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The Use Of Pulsed Magnetic Fields (PEMF) To Inhibit The Plateau Effect In Weight Loss Processes.

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Abstract:
The process of effective weight loss is possible with the adoption of various therapeutic modalities, such as diet and physical activity. However, maintaining this weight loss in the long term is still a challenge for patients and health professionals, and weight regain is unfortunately extremely common. When a patient undergoes weight loss treatment, in the first months of treatment, the body is forced to undergo a series of physiological and adaptive changes, due to caloric restriction and the weight loss process itself.
Objective: This study aims to analyze the effectiveness of using high-intensity pulsed electromagnetic fields (PEMF), applied through supramaximal muscle contractions, as a biophysical resource capable of modulating energy metabolism and combating the plateau effect in weight loss processes. The central proposal is to understand how the application of PEMF can induce the browning phenomenon of white adipose tissue, stimulating mitochondrial biogenesis and the metabolic conversion of adipocytes, favoring the resumption of the weight loss curve, in addition to offering a positive systemic impact on parameters related to metabolic health. The work also seeks to correlate the expression of the myokine irisin, mediated by passively simulated high-intensity muscle contractions via PEMF, with the promotion of adaptive thermogenesis, lipolysis and anti-inflammatory effects, based on current scientific evidence on muscle physiology, energy metabolism and non-invasive strategies to support sustainable weight loss.
Conclusion: The results presented in this study reinforce that the application of high-intensity pulsed electromagnetic fields (PEMF), through the induction of supramaximal muscle contractions, constitutes an effective strategy for dealing with the plateau effect in weight loss processes. Biochemical and physiological evidence demonstrates that this stimulus is capable of promoting profound metabolic adaptations, mainly by increasing the expression of the myokine irisin, a factor directly related to mitochondrial biogenesis, increased thermogenesis and conversion of white adipocytes into beige adipocytes — a process known as browning. Such adaptations not only favor the resumption of the weight loss curve, but also confer systemic benefits that transcend the purely aesthetic scope, positively impacting insulin sensitivity, inflammatory modulation and improving energy homeostasis. The use of PEMF allows the replication of the physiological effects of high-intensity exercises in a passive manner, enabling the sustained production of irisin and its pleiotropic effects on metabolism. Additionally, it is observed that this technology not only offers an impact on the reduction of localized adiposity, with relevant motivational effects for patient adherence to treatment, but also acts as an effective metabolic intervention, promoting lasting changes in the functional profile of adipocytes and energy balance. I n view of the findings, it is concluded that the use of PEMF with free parameterization and optimized protocols represents a highly relevant therapeutic tool, both in the field of advanced aesthetics and in clinical-metabolic support. It therefore becomes a strategic resource in the management of the plateau effect, offering patients a new possibility of continuity in the weight loss process, associated with substantial improvements in metabolic health and quality of life.

Key Word: *cryoexposure, electromagnetic field, health, aesthetics, weight loss, plato effect*

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I. Introduction

The process of effective weight loss is possible with the adoption of various therapeutic modalities, such as diet and physical activity. However, maintaining this weight loss in the long term is still a challenge for patients and health professionals, and weight regain is unfortunately extremely common. When a patient undergoes weight loss treatment, in the first months of treatment, the body is forced to undergo a series of physiological and adaptive changes, due to caloric restriction and the weight loss process itself. These adaptive mechanisms are hormonal, metabolic and appetite-related, and are restricted to continued weight loss after the first four to six months of

treatment. However, this adaptation process can be related to a process of self-preservation of the human body to the new environmental conditions imposed. After an individual undergoes a prolonged diet, the body ends up adapting to the new conditions of dietary restrictions. It is as if the body understands that the best thing to do is to slow down the metabolism and burn fewer calories. As a result, it adapts and the weight loss curve stabilizes. This is the phase known as the plateau effect. The plateau effect corresponds very simply to the lowest weight loss since the beginning of treatment, the duration of which varies between patients. The reduction in energy metabolism, as well as the increase in appetite, plays an extremely important role in the plateau effect. It is estimated that each kilogram of body weight lost reduces metabolism by 20 to 30 kcal/day and increases appetite by around 100 kcal/day compared to the beginning of treatment. Combined with moderate or no physical activity, these are the two main factors of the plateau effect. The graph below is a mathematical model proposed to explain the adaptations during the plateau effect for those patients who experienced weight regain (in blue) and for those who at least maintained the same weight when reaching the plateau effect.

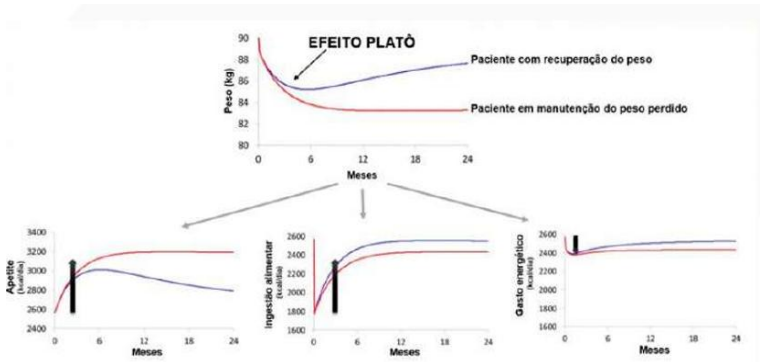

Figure 1 – Representation of the weight loss plateau effect and its metabolic determinants [13].

In contrast, a drop of ~200 kcal/day in caloric consumption during the plateau effect, appetite increases by ~400 to 600 kcal/day and food intake increases by 600 to 700 kcal/day from the beginning of the weight loss process, therefore weight regain is extremely rapid. According to Hall KD, 2017, this evidence contradicts the reports of patients, who believe they are eating the same amount of food as at the beginning of the weight loss process and at the beginning of the plateau. Although they truly believe they are eating the same amount of food, the sensation of hunger is increased in this plateau phase and, as appetite regulation occurs in regions of the brain below the patient's level of consciousness, their perception of portion sizes is impaired. Although these physiological changes are known, the most common typical response among patients in this plateau phase is to blame themselves, attributing the lack of success to psychological problems. Unfortunately, this fact is a contributing factor and a decisive factor in obese people giving up on treatments. And how can electrotherapy available in a beauty clinic be used to alleviate or even avoid the plateau effect in weight loss processes? The most effective interventions are those in which electrotherapy is capable of achieving two effects: 1. Motivational: the use of electrotherapy to reduce localized adiposity, through pathways such as lipolysis and apoptosis, can help reduce measurements and improve body contour and appearance, having a motivational effect on the continuation of the weight loss process. These procedures are possible with cryolipolysis, radiofrequency and hybrid therapy and PEMF. PEMF and apoptosis: Performing procedures between 30 and 60 minutes of supramaximal contractions continuously indicates an increase in apoptotic processes by biopsy and serum biochemistry, according to Weiss, 2019. Performing submaximal contractions (1 to 10Hz) and intervals with supramaximal contractions (10 to 100Hz), simulating the HIIT (High Intensity Interval Training) condition promotes an excessive output of FFA, and with the natural increase in FFA, apoptosis can be induced by stress in the endoplasmic reticulum (Weiss, 2013). It is worth remembering here that this type of HIIT simulation is only possible in PEMF equipment that allows free parameterization of frequencies and emission ON time, which makes this procedure restricted to this type of technology.

II. Browning:

The latest in combating the plateau effect is the activation of biophysical triggers that induce mitochondrial multiplication in WAT-type adipose cells, since this electrotherapeutic modality transcends the apparent aesthetic effects to a systemic modality that efficiently helps to end the plateau effect and the possibility of a new steep weight loss curve. This procedure is possible with cryoexposure and supramaximal muscle contractions by PEMF (Pulsed ElectroMagnetic Field). PEMF and Browning: high-intensity physical activity can be performed passively through the use of pulsed magnetic field (PEMF) equipment, since supramaximal frequency activities (contraction pulse emissions above 10Hz) are related to the production of the hormone irisin. The benefits of regular physical activity are well known: a powerful way to combat comorbidities related to a

sedentary lifestyle and obesity, in addition to preventing other pathologies. Advances in research seeking to understand how intense muscle activity affects the body led, in 2012, to the discovery of a hormone secreted by skeletal muscle when subjected to intense physical activity: irisin. Skeletal muscle is an endocrine organ with the ability to control the homeostasis of the entire organism, capable of expressing myokines (such as irisin), which perform metabolic activity and act as hormones, the release of which is related to the contraction of type II muscle fibers. Myokines can exert their action in places far from where they were produced. Different areas of the body and with different functions respond to this regulatory process, such as mental health, immune response and body composition. Irisin also acts as a hormone modulator in macrophage activity, which gives it potential anti-inflammatory properties. Irisin favors the transformation of white adipocytes (with a reserve function) into beige adipocytes (with a mixed function: reserve and heat). According to Lee YH, 2014, it was demonstrated that one of the responses to intense physical activity is "browning", the name given to the induced process of transformation of white adipocytes into beige ones. Interventions that associate PEMF and a healthier lifestyle can change the metabolic characteristic that induces adipogenesis in white adipocytes, which essentially have a storage function, to activate transcriptional factors that induce mitochondrial multiplication and consequently the metabolic function of adipocytes as energy consumers.

The highest quantity of beige/brown adipocytes is related to adults who do regular intense physical activity, since the release of Browning factors IS MEDIATED BY MUSCLE CONTRACTION. (Lee YH, 2014). Recent studies demonstrate that individuals with morbid obesity have an inverse association between BMI and plasma irisin concentrations. Other studies demonstrate that patients who underwent bariatric surgery also had decreased plasma irisin levels due to loss of lean mass. Irisin is one of the potential mediators of the metabolic benefits of physical exercise, since it is the contractions of this activity that induce the expression of PGC-1, responsible for the release of irisin into the bloodstream.

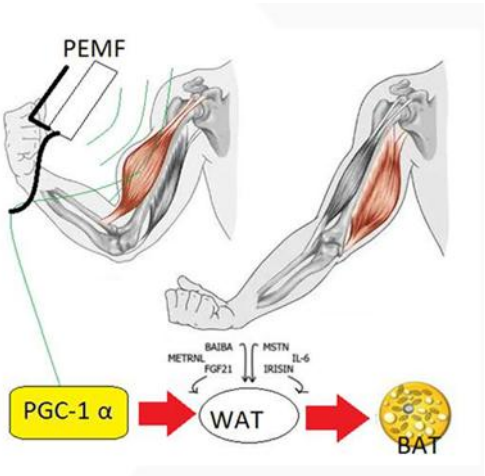

Figure 2 – Effect of PEMF on muscle stimulation and conversion of white adipose tissue (WAT) to brown adipose tissue (BAT).

Figure 3 – Clinical application of the PEMF and Cryolipolysis protocol for plateau effect management. Photographic documentation of the SupraMáximus® (PEMF) and Asgard® (Cryolipolysis) protocol, combining supramaximal muscle contractions and cold exposure. This approach is part of the plateau effect management strategy, aimed at enhancing myokine secretion, such as irisin, and stimulating adipose tissue browning.

A study with patients with heart failure showed that those with a better VO2 max had an increase in irisin concentration. A study with obese individuals in 2012 showed that after 30 minutes of acute exercise, there is an increase in lipolysis - the use of fat as an energy source - and also in ATP levels, raising irisin levels. A study by Tsuchiya et al. in 2014 compared a high-intensity protocol at 80% of VO2 max and a low-intensity protocol at 40% of VO2 max, finding that the irisin release response depends on the exercise intensity, that is, the high-intensity exercise group had plasma irisin concentrations higher than their pre-exercise levels and in relation to the low-intensity exercise group.

The Browning process is therefore activated by high-intensity exercises, but do we really understand what Browning is? When we talk about the plateau effect, we saw that it is a natural condition of adaptation of the individual to a new environment. This is adaptive thermogenesis. Browning is a phenomenon that favors the increase in thermogenesis and daily caloric expenditure at rest, and that can help in the process of a new reduction in body weight in individuals in the plateau effect stage and, indirectly, in metabolic syndrome and fatty liver. Browning is related to a metabolic change induced by factors such as cold exposure, intermittent fasting and supramaximal physical activity through pulsed magnetic fields (PEMF). The energy requirement promoted by this type of muscular activity, after sessions, activates the increase in the expression of the signaling proteins AMPK, P38 MAPK (mitogen-activated protein kinase) and a consequent increase in PGC-1 Alpha, which regulates mitochondrial biogenesis (Harridge, 2006). There is also evidence that irisin is positively correlated with sensitivity to the action of insulin, reduction of osteoporosis and sarcopenia (Dos Santos; Tewari; Benite-Ribeiro, 2014).

The contractions promoted by PEMF and the associated energy expenditure induce the transcriptional factor PGC-1 in skeletal muscle, which, in turn, induces the production of the membrane protein FNDC5. The circulating factor irisin activates thermogenic factors in white adipose tissue, leading to the browning process, including mitochondrial

biogenesis, and the expression of uncoupling protein 1 (UCP1), responsible for mitochondrial heat production – heating. It is concluded that the new PEMF technology applied with free parameter equipment can be an ally in combating the plateau effect, since the therapeutic results demonstrated show a symbiotic benefit in patients in the process of losing weight: the improvement in the general aesthetic aspect, encouraging a healthier lifestyle and continuation of treatment, and the systemic effect of Browning (mediated by the hormone irisin), as a true restart in the weight curve after adaptive thermogenesis.

III. Conclusion

The results presented in this study reinforce that the application of high-intensity pulsed electromagnetic fields (PEMF), through the induction of supramaximal muscle contractions, constitutes an effective strategy for dealing with the plateau effect in weight loss processes. Biochemical and physiological evidence demonstrates that this stimulus is capable of promoting profound metabolic adaptations, mainly by increasing the expression of the myokine irisin, a factor directly related to mitochondrial biogenesis, increased thermogenesis and conversion of white adipocytes into beige adipocytes — a process known as browning (Boström et al., 2012; Lee, Mottillo and Granneman, 2014).

Such adaptations not only favor the resumption of the weight loss curve, but also confer systemic benefits that transcend the purely aesthetic scope, positively impacting insulin sensitivity, inflammatory modulation and improving energy homeostasis (Moreno, Moreno-Navarrete and Fernández-Real, 2014; Dos Santos, Tewari and Benite-Ribeiro, 2014). The use of PEMF allows the replication of the physiological effects of high-intensity exercises in a passive manner, enabling the sustained production of irisin and its pleiotropic effects on metabolism (Mahajan and Patra, 2013; Tsuchiya et al., 2014).

Additionally, it is observed that this technology not only offers an impact on the reduction of localized adiposity, with relevant motivational effects for patient adherence to treatment, but also acts as an effective metabolic intervention, promoting lasting changes in the functional profile of adipocytes and energy balance (Hall and Kahan, 2018; Lo and Sun, 2013).

In view of the findings, it is concluded that the use of PEMF with free parameterization and optimized protocols represents a highly relevant therapeutic tool, both in the field of advanced aesthetics and in clinical-metabolic support. It therefore becomes a strategic resource in the management of the plateau effect, offering patients a new possibility of continuity in the weight loss process, associated with substantial improvements in metabolic health and quality of life.

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References

[1] Lopes-Martins, R.A.B.; Barbosa, L.V.; Sousa, M.M.B.; Lobo, A.B.; Santos, E.L.D.R.; Sá Filho, A.S.D.; Souza, M.B.; Jaime, J.C.; Silva, C.T.X.D.; Ruiz-Silva, C.; Et Al. The Effects Of Body Cold Exposure (Cryolipolysis) On Fat Mass And Plasma Cholesterol. Life 2024, 14, 1082. Https://Doi.Org/10.3390/Life14091082

[2] Ruiz-Silva, C. Efeitos E Aplicações Da Eletrocrioexposição E Contrações Por Pulso Eletromagnetico De Alta Intensidade Para Indução De Browning. 16 Congresso Cientifico Internacional De Saúde Estética, 1 Edição. São Paulo, Triall Editorial, 2023

[3] Martins RAL, Matias M, Bueno FC De P, Oguri M, Leonardo PS, Ruiz-Silva C. Effects And Applications Of The High Intensity Electromagnetic Field (PEMF) In Health And Aesthetics: Perspectives And Clinical Evidence. Research, Society And Development. 2021; 10(14). DOI: 10.33448/Rsd-V10i14.2172

[4] Ruiz-Silva, C , Moleiro, D; Ruiz-Silva,CR. "Treatment Of Lipedema Using Cryolipolysis Associated With Microcurrents" IOSR Journal Of Dental And Medical Sciences (IOSR-JDMS) E-ISSN: 2279-0853, P-ISSN: 2279-0861.Volume 23, Issue 10 Ser. 7 (October. 2024), PP 05-12 Https://Www.Iosrjournals.Org/Iosr-Jdms/Papers/Vol23-Issue10/Ser-7/B2310070512.Pdf

[5] Irisina: La Nueva Mioquina. Luz Maria Trujilo, Daniela Garcia, Astrid Von Oetinger. Rev Chil Nutr Vol. 43, N 3, 2016. –

[6] Boström P, Wu J, Jedrychowski MP, Korde A, Ye L, Lo JC, Rasbach KA, Boström EA, Choi JH, Long JZ, Kajimura S, Zingaretti MC, Vind BF, Tu H, Cinti S, Hojlund K, Gygi SP, Spiegelman BM. A PGC1-?- Dependent Myokine That Drives Brown-Fat-Like Development Of White Fat And Thermogenesis. Nature 2012; 481:463-8

[7] Mahajan RD, Patra SK. Irisin, A Novel Myokine Responsible For Exercise Induced Browning Of White Adipose Tissue. Indian J Clin Biochem. 2013 Jan;28(1):102-3.

[8] Moreno M, Moreno-Navarrete JM, Fernández-Real JM. [Irisin: A Messenger From The Gods?]. Clin Investig Arterioscler. 2014 May-Jun;26(3):140-6.

[9] Dâmaso, Ana R.; Campos, Raquel Munhoz Da Silveira. Exercício Físico Como Remédio Em Obesidade E Síndrome Metabólica Na Adolescência./ Ana R. Dâmaso; Raquel Munhoz Da Silveira Campos. —1. Ed. - São Paulo: Weight Science, 2014. ISBN: 978-85-67931-09-8–

[10] Hall, K. D., & Kahan, S. (2018). Maintenance Of Lost Weight And Long-Term Management Of Obesity. The Medical Clinics Of North America, 102(1), 183–197. Lo, K. A., & Sun, L. (2013).

[11] Turning WAT Into BAT: A Review On Regulators Controlling The Browning Of White Adipocytes. Bioscience Reports, 33(5), E00065.

[12] Lee, Y. H., Mottillo, E. P., & Granneman, J. G. (2014). Adipose Tissue Plasticity From WAT To BAT And In Between. Biochimica Et Biophysica Acta, 1842(3), 358–369.

[13] HALL, K. D. Et Al. Quantification Of The Effect Of Energy Imbalance On Bodyweight. The Lancet, V. 378, N. 9793, P. 826–837, 2011. DOI: Https://Doi.Org/10.1016/S0140-6736(11)60812-X.

[14] DOS SANTOS, Julia; TEWARI, Shikha; BENITE-RIBEIRO, Sandra. The Effect Of Exercise On Epigenetic Modifications Of PGC1: The Impact On Type 2 Diabetes. Medical Hypotheses, V. 82, P. 21–24, 2014. DOI: Https://Doi.Org/10.1016/J.Mehy.2014.03.018.