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Effect of Microcurrent Electrical Stimulation on Microcirculation of Chronic Leg Ulcers

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Abstract

Background: A chronic leg ulcer, also known as a chronic lower limb ulcer, is a chronic wound of the legs that does not show signs of healing after three months of proper treatment and has not healed completely after 12 months of treatment.

Aim of Study: This study was conducted to investigate the impact of micro current electrical stimulation on micro-circulation of chronic leg ulcers.

Patients and Methods: Thirty patients (17 males and 13 females) who had chronic venous leg ulcers more than 3 months recruited in this study. They aged from forty to fifty years. The participants were selected from Al-Zagazig University Hospitals and distributed into two equal groups, From January 2021 to June 2021. The patients were randomized into two groups of equal number (A,B) (15 patients for each group): The study group A received 60 minutes of microcurrent electrical neuromuscular stimulation in addition to standard medical care (medical treatment and regular dressing), three times weekly for four weeks. The control group B received only standard medical care (medical treatment and regular dressing), for four weeks. Evaluation was done two times; pre and post four weeks of treatment using Duplex ultrasound.

Results: Obtained result has revealed that: Within group comparison showed a significant increase blood flow post treatment in both groups compared to that pre-treatment (p>0.001). The percentage of improvement in blood flow of study group was 59.32% and that in control group was 18.13% among group comparison there was no substantial difference between groups before-treatment (p>0.05). Comparison between groups after treatment showed a substantial improvement in blood flow of study group compared to that of control group (p=0.03).

Conclusion: It could be concluded that Microcurrent electrical neuromuscular stimulation shows significant improvement in blood flow of chronic leg ulcers.

Key Words: *Microcurrent electrical stimulation – Microcirculation of chronic leg ulcers.*

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Introduction

A CHRONIC leg ulcer (CLU) is a wound in the lower extremity that does not show signs of healing after three months of proper treatment and has not healed completely after 12 months of treatment [1]. A combination of a growing elderly population and risk factors such as smoking, obesity, as well as diabetes has led to an increase in the number of cases of ulceration [2].

Chronic leg ulcer amongst adults is a relatively a frequent problem, it is estimated that 1.9%-13.1% of all community-based cases of morbidity are attributable to CLU [3]. There is a 2.5% mortality rate due to wounds, and nearly 10% of the population will suffer a chronic wound at a certain time during their lives [4]. Chronic wounds such as venous stasis ulcers, diabetic (neuropathic) foot ulcers, as well as pressure ulcers affect around 15% of older individuals in the United States, as reported by the Wound Healing Society (bedsores). It has been reported that venous ulcers account for 70% of all leg ulcer manifestations, vascular disease for 10%, and mixed a etiology for 15% [5]. The residual 5% of leg ulcers may be as a result of less frequent causes like, trauma, diabetes, pressure ulcers, atherosclerosis, tuberculosis, and leprosy, and these causes include significant difficulties in diagnosis, evaluation, and treatment [6].

CLU is considered a common complication of chronic venous insufficiency; symptoms involve severe pain, a foul odor, fragile granulation tissue, and a wound that is breaking down instead of healing. This leads to considerable healthcare and personal costs and social distress [7]. Reports shown that CLU has effect on almost every part of daily life: Pain is common, mobility and work capacity tend to be restricted, sleep is often impaired, and individual finances are usually negatively affected. Also social activities are known to be limited due to fear of injury as well aspoor body image [7].

Treatment options for CLU involve sclerotherapy, surgery, compressive therapy (traditional therapy), as well as pharmacotherapy; the main principles of intervention are to eliminate or cure precipitating etiology, for e.g. invasive surgery; to encourage circulation and increase venous return, for e.g., compression treatment; to accelerate healing, for e.g. wound care; to accelerate healing; to enhance symptom control; and to do preventative treatment, for e.g. education programs [8].

Soft tissue healing as well as the treatment of non-union fracture are only two examples of the many settings in which microcurrent is used to aid healing today [9].

Although similar to other forms of electrotherapy, microcurrent differs from from treatments that use larger quantities of electric current (mA) for stimulation, including nerve stimulation, transcutaneous electrical, faradizations, or sonophoresis. Microcurrent treatment, not just for wound healing but also for different treatments, uses electric current of A magnitude, which is quite identical to atypical bio-current [10].

Benefits of microcurrents include greater sensory comfort as well as excellent stability without the need for muscle contraction, electrical irritation, or serious side effects. Microcurrents are very high currents, inside this physiological range of electrical impulses in the physical body itself. This has led many to consider it a promising new therapeutic approach [11].

MCT is an unique form of electrotherapy that uses microcurrents to treat patients. A millionth of an ampere is the electrical current utilized in this treatment. Stimulating cellular repair is one way it assists in overall recovery [10].

The theory behind microcurrent stimulation is that it can recover the body's electrical balance when an injury has occurred and the body's natural electrical current has changed direction [12].

In fact, microcurrent therapy can alleviate pain, promote the regeneration of wounded tissue, accelerate wound healing, reduce myofascial trigger points, improve lymphatic flow, and improve protein production. Since a millionth of an ampere is thought to be the amplitude of the body's natural current, microcurrent stimulation is generated at this level in therapy. As a result, the body's natural current is restored [10].

An increase of 500% in ATP generation can be achieved with microcurrent treatment. Every single one of our cells has ATP, the basic molecule our bodies use to generate energy. When microcurrent therapy was used, it was observed that ATP generation increased by a factor of five. As I mentioned before, there was an increase in both protein synthesis as well as amino acid transport [10].

To promote in the healing process, microcurrent therapy restore the normal flow of current into damaged tissue. As a result, the cells are able to restore their own energy flow. There is an increase in electrical resistance between the wounded area and the surrounding tissue after an injury. This in turn reduces or even halts electrical passage across the wounded area, slowing the healing process and increasing inflammation. By lowering this resistance, microcurrent therapy makes it possible for electricity to flow and, in turn, restores normal function. This, in turn, promotes the body's own healing mechanisms [12].

Because different microcurrent frequencies are effective for different tissues and conditions, microcurrent therapy can typically soften tissue and reduce pain, resulting in long-lasting and possibly permanent pain relief. The effects of this are encouraging, and they may be applied to the treatment of chronic pain [13].

From the lake of knowledge about the effect of microcurrent on circulation of chronic leg ulcers so; this study was carried out to determine the impact of microcurrent electrical stimulation on microcirculation of chronic leg ulcers.

Material and Methods

Design of the study:

A prospective, single blind, parallel group, post-test, randomized controlled trial with a 1:1 allocation ratio was carried-out from from January 2021 to June 2021.

Randomization and blinding:

The randomization assigned in to two equal groups in numbers with rolling dice by independent researcher. Group A (once the dice reveled an even number) and Group B (once the dice reveled odd number). The randomization was constrained to allow blocks to ensure that all groups had an equal number of participants. There was no dropout after randomization the study was a single blind clinical study. Group allocation and assessment were blinded. The primary investigator biostatistician were blinded to the treatment allocation.

Subjects: Thirty patients (17 males and 13 females) who had chronic venous leg ulcers more than three months will participate in this study. They aged from 40 to 50 years. The participants were selected from Al-Zagazig University Hospitals and distributed into two equal groups (A, B) equal in numbers. Group (A) involved 15 patients who received 60 minutes of microcurrent electrical neuromuscular stimulation in addition to standard medical care (medical treatment and regular dressing), three times weekly for four weeks. Group B involved 15 patients who received only standard medical care (medical treatment and regular dressing), for four weeks. The inclusion criteria were as follow: Patient with chronic venous leg ulcers, both sexes with age range 40-50, All patients had chronic venous leg ulcer or chronic lower limb venous ulcer that does not show signs of healing after three months of proper treatment. The exclusion criteria were as follow: Participants were excluded if they met one of the subsequent criteria: Any ulcer other than venous ulcer, Cardiac diseases, pulmonary diseases, History of DVT or pulmonary embolism, Dementia or physical/mental incapacity to perform study requirements Presence of a cardiac pacemaker, Epilepsy, Malignancy, Dysesthesia. All study participants gave their informed consent. Before any data were collected, all patients who took part in the trial signed an informed consent form in which they informed that they knew the nature and potential consequences of the treatment and assessment tools. All adverse reactions experienced by a patient during treatment must be reported.

After receiving approval from the Ethical Committee of the Faculty of Physical Therapy at Cairo University, recruitment was initiated.

Procedure of the study:

All patients received a full in detailed information concerning current study and a written approval consent form was signed at the beginning of the current study.

Measurement procedures:

All patients received a complete history taking involving (personal history: Name, age, sex and occupation). Moreover, they were questioned about any disease (past history: Hypertension, diabetes mellitus, any previous operation). Detailed analysis of CLU (present history) and also the medical history including all the drugs taken. All study examining procedures were performed at the beginning and by the end of study protocol after 4 weeks of treatment.

Duplex ultrasound:

Duplex ultrasonography, which involves a more nuanced analysis of ultrasound waves, is widely used in modern medical settings for both diagnosis and treatment. Duplex ultrasound is adiagnostic technique that uses both anatomical and flow ultrasound concepts to provide data to the evaluator. Doppler ultrasound is a technique that applies the Doppler impact to the data gathered from sonograms in order to determine the presence and direction of any motion or flow inside the tissue being imaged. To properly comprehend and interpret duplex ultrasound, you need to have a firm grasp of the technology and underlying physical concepts. Some examples of these concepts containing the Doppler effect, electrical gating, and alternative wave generating strategies [14].

Noninvasive, all-encompassing, transportable, and well accepted are just a few of the benefits of duplex ultrasound compared to other imaging modalities. As an added bonus, individuals with implants are not at risk, and no radiation nor nephrotoxic contrast are used. However, it is very dependent on the skill of the operator, which might cause misunderstanding or a postponement in diagnosis. Constraints might also be brought on by a person's physical habits. DVT, venous dysfunction, and the detection of cerebrovascular, renal, mesenteric, as well as aortoiliac illness are all best diagnosed by duplex ultrasonography [14].

Procedure includes the following steps:

- The patient lay at the table, uncovering the area of your body that's being examined.
- A physician applied a special gel onto the skin there.
- A wand-like instrument called a transducer was moved over the area as the physician performed the exam.
- The instrument transmits sound waves that are then absorbed by the patient.
- When blood cells move, it alters the frequency of the sound waves. Sounds like swishing or a pulse could be audible during the process.
- A monitor displays recorded images or graphs of the waves.
- The provider removed the gel from the patient's body once the examination was complete.
- It takes between 30 and 60 minutes to finish the exam.

Therapeutic procedures:

- *Procedures of Micro-current electrical stimulation:*

Electric stimulation (ES) therapy, in its broadest terms, is the delivery of an electric current via electrodes implanted on the skin, close, or directly within the wounds [15].

It has been proven that when the epidermis of a human being is damaged, an electric field is produced at the wound's edge [16].

It has been hypothesized that the external administration of electrical current can be used to promote in the healing of skin wounds, according to the reported endogenous electrical properties. Many clinical investigations [17] have demonstrated that ES's external wound therapy promotes wound healing.

Due to its anti-inflammatory and angiogenic actions, as well as its ability to control cell migration as well as proliferation, microcurrent stimulation can influence the wound healing process [18].

New blood vessels arise when capillaries divide and grow, a critical step in the process of healing. In matured endothelial cells cultured in vitro, ES has been shown to generate crucial pre-angiogenic responses. Increased blood flow and improved local circulation are two additional benefits of microcurrent stimulation, in besides their role in fostering angiogenesis [19].

The device will be used is the Micro-current electrical stimulation device. MENS device electrodes placed around the wound edges.

- Intensity 300 to 600 μA
- Frequency: From 0.3 to 50Hz
- Total treatment period: 4 weeks.
- A number of sessions: 3 sessions/week.
- Time of application: 60 minutes
- The MENS were given three times per week for four weeks for 60 minutes per session.
- The patients slept in a comfortable long sitting position.
- The device was switched, electrodes were placed around the wound edges.
- Patients monitored carefully during the whole sessions.
- Patients instructed to breathe normally during application of the device.
- After end of the sessions the electrodes removed carefully from the patient's leg and the patient checked for any complications.

Statistical analysis:

The age of the groups was compared using an unpaired *t*-test. The sex distribution of each group was compared using the Chi-square test. The data were tested for a normal distribution utilizing the Shapiro-Wilk test. To examine whether or not there is homogeneity between groups, Levene's test for homogeneity of variances was performed. This study compared blood flow among groups using an unpaired *t*-test. The pre-treatment and post-treatment conditions of each group were compared using a paired *t*-test. Each statistical test's significance level was $p<0.05$. The Windows version of the SPSS statistical software (version 25) was used for all analyses (IBM SPSS, Chicago, IL, USA).

Results

Subject characteristics:

Table (1) presented the subject characteristics of study as well as control groups. There was no substantial difference among groups in age and sex distribution ($p>0.05$).

Table (1): Comparison of subject characteristics between study and control groups.

	Study group Mean ± SD	Control group Mean ± SD	MD	*t*-value	*p*-value
Age (years)	43.8±3.02	43.86±3.24	–0.06	–0.05	0.95
Sex, n (%):					
Females	5 (33%)	8 (53%)		(χ^2=1.22)	0.26
Males	10 (67%)	7 (47%)			

SD : Standard deviation.
MD: Mean difference.
$\chi 2$: Chi squared value.
p-value: Probability value.

Effect of treatment on blood flow:

Within group comparison:

There was a substantial improvement in blood flow post treatment in both groups compared to that pre-treatment ($p>0.001$). The percentage of improvement in blood flow of study group was 59.32% and that in control group was 18.13%. (Table 2).

Between group comparison:

There was no substantial difference among groups pre-treatment ($p>0.05$). Comparison among groups post treatment showed a significant improvement in blood flow of study group compared to that of control group ($p=0.03$). (Table 2).

Table (2): Mean blood flow pre and post treatment of study and control groups.

Blood flow	Study group Mean ± SD	Control group Mean ± SD	MD	*t*-value	*p*-value
Pre treatment	3.22±1.36	3.42±1.27	–0.2	–0.41	0.68
Post treatment	5.13±1.41	4.04±1.26	1.09	2.22	0.03
MD	–1.91	–0.62			
% of change	59.32	18.13			
t-value	–17.86	–7.8			
	p=0.001	*p*=0.001			

SD : Standard deviation. *p*-value: Probability value.
MD: Mean difference.

Discussion

Patients with chronic venous ulcer at the risk of developing significant symptoms and disabilities. Common symptoms of this venous condition include aching, throbbing, or stinging pains within lower legs with extended standing, dry skin accompanied with pruritus, and skin deterioration with painful ulcer formation in the region of the malleoli. Individuals' physical health and activity levels decline, and they become less productive as a result. Because of the severity of the condition and its broad prevalence, physicians are required to take chronic venous ulcers more seriously and treat their patients more effectively [20].

In the current study, the therapeutic effectiveness of microcurrent electrical stimulation on microcirculation was evaluated by using duplex U.S and the values was compared among the two different groups of the study (group A and B) on enhancing microcirculation on patients with chronic venous ulcer. The comparison duplex U.S values between the two groups following 4 weeks of treatment showed a substantial difference in a favor of group (A) *p*=(0.001) compared with group (B) *p*=(0.001). The mean ± SD blood flow post treatment of study group was 5.13±1.41 and that of control group was 4.04±1.26. The mean difference among groups was 1.09. There was a substantial improvement in the blood flow of study group compared with that of control groups post treatment (*p*=0.03). The result of this study showed improvement after 4 weeks of treatment but with different percentages as group A has a parentage of improvement 59.32% post treatment compared with percent of improvement for group B of 18.13%.

This improvement could as a result of:

By promoting fibroblast proliferation, collagen formation, as well as fibroblast production of growth factors and ATP generation, wound epithelialization, and angiogenesis, as well as by enhancing blood supply to the ulcer site, these stimuli accelerate the healing process [21].

The various stages of the healing process are assisted by microcurrent. When applied during the inflammatory response, microcurrent inhibits the production of inflammatory mediators such interleukin (IL)-1, tumour necrosis factor (TNF), as well as nitric oxide (NO) [21].

Promotes the expression of growth factors including vascular endothelial growth factor (VEGF) as well as epidermal growth factor (EGF) throughout the proliferation phase [22]. This promotes in the growth of granulation tissue and the formation of new blood vessels.

Microcurrent helps accelerate epithelization, the last stage of remodelling. It has been shown in a number of clinical as well as experimental models that microcurrent stimulation helps in the healing process once a wound has occurred [23].

Subjects' age, sex, and the presence or absence of concurrent conventional wound care procedures were monitored and recorded because we suspected these would have an impact on blood flow to the ulcer area. Researchers found no difference between MENS and control group participants on any of these measures. So, it is probable that the improvement in healing that was observed was related to the introduction of electrical current to the wound.

This study supports the findings of Park et al., [24] who examined the effects of microcurrents provided by a shoe on the dynamics of foot muscle fatigue, pain, and temperature. Individuals in their 50s who were experiencing foot pain reported significant reductions in both pain and core temperature after receiving microcurrent therapy. Since an increase in core body temperature indicates an improvement in blood flow, it should be expected that the microcurrent treatment helped alleviate pain; in fact, the blood flow was enhanced in the group upon which microcurrents were applied, even more so than that caused by exercise alone, and the level of pain was significantly declined. These findings suggest that microcurrent treatment reduces pain and increases blood flow in individuals with diabetic foot ulcers.

Also, Similarly, Clarke et al. [25] reported that the lower extremity blood flow rate increased with applied of microcurrent stimulation in patients with chronic venous insufficiency.

Blood flow was found to differ substantially between the pre- and post-treatment groups, and

Bora et al. [26] provided an explanation for the beneficial effects of microcurrent stimulation on pressure ulcer healing, suggesting that it works by promoting the production of collagen and fibroblast proliferation, as well as by increasing the production of ATP and growth factors.

Also, Lessiani et al., [27] were consistent with our findings as they conducted a monocentric, double-blind, randomized, prospective clinical trial. 33 patients with pressure ulcers at stage II and III. They aimed to investigate the effect of microcurrent wave therapy on tissue regeneration in pressure ulcer treatment. They reported improvement of microcirculation to a mean of 46% (p<0.001), While in the control group to a mean of 21% of their initial size (p<0.05).

These results corroborated those of Cheng and Goldman., [28] who examined cellular responses to varying electrical current amplitudes as well as frequencies, and who found that MCT and other forms of electrical stimulation can accelerate the healing of numerous wounds on human skin, especially ulcers, by increasing blood flow to the injured area.

A case study conducted by Assimacopoulos et al., [29] which involved the use of MES on three patients with venous leg ulcers, additionally supports the beneficial impact of MENS on chronic leg ulcers. All three patients healed after being subjected to a 100 A current for a period of 6 weeks. Since this was a case study without a control group, the strength of the findings is restricted.

The effects of ES, or microcurrent electrical therapy (MENS), were reported by Ullah et al., in six centers in Belgium. Although it was indicated that MET therapy involved a low-frequency current of lower than 1mA, neither the exact position of the electrodes nor the duration of the stimulation were specified. The wound sizes of 114 patients were measured weekly for 12 weeks and expressed as a regression model; there was no substantial difference between the wound sizes of those treated with MET and those treated with controls. Findings varied greatly and appeared to be heavily influenced by which hospitals offered wound care. This reviewer is unable to determine the true impact of this type of MC since the report is missing clarity concerning wound as well as patient characteristics and because the results are vague and variable, despite the large sample size (n=114) [30].

To the best of our knowledge, there is no study in contrast to our findings that MENS has positive effect on microcirculation of chronic leg ulcers. However, Houghton et al., who studied the effects of high-voltage pulsed current (HVPC) on the recovery from chronic leg ulcers, found that outcomes with a newer form of ES current were better. This study included 27 patients, with 42 cases of chronic leg ulcers. Patients were divided into three groups based on the underlying cause of their wounds (diabetes, arterial insufficiency, as well as venous insufficiency) and then given either HVPC (100 microseconds, 150 V, 100 Hz) or even a sham treatment for 45 minutes, three sessions a week for four weeks. Area and appearance of wounds were evaluated at the beginning of the study, after 1-2 weeks of traditional wound therapy, following 4 weeks of sham or HVPC treatment, and then after 1 month of follow-up. Throughout a 4-week treatment phase, HVPC administered to chronic leg ulcers lowered the wound surface area to nearly half of its initial size (mean decline 44.3%, SD 8.8%, range 2.8%-100%), that was over 2 times higher than that noted in wounds managed with sham units (mean decline 16.0%, SD 8.9%, range 30.3%-83.7%) [31].

Additionally, Ogrin et al., stimulated the sensory nerves of patients with venous ulcers using a novel ES therapy procedure.

As a prospective, randomized, placebo-controlled, double-blind clinical trial, it fulfilled all of the criteria for a score of 42. Sessions of ES treatment lasted 5 minutes, two sessions a day for 12 weeks, and consisted of the application of sub-sensory levels of current (4mA, 5pps) to the peripheral sensory nerves of the extremity. This device has a pending patent, but details about the waveform it employs have been not shown. There was little evidence of a difference in recovery times across the groups, therefore their findings were inconclusive. 42 Microvascular blood flow, transcutaneous partial pressure of oxygen, as well as flare reaction to capsaicin were all shown to increase in ES-treated limbs, although these changes were not statistically different from those in placebo-treated controls. 42 It may be beneficial to study the effects of extended ES therapy sessions [32].

To accelerate up the healing process and improve blood flow to injured tissues, electrical stimulation has been utilised as an adjunctive therapy. Enhanced circulation aids in the transport of essential nutrients.

Zeinab and Mehri [33] observed that the vascular response of older rats might be enhanced by low-frequency electrical stimulation when they employed non-invasive TENS technology to manage wounds in the rats. They also observed that ageing rats' wound healing times were decreased by half by using low-frequency electrical stimulation to trigger vascular responses surrounding sensory nerves. The skin BF of chronic wounds was shown to grow considerably, and the speed of wound healing was enhanced by 60%, when the lesion was managed with electrical stimulation in a warm room (32°C) for 4 weeks.

The reaction of wounds to electrical stimulation was found to be enhanced by increased vasodilation, which increased Blood Flow, according to the study of Jin et al., Evidence found that wound healing time can be reduced by using electrical stimulation to enhance blood flow to injured tissues **[34]**.

The pressure ulcer treatment study by Marwa Eid and Intsar **[35]** found that negative-pressure wound therapy was more successful than microcurrent stimulation therapy.

Although previous studies into the impact of microcurrent electrical stimulation on microvasculature of chronic leg venous ulcers is limited, the current study demonstrates that the administration of microcurrent was efficient for the improvement of chronic venous ulcer microvasculature. Researchers as well as clinicians should give MENS more attention because it may have unrealized possibilities in the therapy of defective tissue repair.

From the preceding discussion of these findings and reports of relevant research studies, it could be concluded that the findings of this study confirm the hypothesis that administration of microcurrent was helpful for the improved microcirculation of chronic venous leg ulcers. Microcirculation improvement in patients with chronic venous leg ulcers in both groups A and B was related with clinically and statistically substantial improvement, as shown above. Patients with chronic leg ulcers may have had a localised improvement in blood flow, which may explain why group A showed greater microcirculatory improvement than group B. Healing of ulcers may benefit from this. Still unclear is the exact reason for the improved blood circulation. As a result, it appears that more study is required to identify which patients can benefit from MENS and similar electrical stimulation. Healing ulcers as well as peripheral circulation will then be then monitored.

Study limitation:

Each individual subject was treated with great effort in order to lower the number of potential study errors. However, there may have been limitations in our analysis. The principal limitations were the study's single-center, small-sample design and the refusal of some patients to participate in the trial.

Future studies are needed to (Recommendation):

- Further clinical trials are needed.
- Longer follow-up period and bigger sample size are recommended.
- Satisfaction level of patients should be detected.
- Multicenter should be included.
- Future research should consider all factors that affect the outcome like medical conditions (D.M & HTN).
- Importantly, more study is needed to examine if the electrical stimulation we utilised can be administered in a way that reduces wound size and facilitates wound closure in addition to increasing blood flow.

Conclusion:

Microcurrent electrical neuromuscular stimulation shows significant improvement in the blood flow.

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Conflict of interest:

None.

The authors have declared no conflicting interests to publish this manuscript.

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تأثير التحفيز الكهربائى بالموجات الدقيقة
على الدورة الدموية الدقيقة
لقرحة الساق المزمنة

الهدف من الدراسة : دراسة تأثير التحفيز الكهربائى بالموجات الدقيقة على الدورة الدموية الدقيقة لقرحة الساق المزمنة.

شارك فى هذه الدراسة ٣٠ مريض من الجنسين يعانون من قرحة الساق المزمنة، وتم تقسيمهم إلى مجموعتين متساويتين فى العدد:

- المجموعة (أ): تم إستخدام ٦٠ دقيقة من التحفيز الكهربائى بالموجات الدقيقة ٣ مرات فى الأسبوع بالإضافة إلى العناية الطبية (الدواء العلاجى، الغيارات الطبية) ، لمدة ٤ أسابيع.
- المجموعة (ب): تم إستخدام العناية الطبية فقط (الدواء العلاجى، الغيارات الطبية) ٣ مرات فى الأسبوع ، لمدة ٤ أسابيع.

تم تقييم الدورة الدموية فى الساق بإستخدام الموجات فوق الصوتية المزدوجة قبل وبعد العلاج.

وقد أظهرت النتائج ما يلى : أوضحت نتائج هذه الدراسة أن التحسن كان غير معنوى إحصائياً بين حالات المجموعة (أ) بالمقارنة مع قيمته المقابلة فى المجموعة (ب). يمكن الإستنتاج أن التحفيز الكهربائى بالموجات الدقيقة كان طريقة غير فعالة فى تحسين الدورة الدموية لقرحة الساق المزمنة.