy in clinical practice. Further research is needed to explore the long-term effects of this therapy.

| | N.O | % | |
|----------------------|-----------|--------------|-------|
| Very Effective | 0 | 0.0 | |
| Effective | 28 | 75.7 | 81.1% |
| Slightly Effective | 2 | 5.4 | |
| Ineffective | 1 | 2.7 | |
| Slightly Exacerbated | 6 | 16.2 | |
| Exacerbated | 0 | 0.0 | |
| Markedly Exacerbated | 0 | 0.0 | |
| Total | 37 | 100.0 | |

“Slightly Effective” and better patients were treated as effective cases



Before Treatment

Immediately After Treatment

15 Minutes After Treatment

The Effects Of Modern Radiofrequency Therapies In The Acute Rehabilitation Of Hamstring Strains.

Iacob GS, Vrabie D, Stegariu VI, Zelenovic M, Bozic D.
Bulletin of the Transilvania University of Braşov Series IX:
Sciences of Human Kinetics 2021 ;
14 (63)(No. 1-2021): 209-216.

Objectives:

The objective of this study is to compare the effectiveness of INDIBA therapy (Group B) with TECAR therapy (Group A) in the treatment of hamstring injuries.

Materials And Methods:

The first stage of rehabilitation was carried out over the first two weeks and consisted of radiofrequency treatments on the back of the thigh, progressive exercise, and cryotherapy. The study evaluated participants using the numerical pain rating scale, manual muscle testing, and range of motion.

Results:

An advantage in pain evaluation was observed in patients of Group B as compared to Group A.

Conclusions:

The present study suggests that INDIBA therapy may be more effective than tecar therapy in treating hamstring injuries. Further research is required to confirm these findings.

| Group A - Week 2 | | ROM Active Knee Extension | Manual Muscle Testing-Hamstrings |
|----------------------------------|-----------------|---------------------------|----------------------------------|
| ROM Active | Pearson | 1 | .610 |
| | Sig. (2-tailed) | | .035 |
| Knee Extension | N | 12 | 12 |
| | | | |
| Manual Muscle Testing-Hamstrings | Pearson | .610 | 1 |
| | Sig. (2-tailed) | .035 | |
| | N | 12 | 12 |

| Group B - Week 2 | | ROM Active Knee Extension | Manual Muscle Testing-Hamstrings |
|----------------------------------|-----------------|---------------------------|----------------------------------|
| ROM Active | Pearson | 1 | .650 |
| | Sig. (2-tailed) | | .022 |
| Knee Extension | N | 12 | 12 |
| | | | |
| Manual Muscle Testing-Hamstrings | Pearson | .650 | 1 |
| | Sig. (2-tailed) | .022 | |
| | N | 12 | 12 |



https://webbut.unitbv.ro/index.php/Series_IX/article/view/408

The Effectiveness Of Thermal Mode Of 448 kHz Capacitive Resistive Monopolar Radiofrequency In Continuous Wave In Patients With Chronic Rotator Cuff Tendinopathy: A Clinical Trial.

Stasinopoulos D, Constantinou A, Lamnisis D.

Journal of Orthopedics & Bone Disorders. 2020 ; 4 (1).

Objectives:

The objective of this clinical trial was to compare the outcomes of exercise alone versus exercise combined with continuous monopolar capacitive resistive radiofrequency (CMCRF) therapy at 448 kHz (thermal or hyperthermal) on patients with chronic rotator cuff tendinopathy.

Results:

The exercise program and CMCRF therapy showed a reduction in pain and an improvement in function and strength among patients with chronic rotator cuff tendinopathy after treatment and follow-up. However, further randomized and controlled clinical trials are needed to establish the efficacy of CMCRF therapy at 448 kHz for the treatment of chronic rotator cuff tendinopathy.

Materials And Methods:

Patients were randomized to two study groups. Pain, mobility, and strength were measured before and after treatment.

Conclusions:

Exercise combined with CMCRF therapy at 448 kHz (thermal or hyperthermal) may be effective in reducing pain and improving function and strength in patients with chronic rotator cuff tendinopathy. More comprehensive randomized and controlled clinical trials are required to establish the efficacy of this treatment approach.

Pain, function, pain-free grip strength and PRTEE questionnaire over the 24h before wach evaluation

| | Pain (cm) | Function (cm) | Pain-free Grip Strength(lb) | PRTEE questionnaire |
|------------------|-----------|---------------|-----------------------------|---------------------|
| Before treatment | 9 | 1 | 15 | 96 |
| After treatment | 2 | 7 | 52 | 18 |

Effects Of Deep Thermotherapy On Chest Wall Mobility Of Healthy Elderly Women.

Bito T, Suzuki Y, Kajiwara Y, Zeidan H, Harada K, Shimoura K, et al. Electromagn Biol Med. 2020: 1-6.

Objectives:

The objective of this study was to analyze the effects of thermal therapy on thoracic mobility in healthy middle-aged women.

Materials And Methods:

Twenty-eight middle-aged women participated in the study. Thoracic mobility (sternal angle, xiphoid process, and tenth rib), respiratory function (forced vital capacity and maximum expiratory volume), and tissue temperature (skin temperature (ST) and deep tissue temperature (DT) at 10 mm and 20 mm) were measured before treatment and fifteen minutes after thermotherapy. The participants were randomly assigned to one of three treatments: capacitive and resistive electrical transfer (CRET), heating patch (HP), and placebo CRET.

Results:

Thoracic mobility significantly increased in all planes after CRET application. The heating patch significantly increased amplitude at the tenth rib level; skin temperature and deep tissue temperature at 10 mm and 20 mm also significantly increased. CRET application significantly increased deep tissue temperature at 10 mm and 20 mm. Real differences in skin temperature and deep tissue temperature at 10 mm and 20 mm were observed between CRET, heating patch, and placebo application. Furthermore, deep tissue temperature at 20 mm increased more with CRET application than with the heating patch. CRET improves thoracic mobility.

Conclusions:

Thermal therapy, specifically CRET, has a positive effect on thoracic mobility in healthy middle-aged women. The use of a heating patch also showed some improvements in specific parameters. These findings contribute to the understanding of the effects of thermal therapy on thoracic mobility and provide valuable insights for future research and clinical applications.



<https://www.ncbi.nlm.nih.gov/pubmed/?term=Effects+of+deep+thermotherapy+on+chest+wall+mobility+of+healthy+elderly+women>

| | CRET (N = 10) | Hot pack (N = 9) | Sham (N = 8) |
|---------------------------------------|---------------------------------|--------------------------------|---------------------|
| Axillary excursion (cm) | 0.50 ± 0.47(0.45) | -0.01 ± 0.73(0.00) | 0.43 ± 0.70(0.25) |
| Xiphoid excursion (cm) ¹ | 0.56 ± 0.56(0.50) | 0.20 ± 0.43(0.4) | 0.11 ± 0.72(0.05) |
| Tenth rib excursion (cm) ¹ | 0.77 ± 0.39(0.85) | 0.69 ± 0.78(0.4) | 0.43 ± 0.57(0.55) |
| FVC (L) | 0.01 ± 0.14(0.00) | -0.01 ± 0.08(0.00) | -0.08 ± 0.06(-0.10) |
| FEV ₁ (L) ¹ | -0.01 ± 0.14(-0.02) | -0.03 ± 0.05(-0.03) | -0.00 ± 0.08(-0.04) |
| ST (°C) ¹ | 0.68 ± 0.100(70) ^{†‡} | 2.04 ± 0.98(1.60) [†] | -0.85 ± 1.00(-0.95) |
| 10 mm DT (°C) | 2.78 ± 1.11(2.70) ^{†‡} | 2.14 ± 1.10(2.00) [†] | -0.69 ± 0.68(-0.45) |
| 20 mm DT (°C) | 3.55 ± 0.77(3.75) ^{†‡} | 2.44 ± 0.79(2.10) [†] | -0.11 ± 0.65(0.05) |

Short-Term Effects of 448 kHz Radio-Frequency Stimulation On Supraspinatus Tendon Elasticity Measured By Quantitative Ultrasound Elastography In Professional Badminton Players: A Double-Blinded Randomized Clinical Trial.

Navarro-Ledesma S, Gonzalez-Muñoz A.
Int J Hyperthermia. 2021; 38(1): 421-7.

Objectives:

The objective of this study was to examine the changes in the elasticity of the supraspinatus tendon following a treatment with capacitive and resistive monopolar radio-frequency (RFMCR) at 448 kHz in professional badminton players.

Materials And Methods:

- Study Design: This was a double-blind, randomized clinical trial.
- Study Setting: All participants were recruited from a private consultation clinic.
- Subjects: The study included professional badminton players (n=38).
- Intervention: The active group received nine treatment sessions of RFMCR at 448 kHz, with three sessions per week. The control group underwent an identical treatment protocol without active RFMCR.

- Main Outcome Measures: The average values observed in three distinct zones of the supraspinatus tendon were measured at baseline (T1), immediately after treatment (T2), and one week after the completion of treatment for all participants (T3) using quantitative elastography ultrasound (SEL).

Results:

Significant differences were observed in the elasticity of the supraspinatus tendon immediately after the intervention ($p < 0.001$) and one week after the end of treatment ($p = 0.001$).

Conclusions:

RFMCR at 448 kHz induces notable changes in the elasticity of the supraspinatus tendon after a three-week treatment period, which persist one week after treatment compared to the control group.



<https://pubmed.ncbi.nlm.nih.gov/33691576/>

<https://www.tandfonline.com/doi/full/10.1080/02656736.2021.1896790>

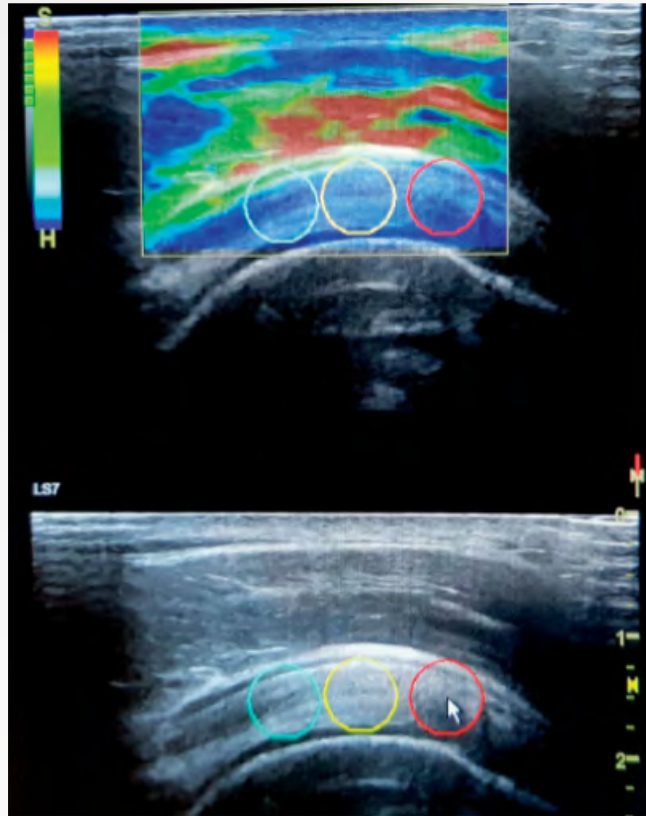


Figure 1. Supraspinatus tendon elasticity measurement by quantified elastography.

Between groups differences on supraspinatus tendon elasticity at baseline, after the intervention and at one week follow-up (95%CI).

| | T0 (baseline) | T1 (immediately after the CRMR intervention) | T2 (one-week follow-up) |
|--|----------------------------|---|--------------------------------|
| Supraspinatus tendon elasticity (mean) | 0.09 | -1.00 | -0.64 |
| | p=.59 | p= <.001** | P= <.001** |
| | (-0.25; 0.44) ^a | (-1.41; -0.59) ^a | (-0.98; -0.31) ^a |
| Cohen's d | 0.17 | -1.62 | -1.25 |
| SE difference | 0.17 | 0.20 | 0.16 |

**p<.001. SE: size effect. ^a95%CI.

Mid- And Long-Term Results Using 448 kHz Stimulation On The Elasticity Of The Supraspinatus Tendon Measured By Quantitative Ultrasound Elastography In Badminton Professionals: Prospective Randomized Double-Blinded Clinical Trial With Nine Months Of Follow-Up.

Navarro-Ledesma S, Gonzalez-Muñoz A.
Journal of clinical medicine. 2022 ; 11(6).

Objectives:

The objective of this study was to analyze the observable changes in the elasticity of the supraspinatus tendon after the application of monopolar capacitive and resistive radiofrequency (CR-RFM) at 448 kHz after 3, 6, and 9 months in professional badminton players.

Materials And Methods:

A double-blind, randomized clinical trial with a 9-month follow-up was conducted. Participants were recruited from a private consultation center and were randomly assigned to receive either CR-RFM treatment (n=19) or placebo (n=19). The experimental group received a total of nine sessions of CR-RFM at 448 kHz, three sessions per week. The control group received the same treatment without radiofrequency. Quantitative ultrasound elastography was used to measure the main values observed in three zones of the supraspinatus tendon. These values were measured at the beginning of the treatment (T1), immediately after the intervention (T2), one week after (T3), three months after (T4), six months after (T5), and nine months after the end of the treatment (T6).

Results:

Statistically significant differences were observed in the elasticity of the supraspinatus tendon immediately after the intervention ($p \leq 0.001$), one week after the treatment ($p \leq 0.001$), and three months after the end of the treatment ($p = 0.01$). No significant changes were noted at six or nine months after the end of the treatment. A three-week treatment of CR-RFM at 448 kHz resulted in significant changes in the elasticity of the supraspinatus tendon for up to three months after the end of the treatment compared to the control group.

Conclusions:

This study demonstrates that a three-week treatment of CR-RFM at 448 kHz leads to significant changes in the elasticity of the supraspinatus tendon for up to three months after the treatment, compared to the control group.

 <https://pubmed.ncbi.nlm.nih.gov/35329990/>
<https://www.mdpi.com/2077-0383/11/6/1664>

Between group differences on supraspinatus tendon elasticity at baseline; after the intervention (I2); and at one-week (I3), three-month (T4), six-month (U5) and nine-month (To) follow-ups (95% CI).

| | T1 (Baseline) | T2 (Immediately after the CRMR Intervention) | T3 (One-Week Follow-Up) | T4 (Three-Month Follow-up) | T5 (Six-Month Follow-up) | T6 (Nine-Month Follow-up) |
|--|--------------------------|---|--|---|---|--|
| Supraspinatus tendon elasticity (Mean) | 0,09 | -1.00 | -0.64 | -0.41 | -0.01 | 0.13 |
| | p = 0.59 | P ≤0.001** | p ≤0.001** | p=0.01 | p= 0.94 | p = 0.44 |
| | (-0.25; 0.44) a | (-1.41;-0.59) a | (-0.98; -0.31) a | (-0.73; -0.09) | (-0.34; 0.32) | (-0.20; 0.26) |
| Cohen's d | 0.17 | -1.62 | -1.25 | -0.84 | -0.02 | 0.26 |
| SE dference | 0.17 | 0.20 | 0.16 | 0.15 | 0.16 | 0.16 |

*Statistically significant differences (p = 0.05). **p < 0.001. SE: Size effect. a 95% CI.

Effect Of Capacitive And Resistive Electric Transfer On Changes In Muscle Flexibility And Lumbopelvic Alignment After Fatiguing Exercise.

Yokota Y, Sonoda T, Tashiro Y, Suzuki Y, Kajiwarra Y, Zeidan H, et al. Journal of physical therapy science. 2018;30(5):719-25.

Objectives:

This study aimed to clarify the effects of capacitive and resistive electric transfer (CRET) on changes in muscle flexibility and lumbo-pelvic alignment following fatiguing exercise.

Materials And Methods:

Twenty-two healthy men were assigned to either the CRET group (n=11) or the control group (n=11). Fatiguing exercise and CRET intervention were applied to the quadriceps muscle of the dominant legs of the participants. The Ely test, pelvic tilt, lumbar lordosis, and surface temperature were measured before and after exercise and for 30 minutes after the intervention. Statistical analysis was performed using a one-way analysis of variance, with Tukey's post-hoc multiple comparison test to clarify changes within the group and Student's t-test to clarify differences between groups.

Results:

The Ely test and pelvic tilt were significantly different in both groups after exercise, but there was no difference in the CRET group after intervention. Surface temperature significantly increased in the CRET group for 30 minutes after the intervention, unlike after exercise and intervention in the control group. There was no significant difference between groups at any time, except for surface temperatures. The CRET current could effectively improve muscle flexibility and lumbo-pelvic alignment after fatiguing exercise.

Conclusions:

Capacitive and resistive electric transfer may be an effective intervention to improve muscle flexibility and lumbo-pelvic alignment after fatiguing exercise.



<https://www.ncbi.nlm.nih.gov/pubmed/29765189>

| | CRET Group | Control Group |
|------------------------------|----------------|---------------|
| Ely test (*) | Pre-Ex | 0 |
| | Post-Ex | 6.0 ± 3.0* |
| | Post-In | 2.6 ± 5.8 |
| | 15-min Post-In | 3.2 ± 5.7 |
| | 30-min Post-In | 3.4 ± 6.0 |
| Pelvic tilt (°) | Pre-Ex | 0 |
| | Post-Ex | 19 ± 1.2** |
| | Post-In | 05 ± 0.8 |
| | 15-min Post-In | -0.9 ± 0.8 |
| | 30-min Post-In | 0.0 ± 0.9 |
| Lumbar lordosis (°) | Pre-Ex | 0 |
| | Post-Ex | 1.1 ± 2.2 |
| | Post-In | 1.7 ± 2.6 |
| | 15-min Post-In | 0.8 ± 2.5 |
| | 30-min Post-In | 0.3 ± 2.3 |
| Superficial temperature (°C) | Pre-Ex | 0 |
| | Post-Ex | 0.3 ± 0.7† |
| | Post-In | 5.1 ± 1.3**‡ |
| | 15-min Post-In | 2.9 ± 1.0**‡ |
| | 30-min Post-In | 1.7 ± 1.3**‡ |

Values are represented as mean ± standard deviation.
Significant difference from Pre-Ex value (p<0.05, Tukey-HSD).
*Significant difference from Pre-Ex value (p<0.01, Tukey-HSD)
†Significant difference between groups (p<0.05, Student t-test)
‡Significant difference between groups (p<0.01, Student t-test)
CRET: Capacitive and Resistive electric transfer.



Clinical Research Intimate Health



Pilot Study To Evaluate The Biological Changes Induced By Radiofrequency Thermal Therapy On The Genital Area.

Calleja J, Fernández S, Corral-Baqués MI, Sendrós S.
Toko - Gin Pract. 2021 ; 80 (1): 6-13.

Objectives:

To design a pilot study to evaluate the biological changes induced by thermal evolutions related to the application of capacitive-resistive monopolar radiofrequency at 448 kHz on the skin of the vulva and vaginal mucosa, with particular attention to patient tolerability and safety.

Materials And Methods:

An observational ambulatory pilot study was conducted on 7 patients divided into two groups according to the area of radiofrequency application (vulva/vaginal mucosa). Three sessions of 20 minutes of radiofrequency were performed, spaced four weeks apart, and a follow-up visit was conducted 16 weeks after the initial visit. The maximum tissue temperature reached was recorded after each session, and a biopsy of the tissue (vulvar skin or vaginal mucosa depending on the treatment application) was performed at the initial visit before the first session and one week after the third session of capacitive-resistive monopolar radiofrequency. 7 before and after

treatment were analyzed to assess the changes induced by the hyperthermia generated by the radiofrequency wave. Safety was also evaluated by recording potential side effects at each session, as well as patient response to treatment.

Results:

In all histological samples, common biological changes induced by hyperthermia were observed: acanthosis (thickening of the layers of the epidermis), inflammation of the dermo-epidermal junction, extensive neocollagenesis, and an increase in the extracellular matrix. An increase in selective neovascularization was also recorded, meaning that it was not present in all patients. These changes were more notable in younger patients with the highest tissue temperature during radiofrequency application. No adverse effects or complications were reported during treatment.

Conclusions:

Capacitive-resistive monopolar radiofrequency at 448 kHz is a safe and painless technology that, when applied to the skin of the vulva and vaginal mucosa, can produce biological changes that lead to tissue remodeling and regeneration.



www.researchgate.net/publication/350037645_Pilot_study_to_evaluate_the_biological_changes_induced_by_radiofrequency_thermal_therapy_on_the_genital_area

Efficacy Of Capacitive Resistive Monopolar Radiofrequency In The Physiotherapeutic Treatment Of Chronic Pelvic Pain Syndrome: A Randomized Control Study.

Carralero-Martínez A, Muñoz Pérez MA, Kauffmann S, Blanco-Ratto L, Ramírez-García I. *Neurourol Urodyn.* 2022. Apr ; 41 (4): 962-972.

Objectives:

To evaluate the effectiveness of a complementary treatment using capacitive resistive monopolar radiofrequency at 448 kHz (RFMCR) compared to physiotherapy techniques with a placebo treatment using the same techniques to relieve pain and improve the quality of life of patients suffering from chronic pelvic pain syndrome (CPPS).

Material And Methods:

A triple-blind, randomized, controlled clinical trial (RCT) was conducted with patients with CPPS randomly assigned (1:1) to an intervention group with active RFMCR or a control group with inactive RFMCR. Both groups received a physiotherapy and pain management program each week for 10 weeks. Visual analog scale (VAS) and F-12 questionnaire data were collected at the beginning of the trial, at the 5th session, and at the 10th session. The primary outcome was pain intensity. The chi-square test and the Student's t-test were used for comparisons between variables. Superiority was analyzed by

estimating the mean change (95% confidence interval). The analysis was conducted based on the protocol and for the attention of the groups of populations concerned. The level of statistical significance was set at $p < 0.05$.

Results:

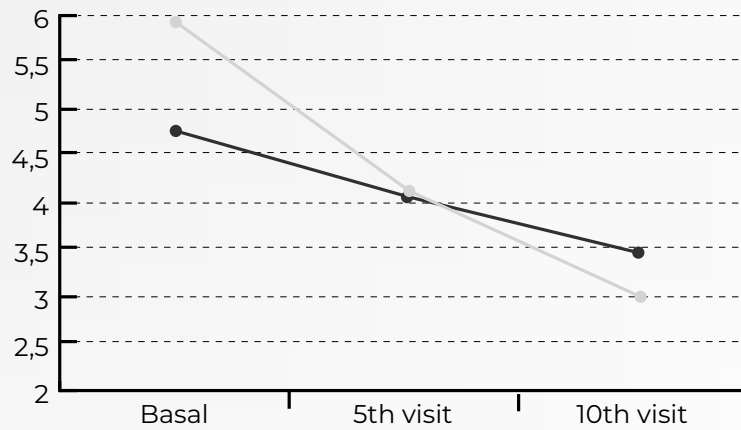
Eighty-one patients (67.9% women) with a mean age of 43.6 years (SD 12.9) participated in the study. It was observed that RFMCR decreased pain-related data by more than 2 points and improved quality of life by 5 points. No side effects were reported and overall treatment adherence was 86.4%.

Conclusions:

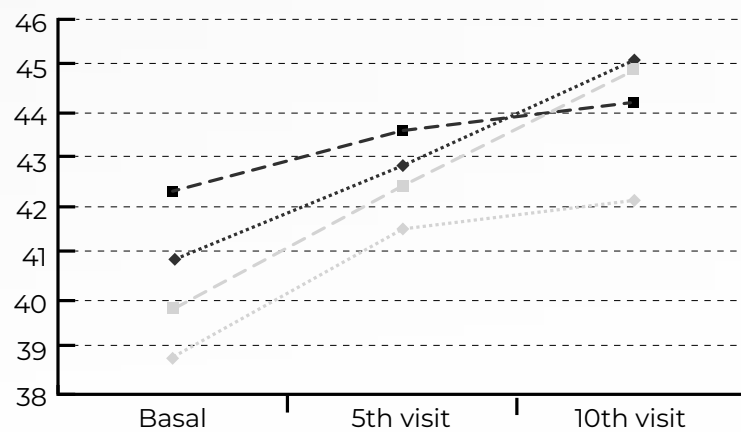
This is the first RCT that analyzes the effectiveness of RFMCR (INDIBA) compared to a placebo and demonstrates its superiority in reducing pain and improving the quality of life. These results could encourage increased use of RFMCR for patients suffering from CPPS.



<https://pubmed.ncbi.nlm.nih.gov/35266184/>



- VAS, Control group (n=32)
- VAS, Intervention Group (n=38)



- -■- - SF-12 Physical sum. Control group (n=32)
-◆..... SF-12 Metal sum. Control group (n=32)
- -■- - SF-12 Physical sum. Intervention group (n=38)
-◆..... SF-12 Metal sum. Intervention group (n=38)

Efficacy Of Capacitive Resistive Monopolar Radiofrequency In The Physiotherapeutic Treatment Of Chronic Pelvic Pain Syndrome: Study Protocol For A Randomized Controlled Trial.

Carralero-Martínez A, Muñoz Pérez MA, Pané-Alemaný R, Blanco-Ratto L, Kauffmann S, Ramírez-García I. *Trials*. 2021 ; 22 (1): 356.

Objectives:

The objective of this study is to evaluate the effectiveness of capacitive resistive monopolar radiofrequency (RFMCR) at 448 kHz as a complement to other physiotherapy techniques to reduce pain and improve the quality of life of patients with chronic pelvic pain syndrome (CPPS).

Materials And Methods:

This triple-blind (1:1) randomized controlled study will include 80 men and women with CPPS. Participants will be randomly assigned to the active group with RFMCR or to the control group with inactive RFMCR and will receive a physiotherapy and pain management program. Both groups will undergo treatment for 10 consecutive weeks. At the beginning of the study, pain intensity (using the VAS scale), quality of life (using the SF-12 questionnaire), fear of treatment (using the TSK questionnaire), and catas-

trophism (using the PCS scale) will be evaluated. These measures will be taken again at the sixth and tenth sessions.

Results:

The results of this study will show that RFMCR presents an advantage for the treatment of patients with CPPS when combined with a physiotherapy and pain management program.

Conclusions:

The findings of this study may offer an alternative treatment option for patients with CPPS.

- Clinical Trial Registration: ClinicalTrials.gov NCT03797911, registered on January 8, 2019.



<https://pubmed.ncbi.nlm.nih.gov/34016168/>

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8136758/pdf/13063_2021_Article_5321.pdf

Radio Wave Electrotherapy With A Radiofrequency Of 448 kHz For The Treatment Of Patients With Organic Erectile Dysfunction: A Prospective, Randomized, Blind, Sham-Controlled, Parallel-Group Study.

Chuvalov LL, Korolev DO, Azilgareeva KR, Taratkin MS, Olefir YV, Fiev DN, et al. Urologiia (Moscow, Russia: 1999. 2022 ; 2: 54-8.

Objectives:

The objective of this study was to observe the efficacy of radiofrequency electrotherapy (at 448 kHz) in patients with erectile dysfunction (ED).

Materials And Methods:

A randomized, blinded, and controlled clinical trial was conducted. The inclusion criteria were: 1) patients with a score of 5 to 20 on the International Index of Erectile Function (IIEF); 2) patients with confirmed erectile dysfunction for at least 6 months; 3) patients with penile arterial and/or venous insufficiency confirmed by penile vascular Doppler ultrasound with drug stimulation (maximum systolic velocity (PSV) <25 cm/s, maximum end-diastolic velocity (DPV) >5 cm/s, and resistance index (RI) <0.8). Participants were randomly assigned to two groups (experimental group and control group) in a 1:1 ratio. The complete treatment lasted for 9 weeks. The patients' erectile function was evaluated by questionnaires (IIEF-5, SEP, Schramek), as well as penile vascular Doppler ultrasound before and after the treatment.

Results:

This study included 61 men (experimental group [n=31] and control group [n=30]). A significant difference was observed in the IIEF-5 scores after treatment between the experimental group and the control group (respectively 19.5 +/- 3.2 vs. 15.1 +/- 5.4, p=0.017). Similar notable differences were observed in the mean final score of the SEP questionnaire: an increase of 3.6 +/- 1.0 for the treatment group and 2.4 +/- 1.1 for the control group (p=0.004). The Schramek questionnaire results also showed a pronounced increase in the mean score in the treatment group compared to the control group: 4.2 +/- 0.6 vs. 3.2 +/- 1.0 (p=0.011). The drug response time and detumescence time varied significantly between the two groups: respectively 11.9 +/- 4.0 min vs. 15.5 +/- 4.1 min, p=0.001 and 126.6 +/- 60.7 min vs. 66.2 +/- 40.9, p<0.001. No complications or adverse effects were reported during or after the treatment.

Conclusions:

In conclusion, radiofrequency electrotherapy at 448 kHz can improve the IIEF-5, SEP, and Schramek scores, as well as Doppler ultrasound indicators in patients with erectile dysfunction.



<https://pubmed.ncbi.nlm.nih.gov/35485814/>

| Indicators | Experimental Group (n = 31) | Control Group (n = 30) | P |
|------------|-----------------------------|------------------------|-------|
| IIEF-5 | 20 (17-21) | 16,5 (10,3-19) | 0,017 |
| SEP | 4 (3-4) | 2 (2-3) | 0,004 |
| Schramek | 4 (4-5) | 3 (3-4) | 0,011 |

Questionnaire scores after CRET radiofrequency treatment. Data represented with the median (IQR).

| Indicators | Experimental Group (n = 31) | Control Group (n = 30) | P |
|--------------------------|-----------------------------|------------------------|--------|
| Drug response time (min) | 10 (10-15) | 15 (15-15) | 0,001 |
| Detumescence time (min) | 120 (68,8 -160) | 60 (45-60) | <0,001 |

Indicators of time after CRET radiofrequency treatment. Data represented with the median (IQR).

Monopolar Radiofrequency Capacitive Resistive At 448 kHz (INDIBA System) For The Treatment Of Chronic Pelvic Pain Of Inflammatory Origin.

Fernández Carnero, Serra Llosa, Llanes González

Objectives:

The treatment of most pelvic floor pathologies requires a multidisciplinary approach that includes, among other things, radiofrequency (RF). The main objective was to evaluate the efficacy (short- and medium-term) of manual therapy combined with intra-cavitary application of INDIBA 448 kHz RF (vagina/rectum) for treating chronic inflammatory pelvic pain.

Materials And Methods:

This was a monocentric, prospective, interventional, randomized, double-blind study with two parallel groups (active group: manual therapy plus INDIBA; control group: manual therapy with fake INDIBA) involving 49 adult patients with a mean age of 40.3 years (control group) and 42.7 years (active group), of both sexes (56.0% women in the control group and 43.5% women in the active group), presenting with chronic pelvic pain (for at least three months) of inflammatory origin.

Results:

In our study, the percentage of improvement in VAS was 40% in both groups (active and control) after 10 treatment sessions (the second week). These improvements persisted at about the same percentage in patients receiving manual therapy at 2 and 4 months after treatment, while patients receiving active treatment improved their VAS by about 50% at two months and a little over 60% at four months of follow-up.

Conclusions:

After 4 months of follow-up, manual therapy combined with radiofrequency showed a significant statistical difference compared to the control group in improving results. The intra-cavitary treatment (vagina/rectum) was found to be safe and well-tolerated, and Proionic® Activ cream was also found to be appropriate for use in this route.

Effectiveness Of Multimodal Rehabilitation (Biofeedback Plus Capacitive-Resistive Radiofrequency) On Chronic Pelvic Pain And Dyspareunia: Prospective Study And Literature Review.

Fernández-Cuadros ME, Kazlauskas SG, Albadalejo-Florin MJ, Robles-López M, Laborda-Delgado A, de la Cal-Alvarez C, et al. *Rehabilitación*. 2020 ; 54 (3): 154-61.

Objectives:

To determine if a multiple rehabilitation protocol (Biofeedback [BFB] combined with capacitive resistive radiofrequency [INDIBA] [RF]) reduces pain and increases muscle strength in patients suffering from chronic pelvic pain and dyspareunia.

Materials And Methods:

We conducted a prospective, quasi-experimental, pre-post study on 37 patients with chronic pelvic pain and/or dyspareunia referred to the rehabilitation department of Santa Cristina University Hospital (from January 2016 to December 2018). The protocol consisted of 8 sessions of pelvic floor muscle training assisted by manometric biofeedback (15 minutes of exercises on tonic/phasic muscles) supervised by a practitioner, followed by the application of bipolar radiofrequency on the suprapubic and perineal-vaginal region (5 minutes of capacitive RF/10 minutes of resistive RF). The parameters analyzed were pain (VAS scale from 0 to 10) and strength (in

mmHg) of the pelvic floor musculature at the beginning and end of treatment.

Results:

The mean age was 41.5 years at ± 12.65 . Prevalence was higher in women aged 21 to 40 (n=20, 54%) and 41 to 60 years (n=12, 32.4%). Dyspareunia was present in 34 patients (91.8%) and 3 suffered from general chronic pelvic pain (8.2%). The protocol reduced pain (from 7.27 ± 1.34 to 3.75 ± 2.21), improved maximal muscle strength (from 25.56 ± 15.9 mmHg to 35.35 ± 20.4 mmHg), and average muscle strength (from 4.86 ± 3.53 mmHg to 7.18 ± 4.46 mmHg) ($p < 0.0001$).

Conclusions:

Chronic pelvic pain and dyspareunia present diagnostic difficulties that require a multidisciplinary approach. Treatment should start early and integrate various therapeutic modalities. The multidisciplinary rehabilitation protocol with BFB and capacitive-resistive RF decreases pain and increases muscle strength in patients suffering from chronic pelvic pain and dyspareunia.



<https://pubmed.ncbi.nlm.nih.gov/32441260/>

New Therapeutical Procedures Of Peyronie's Disease: Transfer Capacitive Resistive Energy In Association With Hydroelectrophoresis With Verapamil.

Maretti C, Canale D.

Int J Pharm Res Allied Sci. 2020 ; 9 (3): 16-23.

Objectives:

To evaluate the effectiveness of a new treatment, combining capacitive and resistive energy transfer therapy (TCARE) with hydroelectrophoresis (HEP), in improving symptoms of Peyronie's disease in patients with penile deviation of $<30^\circ$ for more than six months before the start of treatment.

Materials And Methods:

Sixty-one patients were recruited and randomly divided into two groups. Group 1 received only TCARE treatment, while Group 2 received TCARE and HEP treatment. Each patient in each group underwent 16 treatment sessions, twice a week. The parameters studied were increased pain during erection, the score on the IIEF-15 questionnaire, and penile curvature, evaluated at the beginning of the study, at its conclusion, and three months after the end of treatment. Side effects were also evaluated.

Results:

Both treatments significantly improved pain, erectile function, and penile curvature ($p < 0.001$). Group 2 showed a more significant improvement than Group 1 ($p < 0.001$ for IIEF and penile deviation; $p < 0.05$ for pain). This improvement was maintained up to three months after the end of treatment. No notable side effects were observed or reported by the patients.

Conclusions:

TCARE associated with a Verapamil dose through HEP is an effective and safe treatment for Peyronie's disease.



<https://ijpras.com/article/new-therapeutical-procedures-of-peyronies-disease-transfer-capacitive-resistive-energy-in-association-with-hydroelectrophoresis-with-verapamil>

| Administration | Group 1 30 patients treated with TCARE alone | | | Group 2 31 patients treated with TCARE + HPE | | | P-value (ANOVA) | | |
|--------------------------------------|--|-----------------------|-----------------------|--|-----------------------|-----------------------|--|--|-------|
| | BEFORE | END | AFTER (3months) | BEFORE | END | AFTER (months) | (a) vs (b) and (c) (d) vs (e) and (f) | (b) vs (c) Group A vs (e) vs (f) Group B | |
| | (a) | (b) | (c) | (d) | (e) | (f) | | | |
| Pain score | 3.3±0.19 (2-6) | 2.23±0.12 (0-3) | 1.82±0.11 (0-2) | 3.54±0.16 (1-5) | 0.87±0.12 (0-2) | 0.74±0.11 (0-2) | <0.001 | NS | <0.05 |
| IIEF 15 scale score | 24.62±0.39 (21-29) | 26.43±0.30 (24-29) | 26.56±0.25 (24-29) | 24.32±0.30 (21-29) | 27.80±0.19 (27-30) | 27.83±0.18 (27-30) | <0.001 | NS | <0.01 |
| Penile deviation (degrees) | 17.8±1.01 (10-25) | 13.1±0.77 (5-20) | 12.7±0.77 (5-20) | 17.8±1.0 (10-26) | 9.7±0.81 (0-10) | 9.4±0.76 (0-10) | <0,001 | NS | <0.01 |
| Side effects(%) (Test x2) | 2/30* (6.7%) | | | 0/31 (0%) | | | | | |

Data are shown as median values SE, ranges in parentheses. Statistical analysis was performed using ANOVA for repeated measurements corrected by Bonferroni. The side effects were recorded as well and were compared using the Chi-square test (Test x2).

Keys: * two patients had mild hypotension

A Prospective, Randomized, Placebo Controlled Study Of Radiofrequency Therapy For The Treatment Of Chronic Prostatitis/Chronic Pelvic Pain Syndrome.

Oh MM, Jin MH, Moon DG, Nam SG, Bae JH, Park SH. J Urol. 2009 ; Vol. 181(4), Supplément, dimanche): 122.

Objectives:

Chronic prostatitis and chronic pelvic pain syndrome (CPPS) in men are conditions with uncertain etiology and often unsatisfactory treatment outcomes. It has been established that the complex of symptoms can result from muscular dysfunction of the pelvic floor and/or neuronal hypersensitivity/inflammation. We evaluated whether the application of radiofrequency therapy can have a therapeutic effect on chronic prostatitis and CPPS.

Methods:

Thirty men with chronic prostatitis or CPPS (inflammatory or non-inflammatory) for 6 months, who had not improved with standard antibiotic treatment, were prospectively randomized to receive radiofrequency or placebo. Radiofrequency treatment involved 30 minutes of pelvic floor stimulation at a frequency of 0.5 MHz, twice a week for 4 weeks. Patients were evaluated at baseline and 1 month after treatment using a validated index of chronic prostatitis symptoms from the NIH (NIH-CPSI) and a survey of pelvic pain symptoms (PPSS).

Results:

A total of 30 men with a mean age of 46.3 years (range 23-72 years) were analyzed. Of the 30 men, 20 were randomized to the active treatment group and 10 to the placebo group. Mean symptom scores decreased significantly in the actively treated group at 1 month ($p < 0.05$), unlike the placebo group, which showed no significant change ($p > 0.05$). A sub-analysis of those receiving active treatment showed that the most pronounced improvement was in pain-related symptoms.

Conclusions:

The innovative use of radiofrequency treatment of the pelvic floor could be a promising new non-invasive option for chronic prostatitis and CPPS in men.

Pilot Study To Evaluate The Effect Of Monopolar Capacitive Resistive Radio-Frequency At 448 kHz As An Adjuvant Treatment In Breast Pain During Lactation Associated With Mastitis.

Panal m, Vales D, Núñez de Arenas A, Calleja J, Sendrós S. Toko - Gin Pract. 2023;82(1):13-21.

Objectives:

Design of a pilot study for the validation of treatment with thermal variations secondary to the application of resistive capacitive monopolar radiofrequency at 448 kHz on the lactating breast in the different clinical pictures associated with breast inflammation or mastitis. The objectives of the study have been to determine the decrease in pain, the tolerability and acceptability of the treatment, as well as the safety for the patient.

Material and methods:

An outpatient observational pilot study was designed and carried out with 6 patients who presented pain associated with mastitis. In each one of them, 6 sessions of capacitive-resistive monopolar radiofrequency at 448Hz provided by INDIBA lasting 20 minutes (10 minutes on each breast), 2 times a week (3 weeks). Clinical assessment and breastfeeding counseling were performed on all participants. The presence of inflammatory symptoms, subjective assessment of pain and symptoms of breast engorgement

by the patient was evaluated, as well as an objective assessment by the physician of the effects of INDIBA on pain associated with mastitis. In addition, safety and innocuousness were evaluated, collecting possible adverse effects at each visit, as well as the repercussions on lactation.

Results:

All patients received adjuvant medical treatment to the application of INDIBA based on the combination of ibuprofen, antibiotics and probiotics. The vast majority of the patients who presented breast pain included in the study reported clear pain relief at the end of the study after the INDIBA sessions. After each session, they reported clear improvement. None reported adverse effects, a negative impact on the maintenance of lactation (weaning) or any other negative impact.

Conclusions:

Capacitive resistive monopolar radio frequency at 448 kHz is a safe, painless technology and effective as an adjuvant treatment of subacute, acute mastitis or other inflammatory and pain conditions of the breast associated with breastfeeding.



https://www.tokoginepractica.com/files/ugd/99c-68d_248a36a978344be983128c9acd366820.pdf

TECAR Therapy For Peyronie's Disease: A Phase-One Prospective Study. Great Evidence In Patients With Erectile Dysfunction.

Pavone C, Castrianni D, Romeo S, Napoli E, Usala M, Gambino G, et al. Urologia. 2013;80(2):148-53.

Objectives:

Our prospective phase one study aimed to evaluate the safety and tolerability of TECAR treatment in the management of Peyronie's disease.

Materials And Methods:

From June 2011 to September 2012, we enrolled 70 patients who had undergone prior andrological examination, a questionnaire to assess PPI and urgency, and SF-36 (V1) for general health evaluation. Pain evaluation was done using the SVA pain scale. Each patient underwent TECAR treatment of the fibrous plaque (both resistive and capacitive mode) for a total of three sessions conducted on consecutive days.

Results:

None of the 70 patients reported any side effects, and pain was reduced by the technique in 80% of cases. The entire sample completed the study. Interestingly, patients who also complained of erectile dysfunction reported an improvement in sexual potency.

Conclusions:

TECAR treatment appears to be a safe and effective option for Peyronie's disease treatment, with good compliance by patients and no reported side effects. Furthermore, patients also suffering from erectile dysfunction experienced improvement in sexual potency, suggesting that TECAR treatment may have a positive impact on several aspects of male sexual health.



<https://pubmed.ncbi.nlm.nih.gov/23423676/>



Clinical Research Aesthetics

First Assessment Of The Proionic Effects Resulting From Non-Thermal Application Of 448 kHz Monopolar Radiofrequency For Reduction Of Edema Caused By Fractional Co2 Laser Facial Rejuvenation Treatments.

Naranjo P, López Andrino R, Pinto H.
Journal of Surgery. 2015;3(1): 21.

Objectives:

Among the side effects which occur after treatment with fractional CO2 laser, one of the most frequent and incapacitating is temporary edema, which is functionally and esthetically incompatible with the patient going immediately back to their social and work life. The 448 kHz capacitive/resistive monopolar radiofrequency proionic system is based on the subthermal electrical stimulation of biological tissues, enabling the restoration of physiological membrane potentials, as well as the ionic balance established through the membrane. This system is capable of improving membrane permeability for an adequate maintenance of cell functions, as well as improving circulation and reducing fluid retention.

Materials And Methods:

this study involved one application before laser treatment and one application 24 hours after laser treatment.

Results:

The results of skin ultrasound presented in this study show that proionic effects help restrict edema progression, thereby reducing recovery time.

Conclusions:

These results suggest that proionic effects help shorten patient recovery time by several days compared to the conventional post-fractional CO2 laser treatment protocol. These data should be contrasted by future studies which include a larger sample.



<http://www.journalofsurgery.org/article/253/10.11648.j.js.s.2015030101.17>

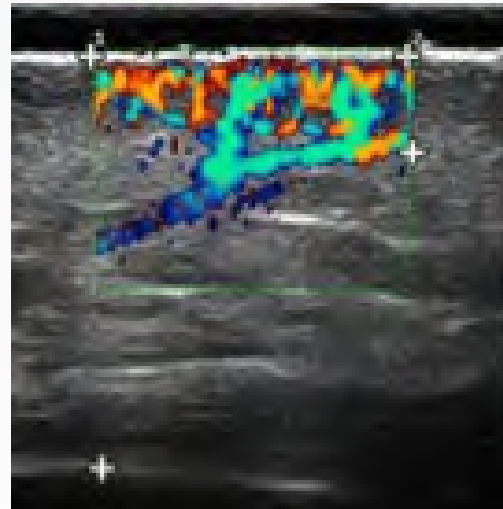
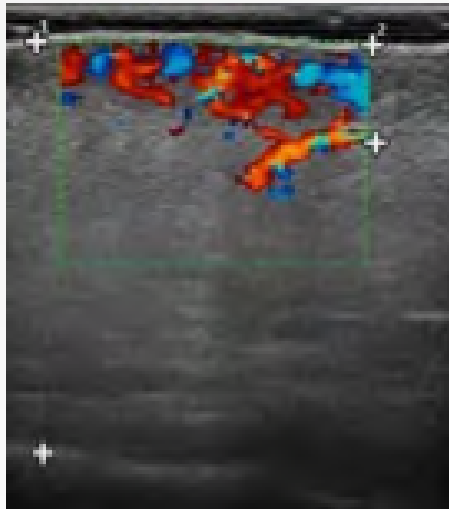


Fig. 1. Color Doppler Echography. Edema has been reduced. Color Doppler (blue and red, according to the direction of blood) shows a slightly increased blood flow, therefore the inflammation process necessary to obtain good results with fractional CO₂ laser will not be compromised. Epidermis-Dermis (ED) Thickness Pre-RF (24h post-L): 2.7 mm and Post-RF (48 h Post-L): 2.4 mm. Epidermis-Muscle Fascia (EF) Thickness Pre-RF (24h post-L): 11.5 mm and Post-RF (48 h Post-L): 10.3 mm.

Reduction Of Erythema After Laser On Rosacea By Subthermal 448 kHz Monopolar Radiofrequency.

Naranjo P, López R, Pinto H. IJDR. 2015;5(3): 3775-3777.

Objectives:

The purpose of this series of cases has been to record the reduction of temporary erythema caused by 595 nm pulsed dye laser (PDL) in patients treated for rosacea with subthermal 448 kHz monopolar radiofrequency.

Materials And Methods:

The 448 kHz radiofrequency was applied following the Proionic® protocol both pre-treatment (24 hours before the PDL session) and post-treatment (immediately after the PDL session).

Results:

Haemoglobin average level before radiofrequency was 1.907 (SD: 0.188), while after radiofrequency it was 1.682 (SD: 0.223). The difference was statistically significant ($p = 0.026$). Haemoglobin average variation before radiofrequency was 0.238 (SD: 0.049), while after radiofrequency it was 0.218 (SD: 0.049). The difference was not statistically significant ($p = 0.36$). Patients reported a mean satisfaction of 4.00 points (SD: 0.8165).

Conclusions:

These results suggest that subthermal 448 kHz radiofrequency treatment significantly reduces post-treatment erythema caused by PDL in the treatment of rosacea. In fact, the Proionic® protocol helps patients go back to their social and work lives more quickly. Again, studies including a greater number of subjects will be necessary in order to confirm or dismiss these results.



<https://www.journalijdr.com/reduction-erythema-after-laser-rosacea-subthermal-448-kHz-monopolar-radiofrequency>

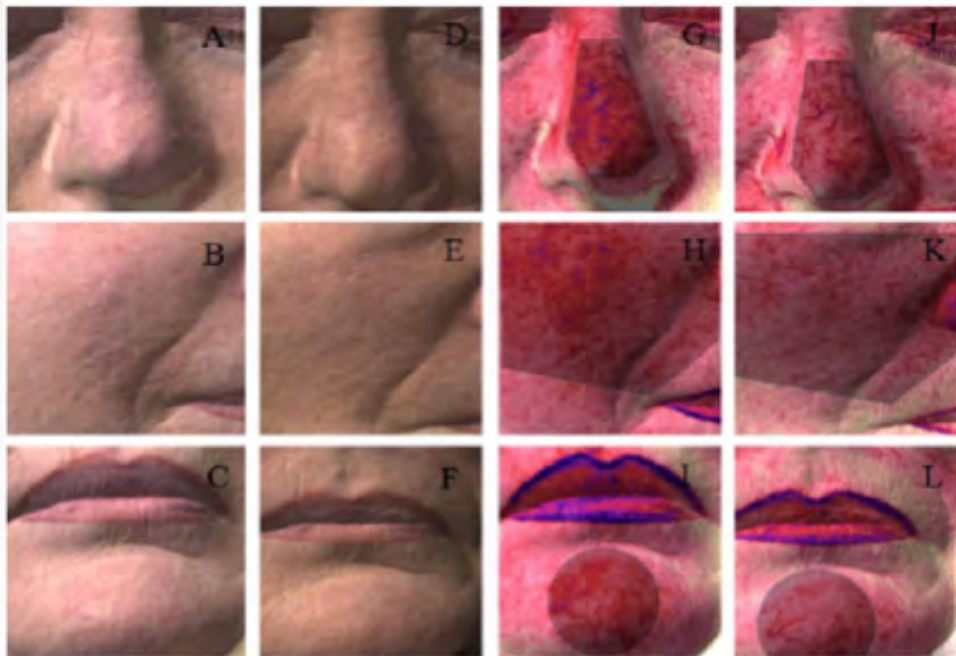


Figure 1. Mexametry. Nose, chin, cheeks. Antera® image processing: standard picture before subthermal 448 kHz monopolar radiofrequency application (A, B, C); standard picture after subthermal 448 kHz monopolar radiofrequency application (D, E, F); mexametry picture before subthermal 448 kHz monopolar radiofrequency application (G, H, I); mexametry picture after subthermal 448 kHz monopolar radiofrequency application (J, K, L)

Capacitive / Resistive Monopolar Radiofrequency At 0.5 MHz In Facial Skin Aging.

Pinto R. Medicina estética. 2009;20:32-37

Objectives:

To assess the efficacy of 0.448 MHz Monopolar Capacitive / Resistive Radiofrequency on skin aging.

Results:

Skin moisture increased by 9.7 %. There was an average skin sebum loss of 3.3 $\mu\text{g}/\text{cm}^2$ (2.1 %). Skin elasticity showed an average relative increase of 19.6 %. Microphotographs of skin showed a mean reduction of wrinkle width of 26.5 % and a 32.6 % reduction of depth (Figure 2 & image 1, 2 & 3).

Materials And Methods:

Twenty-one female patients with ages ranging from 40 to 56 y.o. (mean age 46 y.o.). Patients received 15 session treatments (10 min. capacitive plus 5 min. resistive application) on a daily basis with a medical 0.448 MHz Monopolar Radiofrequency Device (INDIBA, Barcelona Spain). Assessment by changes in skin hydration and sebum, skin elasticity and wrinkles width and depth.

Conclusions:

INDIBA 0.448 MHz Monopolar Capacitive / Resistive radiofrequency has resulted in a favourable evolution for all parameter controls thus being an effective and safe alternative in the treatment of aging skin.

Capacitive / Resistive Monopolar Radiofrequency At 0.5 MHz In Cellulite.

Pinto R. Medicina estética. 2009;19:32-39

Objectives:

To assess the efficacy of 0.448 MHz Monopolar Capacitive / Resistive Radiofrequency on cellulite.

Materials And Methods:

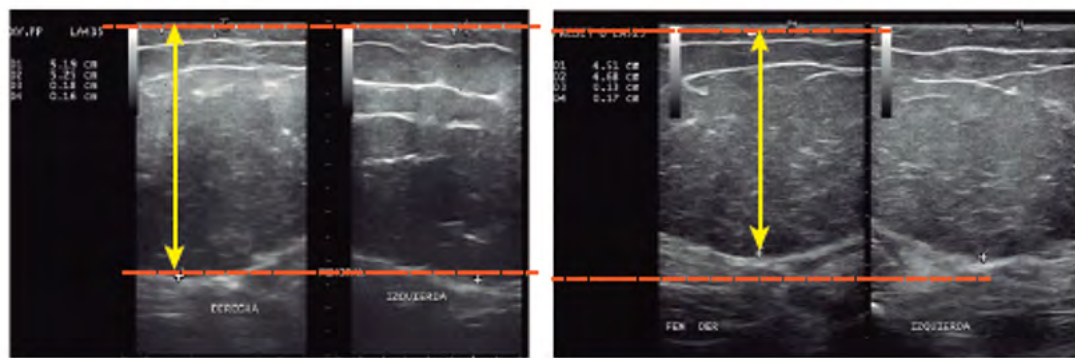
Twenty women with ages ranging from 20 to 45 y.o. with stage 3 Nürnberger-Muller cellulite scale. Patients received 20 session treatments with a 0.448 kHz Monopolar Radiofrequency Device (INDIBA). Assessment by body perimeters, adipose tissue thickness, blood analysis, thermography and photography.

Results:

Circumference average loss of 2.4 cm, mean reduction of 4.1%, a mean loss of 3.4 mm of hypodermal fat tissue (14.5%). Plasma level of free fatty acids showed a significant increase (27%) 2 hours after the session, compatible with a lipolytic effect. Plasma level of triglycerides showed no significant reductions 2 hours after the session. Skin elasticity increased by 22% in the skin around the trochanter area and 19% in the subgluteal region. Thermographies showed an improvement on 82% of patients compatible with thermographic stage 3 and 18% reached stage 2c.

Conclusions:

INDIBA 0.448 MHz Monopolar Capacitive / Resistive radiofrequency is an effective and safe alternative in the treatment of stage 3 cellulite.



Ultrasound control showing the fat tissue depletion after treatment corresponding to a mean reduction of 14.5 %

A Retrospective Study Of The Pre- And Postoperative Treatment Outcomes In Oculoplastic Surgery Using The Proionic® System At 448 kHz.

In: Gassia V, Marie-Anne D, Naranjo P. INDIBA Proionic® RF: reach the excellence in aesthetic treatments. Dermatology, oculoplasty and post laser surgery recovery. Marie-Anne, D. AMWC; Monaco 2015.

Objectives:

To determine whether two pre-operative sessions, in addition to the postoperative application, of the INDIBA Proionico® System affords some advantage in the postoperative period of oculoplasty with respect to the postoperative application only of the same technology.

Materials And Methods:

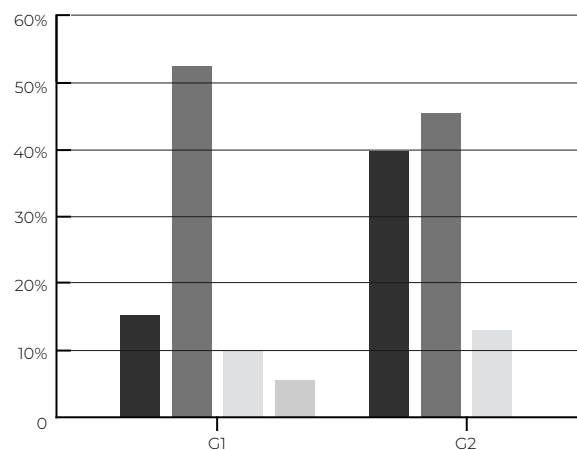
Retrospective study of 83 patients previously treated with INDIBA on a blepharoplasty postoperative basis (Group 1 or G1) as control group, versus 16 patients treated with the same protocol as G1 but adding two pre-operative sessions (Group 2 or G2) as study group. The evaluation criteria were: presence of hematomas (grade 0 = no hematoma to grade 3 = maximum hema-toma) and edemas (grade 0 = no edema to grade 3 = maximum edema) on day three (D3) and day seven (D7) after surgery.

Results:

Hematoma and edema decreased dramatically in G2 vs G1 in the third day post-op.

Conclusions:

Preoperative application reduces the appearance of hematomas and edemas on day three and day seven versus postoperative application alone and accelerates healing and increases the vascularization of skin grafts.



The percentage of patients with each grade of hematoma on the third day after surgery, according to whether they had been treated only after surgery (G1) or both before and after surgery (G2).

■ Grade 0
■ Grade 1
■ Grade 2
■ Grade 3

Efficacy Of Monopolar Radiofrequency Device On Cellulite Treatment.

Yupakorn K, Amornvittayachan O,
Udompataikul M. Srinagarind
Med J. 2010;25(4): 258- 64.

Objectives:

The treatment of cellulite has not been standardized. The aim of this study is to evaluate the efficacy of the 0.5 MHz monopolar radiofrequency device on cellulite treatment.

Materials And Methods:

Twenty-one volunteers were enrolled and received the treatment with monopolar radiofrequency device, 50 minutes for their thighs and 40 minutes for their buttocks. The number of treatment was 10 sessions in total. The volunteers' weight and circumference of buttocks and thighs were recorded. The thickness of subcutaneous tissue of both regions was also evaluated by ultrasound at the end of treatment and at 4 weeks after the final treatment. The clinical evaluation of cellulite improvement was assessed by photograph grading.

Results:

The volunteers had significantly lost their weight ($P = 0.002$). The average circumference reduction of buttocks and thighs on the last treatment were 1.60 cm and 1.67 cm, respectively ($P < 0.001$, $P < 0.001$). The reduction of the thickness of the superficial layer of subcutaneous tissue of the buttocks and thighs was 2.63 mm and 1.56 mm, respectively ($P = 0.004$, $P < 0.001$). The average circumference reduction of buttocks and thighs were 1.75 cm and 1.84 cm, respectively at 4 weeks after the final treatment ($P < 0.001$, $P < 0.001$). The reduction of the thickness of the superficial layer of subcutaneous tissue of buttocks and thighs was 3.31 mm and 2.37 mm, respectively ($P < 0.001$, $P < 0.001$). The clinical evaluation of cellulite demonstrated that most of the volunteers (85.7%) had clinical improvement.

Conclusions:

0.5 MHz monopolar radiofrequency can be considered as an alternative choice of cellulite treatment.

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