Research Article

Effects of Microelectrólisis Percutaneous® on pain and functionality in patients with calcaneal tendinopathy.

Efeitos da microelectrólisis percutânea® na dor e na funcionalidade de pacientes com tendinopatia calcânea.

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Abstract
Introduction: The Achilles tendinopathy with tendon injuries are the third most common in the musculoskeletal system. New therapies have been proposed for the treatment of tendinopathy as Percutaneous Microelectrólisis (MEP ®). **Objectives**: The aim of this study was to evaluate the effects of MEP ® on tendinopathy of Achilles. **Method:** This was a controlled clinical trial, randomized study. The sample comprised 20 patients with Achilles tendinopathy. The volunteers were randomly divided into two groups, control (G1) underwent conventional treatment protocol and experimental (G2) which was under the application of MEP. We made two visits per week for a month, totaling eight sessions. As evaluation method were used four questions from Visa-A questionnaire related to the functionality and exercise pratice. Data were analyzed using paired and independent T test. **Results:** The pain when walking down stairs has been observed a reduction in G1 ($p < 0.05$) and G2 ($p < 0.001$) before and after the protocols. Among the groups there was a greater reduction in G2 ($p < 0.001$). Pain after heating was observed a reduction in G2 ($p < 0.001$). Among them there was a greater reduction ($p < 0.05$) in G2. For pain was observed after walking a reduction in G1 ($p < 0.05$) and G2 ($p < 0.001$) before and after the protocols. Among them there was a reduction ($p < 0.05$) higher in G2. In pain after exercise was observed a reduction in G2 ($p < 0.001$). Among the groups there was a greater decrease in G2 ($p < 0.05$). **Conclusion:** We conclude that the MEP ® helps reduce pain in functional activities.
Keywords: Achilles tendon, tendinopathy, pain, physical therapy modalities, electrotherapy, analgesia, Electric Stimulation.

Resumo
Introdução: As tendinopatias de calcâneo são a terceira lesão tendinosa mais frequente no sistema musculoesquelético. Novas alternativas terapêuticas têm sido propostas para o tratamento de tendinopatia como a Microelectrólisis Percutânea (MEP®). **Objetivos**:O objetivo desse estudo foi avaliar os efeitos da MEP® nas tendinopatias de calcâneo. **Método:** Trata-se de um ensaio clínico controlado, randomizado. A amostra foi composta por 20 pacientes que apresentavam tendinopatia de Aquiles. Os voluntários foram separados aleatoriamente em dois grupos, o controle (G1) submetido ao protocolo de tratamento convencional e o experimental (G2) à aplicação da MEP. Foram realizados dois atendimentos por semana durante um mês, totalizando oito atendimentos. Como método de avaliação foi utilizado 4 perguntas do questionário Visa-A relacionadas à funcionalidade e a prática de exercício. Os dados foram analisados através do teste t pareado e independente. **Resultados:** Na dor ao descer escadas foi observado uma redução no G1 ($p<0,05$) e G2 ($p<0,001$) antes e depois dos protocolos. Entre os grupos verificou-se uma redução maior no G2($p<0,001$). Na dor após o aquecimento foi observado uma redução no G2 ($p<0,001$). Entre eles observou-se uma redução maior ($p<0,05$) no G2. Para a dor após caminhada foi verificada uma redução nos G1 ($p<0,05$) e G2 ($p<0,001$) antes e depois dos protocolos. Entre eles observou-se uma redução ($p<0,05$) maior no G2. Na dor após Exercício foi observado uma redução no G2 ($p<0,001$). Entre os grupos observou-se uma queda maior no G2($p<0,05$). **Conclusão:** Concluímos que a MEP® favorece a redução da dor em atividades funcionais.
Palavras-chaves: Tendão calcâneo, tendinopatia, dor, modalidades da fisioterapia, eletroterapia, Analgesia, Eletrólise, Estimulação Elétrica.

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INTRODUCTION

Tendinopathy is a term for painful conditions in peritendinea region as a result of overuse and tissue degeneration.[1] The increasing number of high performance sports activities in adults is contributing to the growing incidence of such injuries. Moreover, in most cases affects men between 30 and 50 years old during sports activities. Among the tendinopathy, tendinosis which is related to tissue degeneration from the aging process or vascular compromise and tendonitis that is most known tendinopathy, which comes from microtrauma with partial rupture of the tendon fibers and local inflammation.[2] The Achilles tendinopathy are the third highest frequency of involvement, being surpassed only by the tendons of the rotator cuff muscles and the coming of the quadriceps extensor mechanism.[3]

The classic signs and symptoms of calcaneal tendinopathy are pain and swelling, induced mainly by exercise and exacerbated during or after walking or running up and down stairs, beyond the pain when performing a tendon elongation and perform muscle strengthening and during the performance of functional activities.[2] Tendinopathy cause major limitation, because despite being a localized problem, it is a condition that worsens with mainly functional activity, among them the important function of locomotion when the impairment is the calcaneus, considering that the Achilles tendon holds up to 12.5 times body weight.[4] Therefore, it is a condition that directly affects the functionality of the activities of the individual, leading to painful and even disabling processes, with worse quality of life.[3]

Resource use of electrothermal has been of great importance to physiotherapy treatment in decades. However, these resources are being innovated frequently with new eletrotherapy technological alternatives. Thus, new therapies have been proposed for the treatment of tendinopathy. Among these we have Percutaneous Microelectrólisis (MEP®), which is a minimally invasive method which involves the application of a galvanic current that promotes a local inflammatory process and acceleration of repair of the affected tissue.[5]

Percutaneous Microelectrólisis (MEP®) is a technique that utilizes a galvanic current of the order of microamps, percutaneously applied to an acupuncture needle is connected to the cathode. This allows the current density to reach 2.5 to 5 mA/cm^2. Although the use of tendinopathy, trigger points and muscle injuries, among other conditions, spread widely in Latin America. The galvanic current produces electrochemical phenomena, electrolysis and electrophoresis. When the cathode is applied to the healthy tissue of the sodium ion ($Na+$) reacts with water (H_2O) to form sodium hydroxide ($NaOH$) and hydrogen (H_2). NaOH is an alkaline caustic electrolyte generates an athermal ablation. The electrochemical reaction generates a melting point and an increase of the pH, and become alkaline [5,6]

Considering the importance of the Achilles tendon to the function of movement and its relationship with the activities of daily living, tendinopathy of this fabric is a factor of disability that directly affects the functional capacity of patients with this pathology. The MEP® consists of a minimally invasive, safe and easy to use application with fast therapeutic and biological effects, providing an alternative for the treatment of tendinopathy. As clinical practice shows MEP® has shown improvement in pain and function, but lack clarity on the scientific evidence, due to the scarcity of studies on this method to prove its effects. Thus he will need further study, therefore the aim of this study was to analyze the effects of MEP® on Achilles tendinopathy and check the score range of the VISA-A questionnaire related to pain and function before and after sessions.

METHODS

This is a randomized controlled clinical trial, conducted in at physiotherapy department of Clínicas Integradas do Centro Universitário do Rio Grande do Norte - UNI-RN. Clinical procedures of this research had only start after the approval of the Research Ethics Committee of Universidade Potiguar - CEP/UNP with protocol number 099/2011, according to the Declaration of Helsinki.

Population and sample

The study population consisted of 20 patients with clinical diagnosis of Achilles tendinopathy, of both genders, aged 20-50 years, mean 45.4 years, who had symptoms for at least six months of the beginning treatment. The inclusion criteria were patients who had pain in any region of the ankle and Achilles tendon, patients without pregnancy were not using cardiac pacemakers, who did not have cognitive deficits that interfere with the administration of the questionnaires. Individuals in the previous month or during the study have modified the analgesic or anti-inflammatory treatment usual and they missed two or more treatment sessions were excluded from the study.

After sample selection, subjects were randomly separated into two groups, the control (G1) and the experimental (G2). To collect general data of patients a form of physiotherapy assessment consists of identification, medical conditions, history of present illness, pathological and family history, lifestyle habits, medications and physical examination (inspection and palpation) was used as model used by the physiotherapy sector of UNI-RN adapted to pathology.

After application of the evaluation form, the questionnaire Victorian Institute of Sports Assessment Achilles (VISA-A),[7] who demonstrated as a valid tool for evaluation, with high reliability, simple and easy to apply, which was used to evaluate severity of symptoms of tendinopathy and the functional capacity of the individual, among these the level of pain while performing functional activities such as: When descending stairs, after warming, post-exercise and post- walk.

Procedures

After the recruitment of volunteers as the inclusion criteria were then explained the purpose of the research, as well as signing the Informed Consent, whereby patients authorized research, as prescribed by Resolution 196/69 of the Conselho Nacional de Saúde.

Followed the signing of informed consent, patient assessment was made with application of VISA-A questionnaire, with questions about the pain in functional or exercise-related activities. After this, two groups: G1 (control) and G2 (experimental) were subjected to the treatment protocol was conducted in two visits per week for a month, totaling 8 sessions. The procedures used in each group of this study are consistent with the adopted protocols for the conservative treatment of tendinopathy[8,9,10] described in Chart 01 below:

In addition to conventional treatment, G2 underwent the standard treatment protocol and application of MEP once a week after the exercise protocol, applications totaling four for a month. The device Percutaneous Microelectrólisis MEP®, the Fisiomove® brand was used. The execution was as follows: the patient was positioned in the prone position and then was done cleaning the site with alcohol. The needles were introduced on 3 occasions during each session, at different points of the Achilles tendon region, with a needle of 0.22 x 13

Chart 01. Procedures to conduct treatment.

G1 = Control	G2 = Experimental
1- Warming In Stationary Bike (10’); 2-Stretching muscles: adductors, abductors, hamstrings and plantar flexors (3 x 30”); 3- Friction massage in the calcaneal tendon (5’); 4- Stretching of the plantar fascia; 5- Eccentric exercises for plantar flexors (3 x 15 repetitions).	1- Warming In Stationary Bike (10’); 2-Stretching muscles: adductors, abductors, hamstrings and plantar flexors (3 x 30”); 3- Friction massage in the calcaneal tendon (5’); 4- Stretching of the plantar fascia; 5- Eccentric exercises for plantar flexors (3 x 15 repetitions). 6- MEP application (1x per week).

Subtitle: G1 = control; G2 = experimental

Table 01. Descriptive analysis and normality Scores for the VISA-A questionnaire regarding pain when walking down stairs, after warming, post-walk and post-exercises before and after the protocols in control and treated groups.

Level of pain	N	Mean	Standard Deviation	Minimum pain	Maximum pain	KS test	P value
Walking down stairs: G1 before	10	6.90	2.55	1	10	1.159	0.136
Walking down stairs: G1 after	10	5.10	2.46	0	8	0.766	0.600
Walking down stairs: G2 before	10	6.80	3.99	0	10	0.690	0.728
Walking down stairs: G2 after	10	1.90	2.07	0	5	0.011	0.259
After warming: G1 before	10	5.60	3.02	0	9	0.700	0.711
After warming: G1 after	10	4.50	3.27	0	8	0.824	0.505
After warming: G2 before	10	6.80	3.61	0	10	1.044	0.226
After warming: G2 after	10	1.60	2.59	0	8	0.922	0.363
Post-walk: G1 before	10	7.50	2.54	1.00	10.00	1.195	0.115
Post-walk: G1 after	10	4.60	2.63	0.00	8.00	0.823	0.507
Post-walk: G2 before	10	6.30	2.62	0.00	10.00	0.805	0.536
Post-walk: G2 after	10	1.20	1.61	0.00	4.00	1.172	0.128
Post-exercises: G1 before	10	7.00	2.58	1.0	10.000	0.788	0.563
Post-exercises: G1 after	10	4.90	2.92	0.0	8.00	0.780	0.577
Post-exercises: G2 before	10	6.70	2.83	2.0	10.00	0.715	0.687
Post-exercises: G2 after	10	4.40	2.87	0.0	9.00	1.256	0.085

Subtitle: G1 - Control group; G2 - Experimental Group; KS test - Kolmogorov-Smirnov test.

mm and initial intensity of penetration of 100 µa (micro-ampere) increasing to 450 µa. The ratio was applied for 20 s 40 s of rest, totaling 3 minutes.

At the end of treatment for the two groups studied protocols, patients underwent a reassessment of the VISA-A questionnaire to check the scores of pain in functional activities. Only variables related to functionality pain were used.

For data analysis the statistical program Statistical Service Package for the Social Sciences was used-SPSS (version 19.0) with descriptive statistics presented in tables. The verification of the normality of the data was performed using the Kolmogorov-Smirnov test (KS), which verifies the normality distribution of the data. After this, the data were subjected to the following tests: Student's t test for paired values comparing pre-post intervention protocol and test and independent t test for comparison between control and treated groups. For all tests the significance level of $p < 0.05$ was assigned.

RESULTS

Application of Percutaneous Microeletrólisis (MEP®) in a physical therapy protocol for the treatment of calcaneal tendinopathy demonstrated among other things, changes in pain levels. Table 01 presents the results of mean levels of pain and its descriptive analysis as well as the results of normality test.

The results presented in Table 01 show that the distribution of the groups was normal, ie, parametric data were whose p-value> 0.05. Based on these results, the data were subjected to an inferential analysis using Paired t test and independent, to check the difference between the groups.

According to Figure 01 statistically significant difference before and after the intervention protocols with $p < 0.05$ for the control group and $p < 0.001$ in the experimental group was observed. Regarding the values after the interventions, a statistically significant difference with $p < 0.001$ in the G1 and G2 groups after the intervention protocols was observed. Thus, we can observe that the group that used the MEP showed a greater reduction of pain symptoms compared to the control group that performed only the experimental protocol.

Figure 02 shows the results of varying pain after warming.

It was found that no significant difference was observed in pain levels after heating in the control group between the initial and final evaluations. However, in the experimental group a significant decrease in pain levels with $p < 0.001$ was observed.

Figure 03 shows the levels of pain post-walk in different groups.

It was observed that there was a difference in the levels of pain post-walk pain both groups between the initial and final evaluations. In comparing the groups after the intervention there was a significant drop in pain levels between groups with $p < 0.05$.

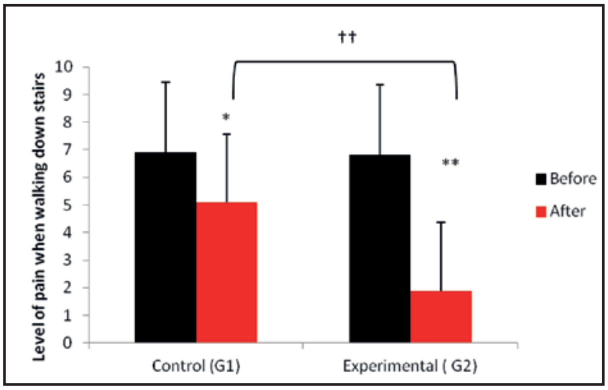

Figure 01. Differences between pain levels observed before and after the treatment protocols of the control and experimental groups for the variable pain when walking down stairs. ** Statistically significant difference ($p < 0.001$). † Statistically significant difference between the control and experimental groups with $p < 0.05$.

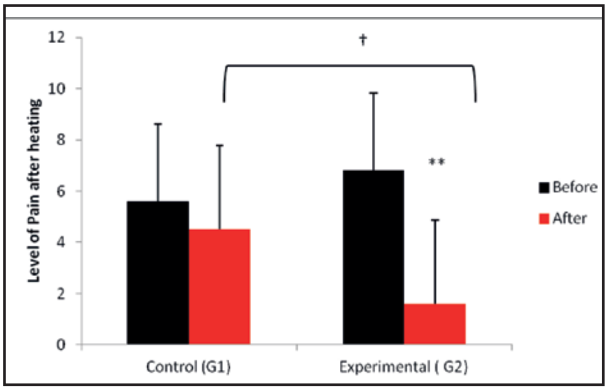

Figure 02. Differences between pain levels observed before and after the treatment protocols of the control and treated groups for the variable Pain After Warming. ** Statistically significant difference ($p < 0.001$). † Statistically significant difference between the control and experimental groups with $p < 0.05$.

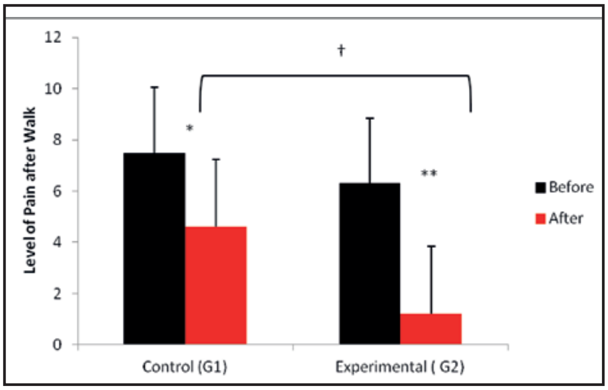

Figure 03. Differences between pain levels observed before and after the treatment protocols of the control and experimental groups for the variable Pain Post-Walk. * Significant statistical difference ($p < .05$) ** statistically significant difference ($p < 0.001$). † statistically significant difference between the control and experimental groups with $p < 0.05$.

Figure 04 shows the levels of pain post-exercise.

There was a significant decrease in pain levels between the initial and final evaluations only in the experimental group, with $p < 0.001$. In the comparison between groups at the final assessment was verified a significant decrease only in the experimental group, with $p < 0.001$.

In comparing the groups, the initial assessments, there was no difference in pain levels, demonstrating the homogeneity of the population before the performance of the protocols.

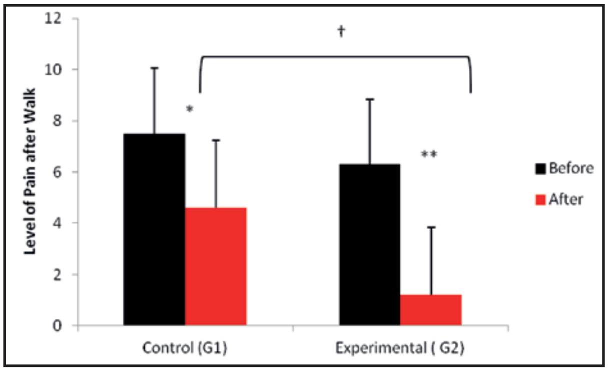

Figure 04. Differences between pain levels observed before and after the treatment protocols of the control and treated groups for Pain post-Exercise variable. Subtitle: ** statistically significant difference ($p < 0.001$). † statistically significant difference between the control and experimental groups with $p < 0.05$.

DISCUSSION

Clinical improvement in pain status of patients in the control group in pain levels when descending stairs and post-walk pain, can be justified by the action of eccentric exercise. The eccentric muscle activity is more appropriately called a muscular response, due to the muscle stretch during production of voltage.[11] The differential effect of the eccentric exercise would involve the interaction of a circular three primary determinants: The muscle force produced by eccentric contractions, the angular velocity of movement and the degree of stretching muscle-tendon during muscle contraction. This triad, called by the author as "triumvirate of eccentric interactive effects", consists of indivisible elements, but which, however, allow great versatility to the physiotherapist with regard to the modification of the effects and results obtained during the rehabilitation of the injured patient.[12]

There was a clinical improvement in all the variables studied. The MEP® is the application of low-intensity galvanic current through needle cathode in order to cause an electrochemical reaction in the degenerating tissue region, generating a controlled inflammatory process. The galvanic current upon contact with the fibrous tissue causes a chemical reaction. Is the dissociation of water molecules (H2O) and salt (NaCl), thus forming molecules sodium hydroxide (NaOH). This compound causes tissue destruction. The term electrolysis means "break", "degradation". In this case the destruction of fibrous tissue occurs Assimilation by favoring the formation of new tissue for eliciting an inflammatory response suitable for regeneration.[13]

The use of unidirectional polarized current, as the galvanic current provides an analgesic and anti-inflammatory effect and, studies in animals and humans (in vivo) of this type.[14] Other studies have found effects of galvanic current of low intensity in the pain reduction in chronic inflammatory processes.[15]

The anodic electrolysis has been used in cancer therapy with a current density of 40 mA/cm2, thereby reducing the primary and secondary tumors.[16] There is a correlation between the dose and the volume of the necrosis and the pole used with the lesion produced by the anode is larger than that of the cathode. At 24 hours after the application showed a significant increase in serum aspartate aminotransferase and alanine aminotransferase, both markers of cell damage.[17]

It believed that Achilles tendinopathy pain is related to a process of degeneration of the tissue, to be reduced or ceased as tissue repair. Tissue repair is a dynamic state comprising different processes, including inflammation, cell proliferation and synthesis of the elements that constitute the extracellular matrix, such as collagen, elastin, and reticulin. Collagen synthesis is fast and harmonic process that starts with the interstitial lesion and extends until the end of the healing phase, when the remodeling of tissues occurs.[18]

Some authors report that the properties of the galvanic current, low intensity, consist of increased rates of collagen synthesis, increased migration of fibroblasts and collagen alignment.[18] The polar effects and the electrolysis favor the repair process on the Achilles tendon, resulting in an effective effect on the pain reduction of these volunteers.

This study presents the limitations of analytical methods of pain that can be considered subjective, and it is recommended to conduct further studies using more reliable resources for analysis of pain, such as algometry. It is suggested to conduct further studies using more reliable methods of evaluation and monitoring of the inflammatory process, such as ultrasound examination or MRI.

CONCLUSION

We can conclude that the use of Percutaneous Microelectrólisis (MEP®), with the effects of the galvanic current of low intensity and needle acupuncture favors the minimization of pain symptoms of these volunteers and the promotion of improved functional capacity.

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