MEDICINAL BIOMAGNETISM FOR PAIN RELIEF IN VASCULAR ALTERATIONS - APPLICATION OF STATIC MAGNETIC FIELDS THROUGH THE PROTOCOL FOR BLOOD FLOW IN LOWER LIMBS

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Abstract: Introduction: Chronic Venous Insufficiency (CVI) is a set of clinical manifestations resul-

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ting from the chronic dysfunction of the peripheral venous system that affects the lower limbs. There is a growing search for complementary therapies, such as Medicinal Biomagnetism (MB), which acts in a non-invasive, painless, low-cost and with rare contraindications, aiming to improve quality of life. MB uses Static Magnetic Fields (SMF) to restore bioenergetic balance and promote health, including CVI. Objective: The aim of this study is to evaluate the effect of SMF application, through the MB Lower Limb Blood Flow Protocol (LLBFP), on pain resulting from vascular alterations of the lower limbs. Methodology: This is a cross-sectional clinical experimental study in three female participants with vascular alterations in the lower limbs who underwent the LLBFP Protocol. Pain, edema and quality of life complaints were assessed using the Venous Insufficiency Epidemiological and Economic Study (VEINES), Visual Analogue Scale (VAS), and perimeter measurements questionnaires, before and after the application of the LLBFP. Results: After treatment with the LLBFP Protocol, there was a trend towards the analgesic effect and reduction of edema, as well as improvement in the aspects related to the symptoms of heavy, restless, tired legs, and tingling, burning and itching, promoting improvement in quality of life. Conclusion: This study demonstrated that the application of the MB LLBFP Protocol has the potential to reduce the subjective perception of pain and edema in lower limbs with vascular alterations. The magnets used in the LLBFP may promote an anti-inflammatory response, contributing to the improvement of quality of life.

Keywords: Medicinal Biomagnetism, Static Magnetic Fields, Chronic Venous Insufficiency, Lower Limbs, Varicose Veins.

INTRODUCTION

The circulatory and lymphatic systems play fundamental roles in maintaining human health. Pathologies that affect these systems can compromise the quality of life of individuals. An example is Chronic Venous Insufficiency (CVI) of the lower limbs, a condition that ranges from asymptomatic cases to serious complications such as ulcers (Abreu et al., 2017; Azizi; Azizi, 2019).

CVI is a condition resulting from abnormalities of the venous system, often associated with valvular incompetence and, in some cases, obstruction of blood flow. Reflux of the great saphenous vein is a central phenomenon in CVI, triggering the formation of ulcers and increasing hydrostatic pressure. It is noteworthy that reflux in the great saphenous vein is identified in up to 80% of patients with CVI. Resection of varicose veins with reflux of the great saphenous vein is a common procedure, although it can lead to complications and recurrence of the condition (Mutlak; Aslam; Standfield, 2019; Abreu et al., 2017; Azizi; Azizi, 2019).

In 2020, the number of surgeries for varicose veins in the public health fell by 59% compared to 2019 due to the pandemic, totaling 28,354 surgeries. In 2021, there was a partial recovery, but still a deficit of 24%, with 21,604 procedures performed. Over a decade (2011-2021), SUS performed 552,332 varicose vein surgeries, with an average of 55,233 cases per year (SBVCV, 2022).

The treatment of CVI involves both clinical and surgical approaches. Patients with signs and symptoms of CVI are initially subjected to conservative measures, including the use of compression stockings, weight loss, regular exercise, and smoking cessation. Surgical interventions, such as great saphenous vein surgery, are often adopted, despite the complications and recurrence associated with these procedures (Huzmeli et al., 2020; Abreu et al., 2017).

In addition to conventional therapeutic options, complementary alternatives such as Medicinal Biomagnetism (MB) are being sought. MB is a non-invasive, low-cost, and easy-to-apply therapeutic approach that uses Static Magnetic Fields (SMF) to restore bioenergetic balance, contributing to the treatment of venous circulatory disorders. Studies have shown the benefits of MB in various health conditions, including CVI, as an alternative for analgesia (Broeringmeyer, 1991; Durán, 2008; Pelissari; Bossa, 2023; Araújo et al., 2022; Rambo et al., 2023; Santos et al., 2023a; Lima et al., 2023). The main objective of MB is to restore and maintain general health conditions, prevent pathological conditions, and be complementary to medical treatment for the sequelae of an illness (Martínez, 2017; Lima et al., 2023).

The Lower Limb Blood Flow Protocol (LLBFP), emerges as a promising strategy in the treatment of CVI. MB sessions have been associated with the reduction of symptoms and signs of the disease, as well as the restoration of normal function of the great saphenous vein, as demonstrated by color Doppler ultrasound examinations, being low-cost and without any side effects (Franco et al., 2023; Rambo et al., 2023).

CVI of the lower limbs represents a substantial challenge to public health, with significant clinical and financial implications. In addition to traditional therapeutic approaches, complementary therapies, such as MB, have the potential to improve the quality of life of patients with CVI. The LLBFP Protocol stands out as a promising option, promoting the restoration of blood flow and the reduction of symptoms associated with the condition (Rambo et al., 2023). Therefore, the aim of this study was to evaluate the effect of the application of Static Magnetic Fields, through the Lower Limb Blood Flow Protocol of Medicinal Biomagnetism, on pain resulting from vascular alterations of the lower limbs.

METHODS

This study was conducted at the Par Magnético Institute - IPM and the Faculdade de Governança, Engenharia e Educação de São Paulo - FGE. It was characterized as a cross-sectional clinical experimental study, and the selection of the participants was carried out through the inclusion criteria of individuals with vascular alterations with pain complaints in the lower limbs, provided that they did not present clinical contraindications to the application of CME such as the use of pacemakers and implantable batteries, pregnant women, those who did not have type 1 or 2 diabetes, people who were not using analgesic medication who started diuretic or anticoagulant medication during the study. Do not use continuous medication such as diuretics and anticoagulants for less than 3 months before the start of the study and, any physical or cognitive factor that limits or prevents understanding and execution of the proposed protocol.

After the inclusion criteria were applied, three participants completed the data collection, all female, aged between 45 and 52 years. Data collection took place in the months of August and September 2023. The participants signed the Free and Informed Consent Form (TCLE) authorizing data collection.

The research participants underwent a medical history immediately after recruitment and were followed for three months from the start of data collection to record clinical evolution. They were also subjected to specific validated questionnaires and perimeter assessment. The instrument used to assess pain perception was the Visual Analogue Scale (VAS) (Martinez et al., 2011; Gift, 1989). The Venous Insufficiency Epidemiological and Economic Study/Quality of Life-Symptoms (VEINES/Sym) (Santos; Queiroz, 2019b; Moura et al., 2011) was used to assess symptoms and quality of life in chronic vascular disease and lower limb perimeter for edema assessment (Pelegrini et al., 2015; Oliveira et al., 2006).

The aim of this work was the Lower Limb Blood Flow Protocol (LLBFP) (Figure 1) of the Medicinal Biomagnetism (MB) technique, which consists of the use of CME developed from clinical practice (Rambo et al., 2023; Franco et al., 2023).

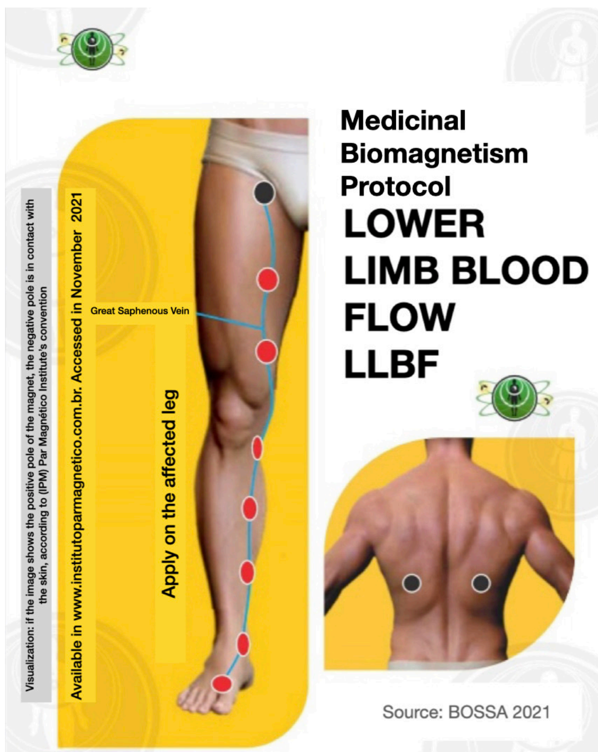


Figure 1: Lower Limb Blood Flow Protocol (LLBFP)

Caption: Illustrative image of magnets applied to the body. When the red color is seen, the black side of the magnet is in contact with the body, and similarly, when the black color is seen. The colors covering the magnets identify the north pole (black) and south pole (red) according to the convention of Calegari and colleagues (2023). Image source: Bossa (2021).

The magnets used to apply the LLBFP Protocol were moderate-intensity neodymium magnets (Zhang et al., 2020), in a disc shape with axial polarization and coated with non-toxic, flexible, and washable PVC. The north pole of the magnet, called negative in MB, is coated in black, while the south pole, called positive, is coated in red, based on the convention for magnet coating established for the MB technique by Calegari et al. (2023), with dimensions of 6.4 cm in diameter, 0.5 cm in thickness, and 3.8 cm in width.

The magnets were positioned on the skin as shown in Figure 1. The north pole of the magnet, the black side, was placed along the course of venous return in the lower limb. The south pole was applied to the inguinal region, over the lymph nodes of the affected leg, and over the two kidneys. The application of the LLBFP Protocol was performed bilaterally in the three participants, for 60 minutes, once a week for 4 weeks. The participants were positioned in the supine position on the stretcher and the magnets were applied over the clothes, as shown in Figure 2.

Figure 2: Practical application of the LLBFP Protocol during data collection

Caption: Participant lying on a stretcher in the supine position, with the magnets positioned according to the LLBFP Protocol. Sources: The authors (2023).

The VEINES questionnaire was applied at the beginning of the first session, on the twenty-ninth day, and three months after the start of the data collection, aiming to assess the influence of the application of the LLBFP Protocol on the quality of life of the participants. Before and after each application of the protocol, the perimeter of both lower limbs was measured to verify the acute effect of the application of the LLBFP Protocol on edema. The VAS was applied in all sessions, with data collection to assess pain perception at time 0 (instant of protocol application) and then at 15, 30, 45, and 60 minutes (instant of protocol removal).

RESULTS

Case 1: 45 years old, married, entrepreneur, presented varicose veins, spider veins, fatigue, swelling, and pain in the legs and feet. She wore compression stockings daily and took medication to control cholesterol. She practiced strength training three times a week and reported spending 6 hours a day on her feet. At the end of the workday, she felt her legs tired and painful. She received four sessions of the Lower Limb Blood Flow Protocol (LLBFP) on a weekly basis. After the first intervention, she reduced the frequency of wearing compression stockings and reported no pain even without wearing them.

The report of the first VEINES (Table 1) indicates that the pain intensity was "moderate" at the beginning of the treatment, and on the 29th day, after the four sessions, it decreased to "very mild". After 3 months from the start of data collection, with 2 months without interventions with the LLBFP Protocol, VEINES was applied for the third time, with a report that the pain returned to "moderate". In this case, the participant reported feeling a significant improvement in the overall condition that lasted 26 days after the interventions ceased. She then underwent breast reconstruction surgery and from the surgery, her legs returned to swelling and pain.

Case 2: 52 years old, single, therapist, presented varicose veins and spider veins, had a thrombosis in her left leg in 2016, felt cramps, fatigue, swelling, and pain in her legs, feet, and ankles at the initial data collection. She used a cream to relieve pain when the pain was very severe and reported not having used it during the treatment with LLBFP. Sedentary. She received four sessions of the LLBFP Protocol on a weekly basis. During the intervention, there was a decrease in swelling, no cramps, no pain, throbbing, or tingling.

The participant presented a pain intensity of "very severe" at the beginning of the treatment with the LLBFP Protocol and "very mild" at the end, as can be seen in the VEINES report (Table 1). After three months, with two without intervention, the pain increased to "mild". Despite the increase in pain perception, the quality of life assessed by the symptoms of cramps, tingling, and itching in the questionnaire remained improved in the intervention period.

Case 3: 48 years old, widow, teacher, in menopause, obese, practicing physical exercises five times a week, two times strength training and three times yoga. She reported spending three to four hours on her feet daily and at the end of the workday, she felt fatigue, swelling, pain, and heaviness in her legs and feet. She reported elevating her lower limbs upon arriving home so that she could work without pain the next day. She treated cancer in 2020 with the removal of her right breast and underwent chemotherapy and radiation therapy. She has been treating arterial hypertension and hypothyroidism for eight years and hypercholesterolemia for a year with allopathic medications. She received four interventions of the LLBFP Protocol on a weekly basis.

In the evaluation of the VEINES questionnaire (Table 1), at the beginning of the treatment, the participant reported a pain intensity of “moderate” and at the end, it decreased to “very mild”. After three months from the start of data collection, the pain returned to “moderate”. After the four sessions, she maintained the VEINES result for five weeks, after that period she returned to feel the heaviness in her legs, but not as intense as at the beginning of the treatment.

Table 1 presents the data from the VEINES questionnaire reported on the 1st day, on the 29th day, and three months after the start of data collection.

	Participant 1			Participant 2			Participant 3		
	1st Day	29th Day	3 Months	1st Day	29th Day	3 Months	1st Day	29th Day	3 Months
Heavy Legs	Several times a week	≈ Once a week	Several times a week	Every day	≈ Once a week	Less than once a week	Every day	Less than once a week	Several times a week
Sore Legs	Several times a week	≈ Once a week	Several times a week	Every day	Never	Less than once a week	Every day	Less than once a week	Several times a week
Edema	Several times a week	≈ Once a week	Every day	Every day	Never	Less than once a week	Every day	≈ Once a week	Several times a week
Cramps	Never	Never	Never	Several times a week	Never	Never	Less than once a week	Never	Never
Warm/Burning Sensation	Never	Never	Less than once a week	Every day	Never	Less than once a week	Never	Never	Never

Restless Legs	Less than once a week	Never	≈ Once a week	Every day	Never	Never	Never	Never	Never
Throbbing	Never	Never	Never	Every day	Never	Less than once a week	Every day	Several times a week	≈ Once a week
Itching	Never	Never	Never	Every day	Less than once a week	≈ Once a week	Never	Never	Never
Tingling Sensation	Less than once a week	Never	≈ Once a week	Several times a week	Never	Less than once a week	Less than once a week	Never	Several times a week
Time of Day with Most Intense Problem	End of the day	End of the day	End of the day	Anytime during the day	Never	End of the day	End of the day	End of the day	End of the day
Leg Problem Compared to One Year Ago	≈ Same as 1 year ago	Much better than 1 year ago	Much better than 1 year ago	Much worse now than 1 year ago	Much better than 1 year ago	Much better than 1 year ago	≈ Same as 1 year ago	Much better than 1 year ago	A little better now than 1 year ago
Leg Problem Limiting Work	Yes, limits a bit	Yes, limits a bit	Yes, limits a bit	Yes, limits a bit	No, does not limit at all	Yes, limits a lot	Yes, limits a bit	Yes, limits a bit	Yes, limits a bit
Leg Problem Limiting at Home	Yes, limits a bit	Yes, limits a bit	Yes, limits a bit	Yes, limits a lot	No, does not limit at all	No, does not limit at all	Yes, limits a bit	No, does not limit at all	Yes, limits a bit
Leg Problem Limiting Standing Social/Leisure Activities	Yes, limits a bit	Yes, limits a bit	No, does not limit at all	Yes, limits a lot	No, does not limit at all	No, does not limit at all	Yes, limits a bit	No, does not limit at all	Yes, limits a bit
Leg Problem Limiting Sitting Social/ Leisure Activities	Yes, limits a bit	No, does not limit at all	No, does not limit at all	Yes, limits a lot	Yes, limits a bit	No, does not limit at all	Yes, limits a bit	Yes, limits a bit	Yes, limits a bit

The Problem Reducing Time Spent on Work or Other Activities	No	No	No	Yes	No	No	Yes	No	No
The Problem Resulting in Doing Less Work Than Desired	No	No	No	Yes	No	No	Yes	No	Yes
The Problem Limiting Type of Work or Activities	Yes	No	No	Yes	No	No	Yes	No	Yes
The Problem Resulting in Difficulty in Work or Other Activities	Yes	No	No	Yes	No	No	Yes	No	Yes
The Problem Interfering with Social Activities	Moderately	Moderately	Not at all	Quite a bit	Not at all	Not at all	Moderately	Not at all	Slightly
Leg Pain Intensity in the Last Four Weeks	Moderately	Very mild	Moderately	Very severe	Very mild	Mild	Moderately	Mild	Moderately
Worried About the Appearance of Your Legs	Most of the time	None of the time	Some of the time	All the time	All the time	All the time	All the time	A little of the time	Some of the time
Felt Irritated	Most of the time	None of the time	Some of the time	Most of the time	Most of the time	None of the time	Some of the time	None of the time	Most of the time
Felt Like a Burden to Family or Friends	Some of the time	None of the time	None of the time	Most of the time	None of the time	None of the time	Some of the time	None of the time	A little of the time
Worried About Bumping Into Things	None of the time	None of the time	None of the time	None of the time	None of the time	None of the time	A little of the time	None of the time	A little of the time

Leg Appearance Influencing Clothing Choices	All the time	None of the time	Most of the time	All the time	All the time	All the time	Most of the time	Most of the time	Most of the time

Caption: ≈ = approximately; - = less; x = times; > = greater. Source: the authors.

The Table 2 demonstrates the subjective pain perception reported by the participants using the Visual Analog Scale (VAS) during the application of the LLBFP Protocol.

Table 2: EVA data collection.

		1st Session	2nd Session	3rd Session	4th Session
Participant 1	**0 min**	0	1	0	0
	15 min	0	1	0	0
	30 min	0	1	0	0
	45 min	0	1	0	0
	60 min	0	0	0	0
Participant 2	**0 min**	1	1	6	0
	15 min	1	0	0	0
	30 min	8	2	0	1
	45 min	5	0	0	0
	60 min	0	0	0	0
Participant 3	**0 min**	5	1	1	0
	15 min	5	1	1	0
	30 min	2	1	1	0
	45 min	2	1	2	1
	60 min	2	0	3	2

Caption: 0 to 2 = Mild Pain; 3 to 7 = Moderate Pain; 8 to 10 = Intense Pain. Source: the authors.

The perimetric data differences before and after the application of the LLBFP Protocol can be observed in the calculation (Table 3 and Figure 3) and in their absolute values (Table 4).

Table 3: Perimetric Difference Results in centimeters (cm) observed before the 1st and after the 4th application of the LLBFP Protocol.

Participant 1

Before 1st session	After 4th session	Difference (cm and %)			
48,5	47,5	-1,0	cm	2,1	%
42,0	41,0	-1,0	cm	2,4	%
24,5	24,5	0,0	cm	0,0	%
49,0	47,5	-1,5	cm	3,1	%
42,0	41,0	-1,0	cm	2,4	%
25,0	23,5	**-1,5**	**cm**	6,0	%

Participant 2

Before 1st session	After 4th session	Difference (cm and %)			
51,0	50,0	-1,0	cm	2,0	%
40,5	41,0	0,5	cm	-1,2	%
25,0	25,0	0,0	cm	0,0	%
50,5	51,0	0,5	cm	-1,0	%
40,0	42,0	**2,0**	**cm**	-5,0	%
25,0	25,5	0,5	cm	-2,0	%

Participant 3

Before 1st session	After 4th session	Difference (cm and %)			
48,5	47,0	-1,5	cm	3,1	%
42,5	37,0	-5,5	cm	12,9	%
24,0	22,0	-2,0	cm	8,3	%
48,5	49,0	0,5	cm	-1,0	%
42,5	36,0	**-6,5**	**cm**	15,3	%
23,5	22,0	-1,5	cm	6,4	%

Legend:
- Right Distal Thigh
- Right calf
- Right ankle
- Left Distal Thigh
- Left calf
- Left ankle

Source: The authors.

Table 4: Perimetric Measurements (cm) of Participants per Session.

	Participant 1						Participant 2						Participant 3					
	Right Distal Thigh	Right calf	Right ankle	Left Distal Thigh	Left calf	Left ankle	Right Distal Thigh	Right calf	Right ankle	Left Distal Thigh	Left calf	Left ankle	Right Distal Thigh	Right calf	Right ankle	Left Distal Thigh	Left calf	Left ankle
1st Session	48,5	42,0	24,5	49,0	42,0	25,0	51,0	40,5	25,0	50,5	40,0	25,0	48,5	42,5	24,0	48,5	42,5	23,5
	48,0	40,4	24,5	48,0	41,0	25,0	50,0	41,0	25,0	52,0	40,0	25,5	49,0	42,0	23,0	48,5	42,0	23,5
	-0,5	-1,6	0,0	-1,0	-1,0	0,0	-1,0	0,5	0,0	1,5	0,0	0,5	0,5	-0,5	-1,0	0,0	-0,5	0,0
2nd Session	49,0	42,5	26,0	49,0	42,7	25,0	51,0	43,0	27,0	50,0	44,0	26,0	45,0	38,0	23,5	48,5	37,0	22,0
	48,8	41,2	25,5	50,0	43,0	24,0	50,0	41,2	25,7	50,6	42,0	26,0	46,0	38,0	22,5	47,0	36,0	22,0
	-0,2	-1,3	-0,5	1,0	0,3	-1,0	-1,0	-1,8	-1,3	0,6	-2,0	0,0	1,0	0,0	-1,0	-1,5	-1,0	0,0
3rd Session	48,5	42,0	24,5	49,5	43,0	24,5	50,0	42,0	24,5	51,5	43,0	26,5	52,0	35,0	22,5	50,5	37,0	23,0
	48,0	41,0	24,0	48,5	42,5	24,0	49,5	41,0	25,0	51,0	42,0	25,5	52,0	36,0	22,5	49,0	35,5	22,5
	-0,5	-1,0	-0,5	-1,0	-0,5	-0,5	-0,5	-1,0	0,5	-0,5	-1,0	-1,0	0,0	1,0	0,0	-1,5	-1,5	-0,5
4th Session	47,5	42,0	24,5	48,0	42,0	24,0	50,0	41,5	25,0	50,5	42,5	25,0	47,0	38,0	22,0	50,0	37,0	22,5
	47,5	41,0	24,5	47,5	41,0	23,5	50,0	41,0	25,0	51,0	42,0	25,5	47,0	37,0	22,0	49,0	36,0	22,0
	0,0	-1,0	0,0	-0,5	-1,0	-0,5	0,0	-0,5	0,0	0,5	-0,5	0,5	0,0	-1,0	0,0	-1,0	-1,0	-0,5

	=	↑	↓
P1	4	2	18
P2	5	7	12
P3	8	3	13
Total	**17**	**12**	**43**
%	**23,6**	**16,7**	**59,7**

Caption: P1: Participant 1; P2: Participant 2; P3: Participant 3;

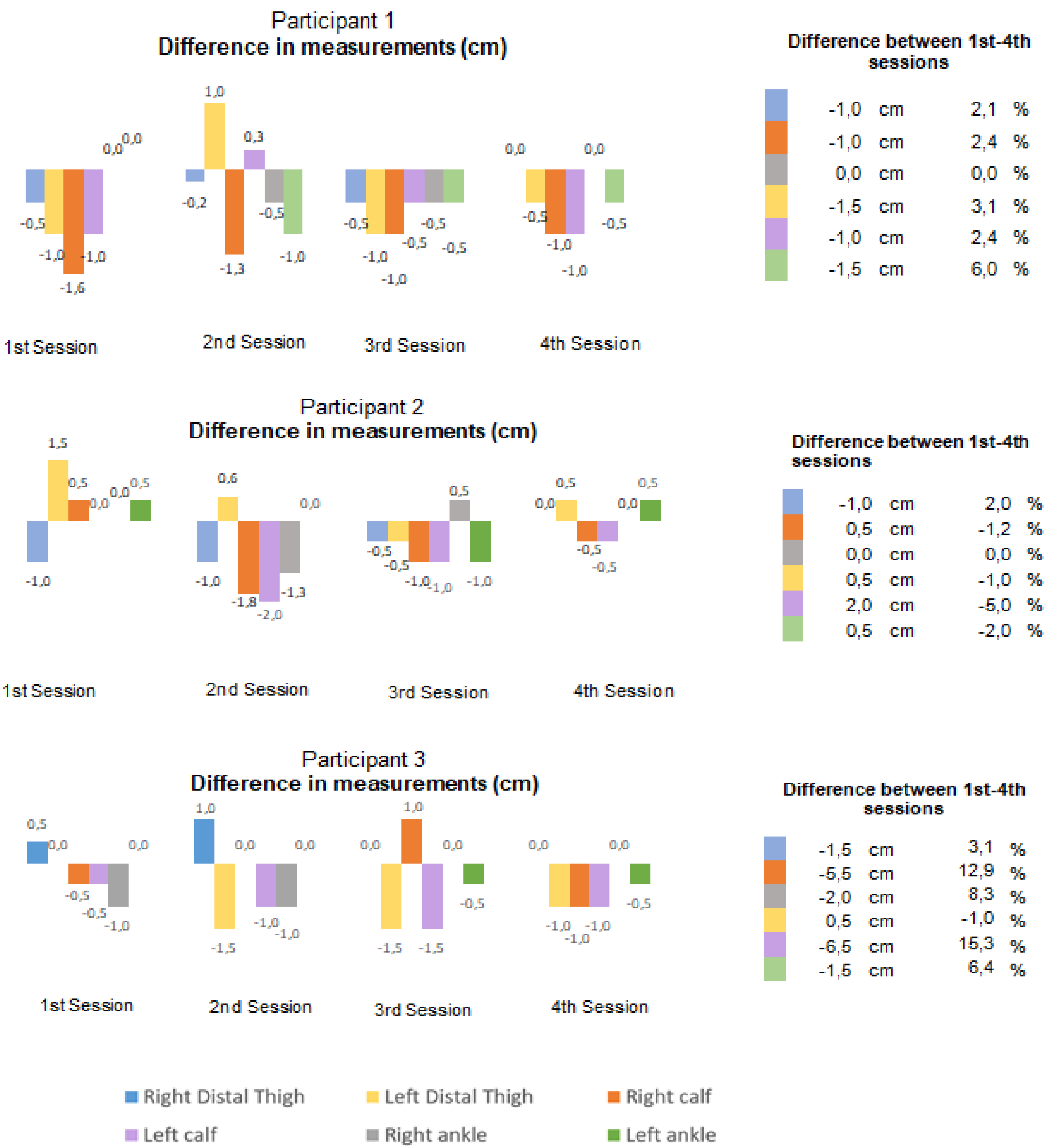
= : maintained measurement; : ↑ increased measurement;

↓ : decreased measurement.

Source: the authors.

Source: the authors.

Figure 3: Analysis of perimetric data by participant.



Source: The authors.

DISCUSSION

This study aimed to evaluate the analgesic effect of static magnetic fields (SMF) in vascular changes using the Lower Limb Blood Flow Protocol (LLBFP) of Medicinal Biomagnetism (MB). The results demonstrated a reduction in reported pain and an acute decrease in observed edema in the participants, possibly linked to the anti-inflammatory effect produced by exposure to SMF applied along the venous path in the lower limbs. These findings align with previous research indicating the potential benefits of SMF generated by magnets in treating circulatory and lymphatic dysfunctions, leading to symptom remission.

Improvements in the vascular system were observed in diabetic mouse wound studies after exposure to SMF, promoting an anti-inflammatory effect (Li et al., 2020). Another study conducted by Xu et al. (2013) applied SMF to wounds in the tails of Wistar rats, revealing improved perfusion in the caudal artery, regulation of rhythmic vasomotion in the ischemic area, and positive reduction in vasomotion amplitude in the early phase of wound healing, accelerating tissue repair.

An interesting opposite evidence to mention is the study by Harvei et al. (2001), which describes that SMF does not affect healthy tissue, as observed in skin blood perfusion in the studied anatomical area. These findings demonstrate that SMF has modulatory effects, reinforcing the safety of its use and encouraging further studies in the field. This may be related to the case of Participant 1 (P1), who started treatment with zero pain and SMF did not alter the analgesic condition during the application, while Participants 2 (P2) and 3 (P3), who started sessions reporting some level of pain, according to the VAS, initially indicated an increase in pain perception, possibly a consequence of increased blood perfusion stimulated by the effects of SMF, followed by pain reduction.

In chronic venous insufficiency (CVI), dilation of capillaries and accumulation of venous blood in the microcirculation at the skin level result in venous hypervolemia and peripheral edema, disrupting the normal exchange between venous and arterial blood. Accumulated venous blood with low oxygen levels can lead to venous hypoxia and ischemia (Mutlak; Aslam; Standfield, 2019; Abreu et al., 2017; Azizi; Azizi, 2019), promoting inflammation, resulting in pain and edema, supporting the results obtained in this study. The evaluation of data through the VEINES and VAS questionnaires demonstrated a reduction in perceived pain.

The inflammatory process is a response to local aggression, releasing pro-inflammatory chemical mediators manifested by dilation of microcirculation vessels, promoting increased blood flow and vascular permeability with plasma fluid extravasation, increased blood viscosity, and decreased blood flow (Bechara; Szabó, 2006). This description may represent the clinical picture presented by the participants in this study. After the application of the LLBFP, they reported an increase in blood circulation at the magnet impact site, coinciding with the moment of elevated pain perception reported in the VAS. This may be related to changes in the functioning of cell membranes, interfering with calcium flow, affecting the tone of vascular walls, and consequently, blood flow.

A study describes one of the pathways of action of SMF with moderate force on living tissues, demonstrating that they can alter biophysical properties of cell membranes, affecting the ionic flow of sodium and calcium. Investigating the effects of SMF on human embryonic cells, the mRNA profile and affected signaling pathways were observed. Nine signaling pathways influenced by SMF were identified, with biochemical validation analyzed for the network linked to interleukin-6 (IL-6), a pro-inflammatory cytokine that recruits immune cells to the site of infection or injury. An activation less than 24 hours, considered short-term for IL-6, reduced the glycoside GM3 antibody, which increases IL-6. The responses mediated by SMF demonstrates some effects at the cellular level, such as morphological changes and changes in biochemical markers, such as GM3 and IL-6 (Wang et al., 2009).

These findings indicate that the action of SMF is directly related to the inflammatory process, providing strong evidence that they can indeed be a cause of its reduction. This is widely observed in studies using therapies that use magnets, such as Medicinal Biomagnetism and magnetotherapy. The results of VEINES, assessing quality of life, indicate that participants in this study reported indicators of inflammatory reduction in the lower limbs by improving symptoms of sore legs, heavy legs, cramps, restless legs, throbbing, and tingling during the intervention and also the non-interventional period, even though the analgesic effect did not persist in the subsequent follow-up period.

The values of the perimetric measurements indicate an acute effect on blood and lymphatic return flow, stimulated by the application of SMF generated by magnets, as described by Morris and Skalak (2008), reducing more than 59.7% of the 72 collected data. Even with 16.7% of perimetric measurements showing an increase, a potential effect on reducing edema is demonstrated.

One hypothesis for the increase in measurements is the increased blood flow in the muscle, raising entropy (Wang et al., 2009; Bechara; Szabó, 2006), which may be related to the subsequent anti-inflammatory effect generated by SMF (Rambo et al., 2023; Philpott; Kalit; Lothrop, 2000; Rumbaut and Mirkovic, 2008), a fact that could only be observed in a longer study with more participants and LLBFP Protocol interventions.

Other factors such as hydration, daily activities, diet, the time at which measurements were taken, ambient temperature, and the limited number of sessions can influence the result (Belczak et al., 2004). These are some of the limitations found in this perimetric collection study, as it did not follow a standard, as each participant underwent the LLBFP according to their time availability. As described in Rambo et al. (2023), chronic diseases such as CVI require a longer treatment period with MB and more frequent sessions, and this study applied 14 interventions within a 56-day interval. Another methodological limitation was the lack of application of a new perimetry after the period without LLBFP intervention to assess the maintenance of the edema effect.

Morris and Skalak (2008) describe the potential mechanism of action caused by SMF generated by magnets in edemas resulting from inflammation in soft tissues induced in rats. They suggest that the application of magnetic fields promotes constriction of vessels, reducing the formation of edemas by opening/activating L-type calcium channels in the cell membrane of vascular and lymphatic smooth muscle, increasing intracellular calcium concentration, reducing vessel diameter.

These results are influenced by the aforementioned, observing justifiable measures due to changes in vascular tone, influencing the functioning of the lymphatic system. Philpott, Kalita, and Lothrop (2000) describe that the north pole of the magnet has the ability to reverse and prevent cellular edema, acting on the ATPase enzyme of membrane channels and pumps. The action of the Na+-K+ ATPase pump is attributed to the enzyme that, in a more alkaline environment stimulates the cellular machinery, depolarizing the membrane. Thus, the ideal functioning of the pump allows the elimination of water from inside the cell, reducing edema and restoring cellular health. Magnets with the north polarity of the LLBFP applied over the venous return path act on the membranes of cells in vascular and lymphatic tissue, promoting such an effect.

The results indicate relative aspects that the treatment with the LLBFP provided acute inhibition of pain and the possibility of reducing measurements. SMF can reduce the inflammatory condition, promoting local circulation and analgesia, decreasing edemas (Morris; Skalak, 2008; Rumbaut; Mirkovic, 2008; Manjua et al., 2021).

The improvement felt by the participants may be related to what Broeringmeyer (1991), Philpott, Kalita, and Lothrop (2000), and Martínez (2018) described, where the north pole of the magnet has the ability to direct and push magnetizable elements of the body in the natural direction of flows, in this case, blood and lymphatic, providing better conditions for venous return. In turn, the positive polarity of the magnet, applied over inguinal lymph nodes and kidneys, restores tonicity, vitality, natural tissue acidity, stressing and oxygenating them, reducing oxidative stress. This effect activates the renal and lymphatic system, favoring diuresis, filtration, and blood cleaning, reducing inflammation and consequently, edema. Such effects promote an improvement in the quality of life and can be used as a complementary treatment for various dysfunctions. To validate and expand the findings of this study, more research exploring the various mechanisms by which SMF acts on the human body is important.

The application of the LLBFP for the treatment of vascular changes evidenced a reduction in signs and symptoms, providing a higher quality of life, and demonstrating therapeutic potential for relieving pain. This study highlighted that the implementation of the LLBFP, conducted in four sessions spaced weekly, reflected in the edema condition in the lower limbs.

CONCLUSION

The results of this preliminary study indicate a trend toward a reduction in the subjective perception of pain and edema. It demonstrates that the Lower Limb Blood Flow Protocol (LLBFP) of Medicinal Biomagnetism (MB) may be a complementary therapy for chronic venous insufficiency. This approach proved to be a low-cost and low-risk alternative, playing a supportive role in preventing and treating people with vascular changes. It deserves to be evaluated in studies with greater methodological rigor due to improvements observed in the quality of life that may be a reflection of anti-inflammatory mechanisms provided from the use of magnets.

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