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The Conjugated Action of Photobiomodulation and Pneumatic Compression in Chronic Venous Insufficiency: A Case Study

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Abstract

Chronic venous insufficiency of the lower limbs promotes the inability to maintain the balance of the venous complex, which can alter both the superficial and deep venous systems. As a result, there is an increase in venous vascular pressure and the formation of reticular and varicose veins in the limbs, affecting around 10% of the world's population. The objective of this study was to promote a combined action of technologies through a case study, which compared the singular action of resources in relation to the combined action of Photobiomodulation and the pneumatic boot. For this, a case study was carried out, following the patient for 16 weeks, 8 weeks intervening with the pneumatic compression boot and 8 weeks performing the intervention with the pneumatic compression boot associated with the 660nm and 808nm laser, for 30 minutes, 2 Times a week. All monitoring of the patient's progress and a visual analogue scale showed that in the 8-week intervention period there was a 33% reduction in pain using only pneumatic compression and a 100% reduction in pain with the combined action of pneumatic compression and symptoms presented by the patient.

Keywords: Pneumatic compression; Photobiomodulation; Chronic venous insufficiency; Vascular pressure

Introduction

Chronic venous insufficiency of the lower limbs (IVCMI) is an inability to maintain the balance of the venous complex, where it has to drain blood flow from the lower limbs and return it. Therefore, IVCMI is considered an abnormality of the venous system, which may be due to venous obstruction and/or valvular insufficiency, which may alter both the superficial and deep venous systems [1]. As a consequence of the malfunction, an increase in venous vascular pressure is induced, with venous hypertension, and consequently the formation of reticular and varicose veins in the limbs [2].

The most common symptoms include discomfort in the lower limbs, such as pain, telangiectasia's, varicose veins, edema, skin changes and the most serious complications, ulcerations [1].

IVCMI is a serious public health problem, with causes of sick leave presenting a socioeconomic challenge at national and global levels, which in turn is estimated to have an incidence of around 10% in the world population, making it one of the most common diseases. In clinical practice, with a higher prevalence in females affecting individuals in the third decade of life [3-5].

In relation to treatments for this condition, there are several, such as pharmacological, physiotherapeutic and also alternative ones, such as stretching, metabolic, strengthening, aerobic and proprioceptive exercises, breathing exercises, manual lymphatic drainage, pressotherapy, elastocompression, vascular incentive positioning, with the aim of preventing and recovering the damage caused, providing improvement in pain, edema, venous reflux, inflammation, preventing the emergence of venous hypertension, therefore reducing the biggest complication of the disease, which is venous ulcers [6].

In recent years, researchers from the São Carlos Physics Institute (IFSC) have been developing projects and publishing articles with positive results through combined technologies, associating two physiotherapeutic resources for simultaneous use, enabling the overlapping of the area of activity of the two resources, enhancing and accelerating treatments [7-14].

Using these new technologies, IFSC developed a prototype that simultaneously combines two therapeutic resources, the pneumatic boot and photobiomodulation, where the boot involves the entire region of the leg, the calf and foot, promoting pneumatic compression, acting on macrocirculation, increasing the venous return, and tissue pressure, favouring the reabsorption of edema and the return of fluids located in the interstitial spaces to the interior of the vascular and lymphatic system [15], together with photobiomodulation, which uses visible or low-power infrared light that exerts anti-inflammatory effects.-inflammatory, reducing chemical mediators, cytokines, edema, reducing the migration of inflammatory cells and increasing growth factors, therefore contributing to the process of pain relief, inflammation and tissue rehabilitation [16].

Therefore, the objective of this study was to promote a combined action of technologies through a case study, which compared the

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singular action of resources in relation to the combined action of photobiomodulation and the pneumatic compression boot.

Methods

Research ethics committee

The project was approved by the Ethics Committee for Human Beings of Santa Casa de Misericórdia de São Carlos, under responsibility number CAAE 53382021.8.0000.8148, according to resolution 466/2012. The procedure was obtained through free and informed consent.

Equipment

The prototype was developed by the Technological Support Laboratory (LAT) of the São Carlos Physics Institute (IFSC), and has a boot that surrounds the entire region of the leg, calf and foot, promoting pneumatic compression together with photobiomodulation with the spectra and their respective red (660nm) and infrared (808nm) wavelengths, under patent process BR 10 2021 009139 8 (Figure 1).

Clinical research and protocol

A case study was carried out on a 63-year-old Caucasian male patient, who presented a Doppler examination confirming chronic venous disease in both lower limbs.

Since 1996, he has had stitches in his right and left calves, itching in the ankle area and a feeling of tiredness and edema in his lower limbs, due to his job as a night watchman.

The patient undergoes medical monitoring and takes medication for high blood pressure, edema, compression stockings and practices physical activities.

The interventions carried out were: Pneumatic Boot, for a period of twice a week, 8 sessions, lasting 30 minutes; Pneumatic Boot + Photobiomodulation (660nm and 808nm) were performed on both lower limbs, for a period of 2 times a week, 8 sessions, lasting 30 minutes.

Evolution assessment mechanisms

As a form of assessment, the Visual Analogue Scale (VAS) was used, which is capable of evaluating the individual's pain. The assessment was carried out at two moments, before treatment and after the 8th treatment session in all interventions.



Figure 1: Application of the pneumatic compression boot and Photobiomodulation.

Results

Figure 2 shows the Visual Analogue Scale represented in the 8-week intervention periods. A reduction was observed in both interventions, with the reduction of the intervention using only pneumatic compression reducing pain by 33%, while the combined action of pneumatic compression and Photobiomodulation reduced pain by 100%.

Table 1 shows the comparison between the intervention periods in relation to the patient's report. Each intervention took place over an 8-week period. There was an interval of 1 week between interventions.

Discussion

IVCMI is an abnormality of the venous system, the main cause of which is venous obstruction and/or valve insufficiency, resulting in discomfort in the lower limbs, pain, telangiectasias, varicose veins, edema, skin changes and ulcerations [1].

There are treatments to recover the damage caused by IVCMI, such as pharmacological, physiotherapeutic and alternative treatments, such as the pneumatic boot that acts on the leg, calf and foot, obtaining pneumatic compression, acting to increase venous return and reabsorption of edema and return of fluids. located in the interstitial spaces of the vascular and lymphatic system and photobiomodulation through low-power red or infrared light, acting directly on anti-inflammatory effects [15,16].

In this present study, with the new technology developed by the Physics Institute of São Carlos (University of São Paulo) with two therapeutic resources, in the first phase the action of the pneumatic boot alone and in the second phase the combined action of the pneumatic boot and photobiomodulation. Given the results analyzed through the EVA, it was observed that in the 8-week intervention period there was a 33% reduction in pain using only pneumatic compression and a 100%



Figure 2: Comparison before and after the 8-week intervention, pneumatic compression versus pneumatic compression and photobiomodulation. Visual Analogue Scale data, ranging from 0 to 10, with 0 being no pain and 10 being extreme pain. Pre (3) and post (2) values are presented for the pneumatic compression intervention, with a reduction of 33%; Pre values (3) and (0) for the pneumatic compression + photobiomodulation intervention, with a 100% reduction.

 Table 1: Comparison of proposed intervention periods lasting 8 weeks each.

Pneumatic Compression	Pneumatic Compression + Photobiomodulation
During the period, the patient felt better, with less feeling of heavy legs, few twinges, but the itching in the ankles remained.	During this period, the patient reported a more marked improvement, completely relieving the pain, the feeling of heavy legs and the itching in his ankles.

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reduction in pain with the combined action of pneumatic compression and photobiomodulation.

In this way, the combined action of pneumatic compression and photobiomodulation resulted in a better form of treatment, eliminating the symptoms of CIVI, such as stitches, the feeling of heavy legs and itchy ankles.

Conclusion

The present work showed that the use of technologies in conjunction, in this case pneumatic compression and photobiomodulation, provided better results for the patient after a comparative period of interventions, improving the patient's quality of life.

Author Contributions

All authors contributed equally.

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Conflict of Interest Statement

The authors declare no conflict of interest.

Data Availability Statement

All the data are available in the text.

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