IMPACTO CIENTÍFICO EDITORA

EFFECTIVENESS OF THE PUSH (PRESSURE ULCER SCALE FOR HEALING) SCALE IN ASSESSING THE HEALING OF VENOUS ULCERS TREATED CONVENTIONALLY OR WITH LASER THERAPY

EFICÁCIA DA ESCALA PUSH (PRESSURE ULCER SCALE FOR HEALING) NA AVALIAÇÃO DA CICATRIZAÇÃO DE ÚLCERAS VENOSAS TRATADAS DE MANEIRA CONVENCIONAL OU POR LASERTERAPIA

EFICACIA DE LA ESCALA PUSH (PRESSURE ULCER SCALE FOR HEALING) EN LA EVALUACIÓN DE LA CICATRIZACIÓN DE ÚLCERAS VENOSAS TRATADAS DE MANERA CONVENCIONAL O CON LASERTERAPIA

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ABSTRACT

Venous ulcers represent a significant public health problem, affecting 1% to 3% of the population, particularly older adults, and generating high healthcare costs as well as a substantial impact on quality of life. In this context, standardized wound assessment is essential for safely monitoring healing progression. This study aimed to analyze the effectiveness of the PUSH Tool as a monitoring instrument for chronic wounds treated with conventional therapy or combined with photobiomodulation (PBM) using a Gallium Arsenide (AsGa) laser. Wound progression was recorded at two time points (day 0 and 15th session) using the PUSH Tool, which evaluates wound area, tissue type, and exudate amount. The wound area (cm²) was measured with a Vernier caliper (0–15 cm measuring range) and analyzed using ImageJ® software.The results demonstrated that the PUSH Tool was sensitive in detecting significant changes in the healing process, allowing for the identification

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of area reduction and improved tissue characteristics, regardless of the therapeutic modality used. Although the PBM group showed faster progression, the central finding of this study is the PUSH Tool's capability to objectively, reproducibly, and clinically monitor the evolution of venous ulcers, highlighting its usefulness across services with varying resources and demands. It is concluded that the PUSH Tool is an essential instrument for the systematic follow-up of venous ulcers, contributing to safer therapeutic decision-making and to the standardization of clinical practice. Future studies should expand its application in diverse contexts and encourage the standardization of assessment protocols.

Keywords: Photobiomodulation. Venous Ulcer. Wound Healing. Laser. PUSH Tool.

RESUMO

As úlceras venosas representam um importante problema de saúde pública, acometendo entre 1% e 3% da população, especialmente idosos, e gerando elevados custos assistenciais e impacto significativo na qualidade de vida. Diante desse cenário, a avaliação padronizada da ferida é fundamental para o acompanhamento seguro da evolução cicatricial. Este estudo teve como objetivo analisar a eficácia da Escala PUSH como ferramenta de monitoramento de feridas crônicas tratadas por terapia convencional ou associada à fotobiomodulação (FBM) com Laser de Arseneto de Gálio (AsGa). A evolução das lesões foi registrada em dois momentos (dia 0 e 15ª sessão) utilizando a Escala PUSH, que avalia área, tipo de tecido e quantidade de exsudato. A área (cm²) foi mensurada com paquímetro Vernier (faixa de medição 0-15 cm) e analisada pelo software ImageJ®.Os resultados evidenciaram que a Escala PUSH foi sensível para detectar mudanças importantes no processo cicatricial, permitindo identificar redução da área e melhora do aspecto tecidual, independentemente da modalidade terapêutica utilizada. Embora o grupo submetido à FBM tenha apresentado progressão mais rápida, o achado central do estudo é a capacidade da PUSH de monitorar a evolução das úlceras venosas de forma objetiva, reprodutível e clinicamente aplicável, demonstrando sua utilidade em serviços com diferentes recursos e demandas. Conclui-se que a Escala PUSH é uma ferramenta essencial para o acompanhamento sistemático de úlceras venosas, contribuindo para decisões terapêuticas mais seguras e para a padronização da prática clínica. Estudos futuros devem ampliar sua aplicação em diferentes contextos e favorecer a padronização de protocolos avaliativos.

Palavras-chave: Fotobiomodulação. Úlcera Venosa. Cicatrização. Laser. Escala PUSH.

RESUMEN

Las úlceras venosas representan un importante problema de salud pública, afectando entre el 1% y el 3% de la población, especialmente a los adultos mayores, y generando altos costos asistenciales e impacto significativo en la calidad de vida. En este contexto, la evaluación estandarizada de la herida es fundamental para el seguimiento seguro de la evolución cicatricial. Este estudio tuvo como objetivo analizar la eficacia de la Escala PUSH como herramienta de monitoreo de heridas crónicas tratadas con terapia convencional o asociada a la fotobiomodulación (FBM) con láser de Arseniuro de Galio (AsGa). La evolución de las lesiones fue registrada en dos momentos (día 0 y 15ª sesión) mediante la Escala PUSH, que evalúa área, tipo de tejido y cantidad de exudado. El área (cm²) fue medida con un calibrador Vernier (rango de medición 0–15 cm) y analizada con el software ImageJ®. Los resultados evidenciaron que la Escala PUSH fue sensible para detectar cambios importantes en el proceso de cicatrización, permitiendo identificar reducción del área y mejora del aspecto tisular, independientemente de la modalidad terapéutica utilizada. Aunque el grupo sometido a FBM presentó una progresión más rápida, el hallazgo central del estudio es la capacidad de la Escala PUSH para monitorear la evolución de las úlceras venosas de manera objetiva, reproducible y clínicamente aplicable, demostrando su utilidad en servicios con diferentes recursos y demandas. Se concluye que la Escala PUSH es una

herramienta esencial para el seguimiento sistemático de las úlceras venosas, contribuyendo a decisiones terapéuticas más seguras y a la estandarización de la práctica clínica. Estudios futuros deben ampliar su aplicación en diferentes contextos y favorecer la estandarización de protocolos de evaluación.

Palabras clave: Fotobiomodulación. Úlcera Venosa. Cicatrización. Láser. Escala PUSH.

1 INTRODUCTION

1.1 PROBLEMATIZATION

Wound is defined as any interruption in the continuity of the skin that affects its integrity. It represents a public health problem because it affects the general population and causes negative impacts on the individual's quality of life. The incidence, prevalence, and chronicity of these lesions are associated with increased longevity and inadequate lifestyle habits, which predispose to diseases such as Diabetes Mellitus and vascular diseases, among others (Lentsck *et al.*, 2018).

Wounds lasting more than six weeks and with high recurrence rates are classified as chronic (Ribeiro *et al.,* 2019). Vasculogenic ulcers, for example, are caused by arterial, venous or mixed problems, often affecting the lower limbs and being difficult to heal (Bavaresco; Lucena, 2022).

Therefore, even with the availability of numerous dressings for wound care, there are still lesions that are difficult to heal, fostering the search for new therapeutic conducts as a way to accelerate the tissue regeneration process and provide a higher quality of life to patients (Cavassan *et al*., 2019).

Over the years, several technologies have been used in the treatment of chronic wounds, especially photobiomodulation. This therapeutic approach is based on the interaction of light, usually emitted by LASER (Light Amplification by Stimulated Emission of Radiation) or LED (Light Emitting Diode), with the tissues of the body. Studies indicate that laser therapy plays an important role in tissue regeneration, promoting recovery from chronic injuries. Its benefits include accelerating healing, reducing edema, pain, inflammation, and the risk of infection (Sobest, 2022), as well as stimulating collagen production (Cunha, 2019). These combined effects contribute not only to the improvement of the clinical picture, but also provide greater comfort to the patient during treatment.

At the same time, conventional methods continue to be the basis of wound management, involving fundamental steps such as hygiene, debridement, and the choice of appropriate dressings. There are several dressing options available, each with specific characteristics to favor healing, protect the wound, and reduce secondary complications (Brasil, 2023). The integration of traditional therapies and innovative technologies, such as photobiomodulation, has shown promise for optimizing clinical outcomes in patients with chronic wounds.

In addition to selecting the appropriate treatment, it is essential to evaluate the healing process systematically. This evaluation ensures proper wound recovery and prevents complications through early detection of infections and individualized care. According to recent studies, there are different methods to evaluate acute and chronic wounds, both

surgical and non-surgical. These assessments include area, volume, and perimeter measurements. A traditional technique consists of estimating the area by multiplying the longest length by the largest perpendicular diameter, while more accurate alternatives track the percentage reduction of the area over time. The latter offers a detailed view of the healing process and allows monitoring the response to treatment (Mehl *et al*., 2021).

Among the methods of measuring the wound area, the following stand out: 1) the Manual Method, performed by direct measurement of the wound with a millimeter ruler, still widely used in clinical practice; 2) Digital Photography, which involves capturing images over time, requiring software to measure the wound area; and 3) planimetry, which consists of measuring the area by superimposing the tracing or photograph on a graph paper and then counting the complete squares (Eberhardt *et al*., 2015). For the use of these methods, it is necessary to standardize image acquisition, training of health professionals, and use of specialized software, which often makes it difficult to perform them in clinical practice.

Several tools and metrics have been developed to identify patients at risk of developing pressure ulcers (PU), such as the Braden Scale. Among the instruments aimed at monitoring the evolution of lesions, the Pressure Ulcer Scale for Healing (PUSH) stands out, developed and validated by the Task Force of the National Pressure Ulcer Advisory Panel (NPUAP) and adapted to Brazil by Santos *et al.* (2005). Although there are several validated tools, such as the **Bates-Jensen Wound Assessment Tool (BWAT)** (Bates-Jensen, 1990), **RESVECH 2.0** (Schaefer *et al*., 2017) and structured approaches such as the **TIME Framework** (Schultz *et al*., 2003), PUSH stands out in the context of clinical practice for being **fast, objective and easy to apply,** facilitating serial wound assessment and care decision-making.

Clinical evidence reinforces the importance of using validated scales in both prevention and therapeutic follow-up, since these tools are practical, reliable, and contribute to guiding interventions more accurately. In addition, the adoption of instruments such as PUSH improves the standardization of assessments and qualifies nursing practices (Silveira *et al*., 2013).

Although the PUSH scale was developed for pressure ulcers, its simple, standardized structure and sensitivity to changes in the healing process has favored its application in other etiologies. However, its use in venous ulcers is still limited and little explored in the literature, despite the instrument's potential to systematically monitor the evolution of chronic wounds.

In view of the efficacy and broad validation of PUSH for PU, and considering the scarcity of studies evaluating its performance in chronic wounds of other origins submitted to different therapeutic approaches, a careful analysis of its applicability in these contexts is necessary. Thus, the present study aims to evaluate the efficacy of the PUSH scale in

monitoring the healing process of chronic venous wounds treated conventionally or by laser therapy, seeking to provide evidence that guides more assertive clinical practices in line with validated protocols.

2 LASER THERAPY

Since the 1960s, photobiomodulation has been associated with several therapeutic benefits in multiple areas of health, such as post-surgical management, pain relief, neural regeneration in dentistry, skeletal muscle recovery, driven by increased production of adenosine triphosphate (ATP), and acceleration of the wound healing process. This technique stimulates cellular functions through the emission of electromagnetic waves located in the red to infrared spectrum (600–1000 nm). Photobiomodulation is characterized by being a non-invasive approach, carried out through the application of devices such as laser (*Light Amplification by Stimulated Emission of Radiation*) and LED (*Light Emitting Diode*), both capable of triggering similar biological effects (Chaves, 2015; Oliveira *et al*., 2021; Ribeiro *et al*., 2022).

The laser is a monochromatic, coherent, collimated and non-invasive light source capable of promoting behavioral changes in cells, emitting greater penetration and concentration of light energy at specific points (Marcolino *et al.*, 2022). It has the ability to penetrate the skin and transfer photons to the cells of the injured region, acting especially on the electron transport chain of the mitochondrial membrane, without generating heat, with the intention of reestablishing homeostatic balance in the wound bed. This interaction stimulates an increase in proton production and, consequently, increases intracellular ATP levels (Bernardes; Juror, 2018; Lima *et al*., 2022).

Its therapeutic effects include reducing the wound area, accelerating tissue repair, decreasing pain, stimulating fibroblast proliferation, and increasing collagen synthesis. Laser therapy also modulates the inflammatory response, promoting greater macrophage activity, vasodilation, and improved lymphatic flow. Throughout the healing process, there is also an increase in granulation tissue, the formation of new blood vessels, and the progressive deposition of collagen (Baracho *et al*., 2021; Weber, 2022; Silva; Olive tree; Souza, 2023). Another important point is the significant increase in collagen production, with faster replacement of type III collagen by type I, which results in better tissue organization and higher scar quality (Cunha *et al*., 2017).

The association of photobiomodulation with low-level laser with conventional dressing methods has been supported by recent evidence, demonstrating important benefits in the management of chronic wounds. Updated studies show that the laser acts as an adjuvant

therapy by modulating inflammation, stimulating cell proliferation, favoring collagen deposition, and optimizing the moist microenvironment provided by modern dressings. A 2024 meta-analysis confirmed that laser therapy accelerates healing and reduces pain in different types of skin lesions (Taha *et al*., 2024), while recent national reviews reinforce that its combination with conventional dressings significantly improves the clinical evolution of wounds (Bueno da Silva *et al*., 2023). Current reports in diabetic foot ulcers also demonstrate reduced pain, decreased inflammatory signs, and progression of lesion closure when LLLT is integrated into standard care (Silva, 2023).

In addition, experimental and clinical studies analyzed between 2023 and 2025 show that photobiomodulation can enhance topical therapies, such as the use of *Helianthus annuus* oil, promoting synergism in tissue regeneration (Silva *et al*., 2024). Recent research also points out that this integration is feasible at different levels of care, expanding care resolution and qualifying the management of chronic wounds when combined with technological dressings such as hydrogels, foams, and alginates (Faria *et al*., 2023). More current national productions reinforce that combined protocols between conventional methods and laser are capable of improving epithelialization, increasing the quality of granulation tissue, and reducing bacterial load, consolidating laser as a safe and effective resource in clinical practice (Baracho Silva *et al*., 2025).

However, the use of therapeutic laser in wound treatment requires technical rigor, especially regarding the standardization of application parameters, such as wavelength, energy density, power, and exposure time, as these variables determine the depth of penetration and the biological effect produced. The absence of standardized protocols can compromise the results, leading to under- or overdose and reducing clinical efficacy. Likewise, professional training is essential, since photobiomodulation requires knowledge about photobiology, interaction of light with tissues, indications, contraindications, and safety in application. Thus, evidence-based practice, combined with continuous training, ensures safer, reproducible and more effective interventions, consolidating the laser as a qualified therapeutic resource in wound care.

3 INSTRUMENTS FOR MEASURING AND EVALUATING THE HEALING PROCESS

Systematic wound assessment is a central component for therapeutic success, as it allows understanding its evolutionary stage, identifying factors that interfere with healing, and providing appropriate guidance to conduct. Direct clinical inspection remains the basis of this analysis, including observation of the size and depth of the lesion, the type of tissue present, the amount and characteristics of the exudate, the conditions of the borders, and the

presence of signs of infection. These elements provide a global view of the wound's condition and allow for immediate adjustments to the care plan (Bates-Jensen, 2016; NPUAP; EPUAP; PPPIA, 2019).

In addition to clinical evaluation, the use of standardized methods and validated instruments contributes to the objective measurement of scar evolution. Scales such as the *Pressure Ulcer Scale for Healing* (PUSH), developed by the NPUAP and validated in Brazil by Santos et al. (2005), transform qualitative aspects of the wound into measurable scores, favoring accurate and continuous monitoring. The integration between careful clinical observation and standardized measurements strengthens decision-making, qualifies interventions, and significantly increases the chances of a favorable therapeutic outcome (Campos; Silva, 2020; Silveira *et al*., 2013).

4 METHOD

This is a descriptive study, with a quantitative approach, developed from a university extension experience focused on the care of people with chronic wounds. The activities were carried out in a multidisciplinary outpatient service institution located in the municipality of Diamantina, Minas Gerais, Brazil, within the scope of the extension project "Acting with the Polyclinic for the care of patients with chronic wounds". This initiative involved the participation of health professionals, graduate students, and nursing and physiotherapy students linked to the Federal University of the Jequitinhonha and Mucuri Valleys (UFVJM), integrating theoretical and practical knowledge in outpatient care.

The conduct of the actions followed ethical, scientific and welfare principles, with the approval of the Research Ethics Committee of UFVJM, under protocol No. 5,331,786. All participants were duly instructed about the objectives and procedures involved, signing the Informed Consent Form (ICF) before their inclusion in the study. This methodological structure allowed the development of a well-founded care process, ensuring patient safety, professional qualification, and systematization of clinical practices aimed at the treatment of chronic wounds.

The study population was composed of individuals aged 18 years or older, with chronic venous or neuropathic wounds in the lower limbs, living in the city of Diamantina or in the region of Vale do Jequitinhonha, users of the Unified Health System (SUS). Participants were randomly allocated into two treatment groups: the Active Laser Group (AL), which received laser phototherapy adjunctive to conventional treatment, and the Placebo Laser (PL) Group, which received sham phototherapy associated with conventional treatment. The conventional treatment consisted of cleaning the lesion with 0.9% saline solution, followed by topical

therapy according to the characteristics of the lesion. The applications were performed twice a week, totaling 15 treatment sessions or until the lesion had completely healed. Data were collected regarding the presence of comorbidities, gender, age, and etiology of the lesion.

A photobiomodulation device (FBM) of the AsGa LASER type (Mid Laser/Sweden) with 12 super-pulsed infrared diodes, wavelength of 904 ± 10 nm, frequency of 200 Hz, power of 60 mW, energy of 8 J/cm² was used. This laser has the advantage of covering a larger area of the wound compared to point devices (pen-type), reducing application time. The dosage of 8 J/cm² was adopted based on previous research that demonstrated its effectiveness in healing diabetic wounds (Cardoso *et al*., 2024). To ensure the safety of the procedure, the device was disinfected with 70% alcohol and coated with PVC film before each session in order to avoid cross-contamination. Protective goggles were used by the patient and researcher during all applications.

The wound area was measured throughout the study to monitor the progress of healing, using a 0–15 cm Vernier caliper positioned above the lesion, without contact with the skin, along with photographic documentation. Images were captured with a Canon EOS Rebel XS camera (10.1 megapixels, 18–55 mm lens), and the wound area was measured using ImageJ® software (US National Institutes of Health, Bethesda, MD). Two distinct moments were defined for the evaluation of the healing process, on day 0 (1st session) and on day 15 ^{the} treatment session.

The evolution of the wounds was evaluated using the PUSH Scale, adapted to measure the lesional area with a caliper. The scale considers three parameters: area (length × width), with scores from 0 to 10; amount of exudate (0 to 3), classified as absent (0), small (1), moderate (2) or large (3); and appearance of the wound bed (0 to 4), determined by the predominant tissue type, being 0 (closed wound), 1 (epithelial tissue), 2 (granulation tissue), 3 (slough The sum generates a total score from 0 to 17, in which higher values indicate worse wound condition. In addition, in order to verify whether only the qualitative analysis of the PUSH scale would be efficient for evaluating the healing process, an analysis was performed with the modified PUSH scale, where only the parameters of amount of exudate and appearance of the wound bed were evaluated, removing the scores from the area. Thus, the scale enables systematic and standardized follow-up of the response to treatment, contributing to clinical decision-making and monitoring of therapeutic evolution.

For the statistical analysis of the PUSH scores and the wound area, the Shapiro-Wilk normality test was applied. Variables with normal distribution were compared using repeated measures ANOVA, followed by Bonferroni's post-test for multiple comparisons. To analyze the effect of the treatment (laser versus control) and the time factor (before and after), a mixed

effects model was used, considering the patients as a random effect. The results were expressed as mean ± standard error (SE). The significance level adopted was 5% ($p < 0.05$). All analyses were performed using the GraphPad Prism statistical software (version 8, San Diego, CA, USA).

5 RESULTS

A total of 24 patients were recruited for the study, divided into 11 in the Placebo Laser (PL) group and 13 in the Active Laser (AL) group. At the end of the follow-up, 17 participants completed the study, 8 in the PL group and 9 in the AL group, after exclusions due to non-adherence to the treatment protocol, abandonment or discontinuation of participation. The mean age of the participants was 75 ± 12.5 years in the PL group and 79 ± 21.8 years in the AL group, with 12 individuals (70.6%) aged over 70 years. The etiology of the wounds was predominantly venous ulcers. Eleven participants (64.7%) were male and 9 (52.9%) declared themselves black. Systemic arterial hypertension (SAH) was the most prevalent comorbidity, affecting 13 participants (76.5%), followed by type 2 diabetes mellitus (DM2), reported in 5 cases (29.4%). There was no statistically significant difference between the groups in relation to age or gender.

The evaluation of the evolution of the wounds was performed using the PUSH Scale, which integrates three fundamental components of the healing process: lesion area, amount of exudate, and bed appearance. For the purposes of analysis and presentation of the findings, these parameters were organized into three graphic representations. Figure 1A shows the analysis of the wound area, allowing us to observe whether there was a measurable reduction in the size of the lesion throughout the treatment. The results showed that the Placebo Laser group did not present a significant difference between the initial and final moments ($p > 0.9999$), while the Active Laser group showed a statistically significant reduction in the area ($p = 0.0007$), evidencing greater effectiveness in closing the lesion.

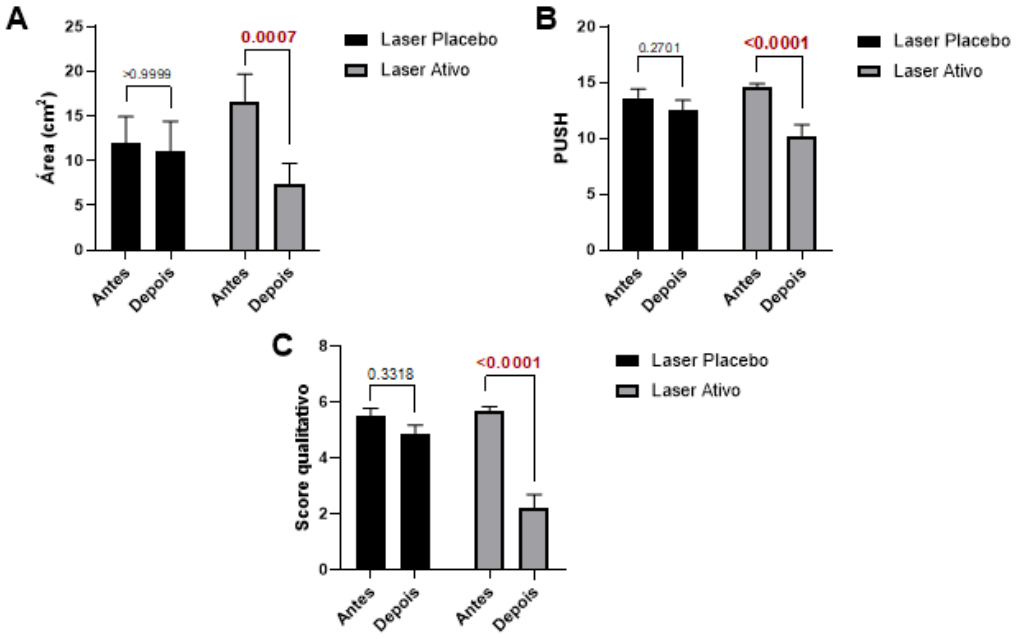
Figure 1B shows the total score of the PUSH Scale, which combines the three domains evaluated (wound area, tissue aspect, and amount of exudate). This global analysis showed no difference in the Placebo group ($p = 0.3318$), while the Active Laser group showed a significant reduction in the score ($p < 0.0001$), confirming a consistent and integrated improvement in the healing process.

Figure 1C illustrates the qualitative score of the PUSH considering only two qualitative clinical parameters: tissue aspect and amount of exudate. In the placebo group, there was no significant improvement ($p = 0.2701$), indicating stability of the clinical picture. However, the group that received the Active Laser showed significant improvement in these

components ($p < 0.0001$), reflecting a structured advance in tissue quality and exudate reduction.

Figure 1

Evaluation of the healing of chronic wounds submitted to adjuvant treatment with AsGa LASER before and after 15 sessions. A) Evaluation of the wound area; B) Evaluation of healing by the PUSH scale; 3) Evaluation of healing by the modified PUSH scale containing only the tissue aspect and exudate scores; The data represent mean ± standard error, and were submitted to repeated measures ANOVA, followed by the Bonferroni post-test, with P values represented above the bars of the graphs

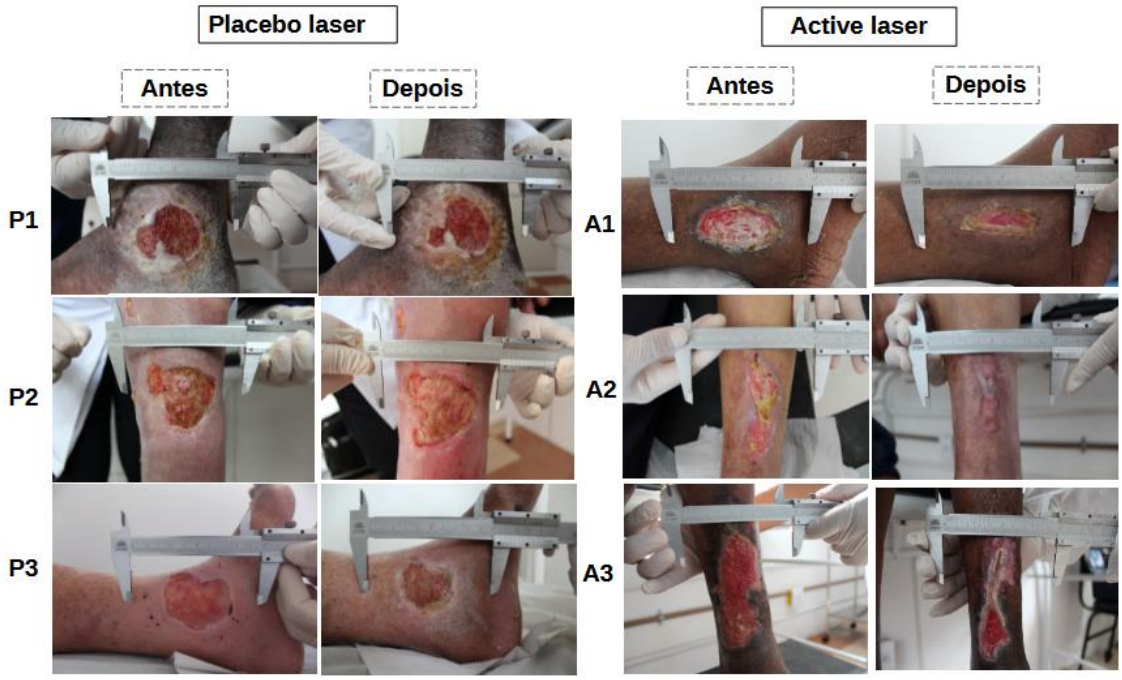


Such results reinforce the potential of **photobiomodulation** as an effective resource to aid the healing of chronic wounds, especially evidenced by the functional improvement measured by the PUSH Scale in the group submitted to laser treatment.

Regarding the evolution of healing in chronic wounds between the groups, the participants in the LA group showed a faster healing of the lesion, when compared to the PL, in which the lesions lasted longer to evolve in the healing process, as shown in the comparative image in Figure 2. These findings are in agreement with the statistical analysis that showed a difference between laser phototherapy treatments and sham therapy, both associated with conventional treatment.

Figure 2

Evaluation of the healing of chronic wounds submitted to adjuvant treatment with AsGa LASER before and after 15 sessions. The images represent 3 patients from the Placebo laser group (P1/P2/P3) and the Active laser group (A1/A2/A3)



6 DISCUSSION

This study aimed to evaluate the efficacy of the PUSH scale in monitoring the healing process of chronic venous wounds treated conventionally or associated with laser therapy. In an innovative approach, the PUSH Scale, originally developed by the National Pressure Ulcer Advisory Panel (NPUAP) for the evaluation of pressure ulcers, was used as a central tool for clinical monitoring in chronic wounds. Its application proved to be adequate and sensitive to follow the scar evolution, allowing a detailed and systematic evaluation of tissue changes. The scale was used both in its complete version, which includes the measurement of the lesion area, and in its modified version, with exclusive analysis of the clinical components. This strategy has expanded the capacity to detect changes throughout treatment, reinforcing its usefulness and versatility as an instrument capable of guiding effective and evidence-based therapeutic interventions.

The findings regarding the profile of the participants allow a better understanding of the context in which the wounds develop. A predominance of venous ulcers was observed, in line with what has been described in previous studies (Galvão, 2016; Ferreira, 2022). The higher frequency of venous ulcers in elderly patients, especially those over 65 years of age, confirms the impact of the physiological changes of aging, chronic venous stasis, and the high burden of comorbidities, as pointed out by Mendes *et al*. (2020). These factors reinforce

the relevance of chronic wounds as a condition of high prevalence and significant impact on quality of life.

Regarding comorbidities, most patients with venous ulcers had systemic arterial hypertension, associated or not with diabetes mellitus. These findings corroborate studies by Bavaresco (2021) and Osmarim *et al.* (2021), which point to a strong association between these conditions and the delay in the healing process. In addition, Charlo *et al*. (2020) demonstrate that the combination of venous insufficiency and systemic arterial hypertension increases the risk of deep vein thrombosis, constituting an important indicator of clinical risk. This information reinforces the need for specific interventions to prevent adverse events and improve healing in populations of greater vulnerability.

Proper assessment of a wound is a key step towards the success of any therapeutic intervention. A careful analysis of the type of tissue, the presence of infection, the amount of exudate, the characteristics of the borders, and the temporal evolution of the lesion allows for early identification of complications, adjustment of conducts, and selection of the most appropriate treatment for each phase of healing. Without a systematic and standardized assessment, there is a risk of inappropriate therapeutic choices, delays in wound closure, and increased care costs. Therefore, structured instruments, such as the PUSH scale, play a central role in guiding clinical reasoning, reducing variability among professionals, and ensuring that decision-making is guided by objective and reproducible parameters, thus promoting better scarring outcomes (Bergstrom *et al*., 1994; Gardner *et al*., 2009; García-Fernández *et al*., 2017).

To effectively monitor the clinical evolution of these lesions, the PUSH Scale proved to be adequate. Recognized for its simplicity, reliability, and sensitivity in detecting tissue changes, it allows you to consistently assess exudate, tissue type, and, where available, wound area. Developed by the National Pressure Ulcer Advisory Panel (NPUAP), PUSH is widely used in clinical practice and research, and has been validated as an instrument capable of monitoring the progression of chronic wounds (Bergstrom *et al*., 1994; Santos *et al*., 2016).

The care overload, characterized by high patient turnover, accumulation of demands, and limited material or technological resources, often makes it difficult to carry out detailed and systematic evaluations. In this scenario, there is a need for standardized tools that guide the recording and monitoring of scar evolution, reducing variability among professionals and increasing clinical safety. The literature highlights that standardized instruments provide greater uniformity in conduct and strengthen interdisciplinary communication (García-Fernández *et al*., 2017).

Although instruments such as the **Bates-Jensen Wound Assessment Tool (BWAT)** offer more detailed assessment, their application requires more time, training, and adequate structural conditions, which limits their use in services with high demand. In contrast, the **PUSH scale** has excellent clinical applicability, especially in resource-constrained settings (Hon *et al*., 2010). The findings of this study reinforce that its **modified version**, without the item area, maintains sensitivity to detect changes in tissue, exudate, and healing evolution, corroborating evidence from Gardner *et al.* (2009), Santos *et al.* (2016), Oliveira *et al.* (2017) and Ferreira *et al.* (2019). These authors demonstrate that adaptations to the scale, such as the exclusion of the area measurement when there are no adequate instruments, **do not compromise its monitoring capacity**, supporting its applicability in various care contexts, especially those with structural limitations.

In general, the findings of this study consolidate PUSH as an applicable instrument in clinical practice for the evaluation of chronic wounds of different etiologies. In addition, its integration with advanced therapies, such as photobiomodulation, demonstrates its potential as a central outcome measure in research. However, there is still a need to unify parameters and protocols applied to photobiomodulation, since there is great variation in the literature regarding the dose, frequency, and characteristics of the laser used (Ferreira *et al*., 2020). The standardization and validation of specific methods are essential to consolidate evidence and improve clinical practices.

7 FINAL CONSIDERATIONS

The results of this study demonstrate that laser photobiomodulation, when associated with conventional treatment, favors the reduction of the wound area and the formation of viable granulation tissue, contributing to a faster healing process and better clinical prognosis. Although the therapy has shown promising efficacy, especially in the treated group, studies with expanded samples are still needed to strengthen the consistency of the evidence.

In addition to the benefits observed with photobiomodulation, this study highlights the application of the PUSH scale in both its full and modified versions, showing that both have similar performance in the evaluation of scar evolution. Although originally developed for pressure ulcers, the scale has been shown to be fully applicable in venous ulcers, maintaining sensitivity and consistency even when used without the area component. This adaptation is particularly relevant in clinical scenarios where the professional may not have measurement instruments or photographic resources, which are frequent limitations in care practice.

In this sense, the modified PUSH scale proved to be a practical and reproducible tool, allowing the objective monitoring of changes in exudate and tissue type, and offering an

accessible and reliable evaluation method. Its simplified applicability favors routine use in health services, increasing the accuracy of records and qualifying clinical decision-making.

These findings reinforce the need for continuous investments in professional training and in the standardization of protocols that guide both the use of laser therapy and the appropriate application of assessment scales. It is also important to highlight the importance of future research aimed at expanding the validation of the modified PUSH scale in multiple etiologies of wounds and strengthening the qualitative components of the score. Consolidating this simplified version as a standard instrument may represent a significant advance for the safe, effective, and accessible assessment of chronic wounds in care practice.

8 IMPLICATIONS FOR CLINICAL PRACTICE

- Standardization of wound assessment: The systematic use of the PUSH scale, either in its full version, which includes the measurement of the lesion area, or in its modified version, based only on the clinical components, offers a standardized, reproducible, and sensitive method to monitor the scar evolution, reducing subjectivity and allowing comparability between professionals and services.
- Improved therapeutic decision-making: By quantifying critical parameters (size, tissue type, and exudate), PUSH assists in the more accurate selection of dressings, the indication or discontinuation of adjuvant therapies, and the early identification of clinical worsening.
- Objective monitoring of therapeutic response: Serial scores allow the effectiveness of the protocols used to be evaluated, favoring timely adjustments in the care plan and avoiding unnecessary prolongation of conduct.
- Improved multi-professional communication: The scale facilitates clinical recording and dialogue between nurses, physicians, and physical therapists, ensuring that everyone uses the same descriptive language of the wound.
- Safety and continuity of care: Because it is quick and easy to apply, PUSH improves care safety, reduces variations in evaluation, and contributes to continuity between different shifts and professionals.
- Regarding the complementarity of laser therapy to conventional dressings, the need for **professional training and standardization of parameters** for safe and effective results is reinforced. It is essential that professionals receive specific training and that institutions adopt defined parameters (dose, wavelength, frequency, and time of application), avoiding variations that compromise the therapeutic effects.

- The adoption of institutional protocols strengthens the performance of the multidisciplinary team by creating a common language for the description of the wound, its clinical signs and its evolution.

REFERENCES

Baracho Silva, V., & colaboradores. (2025). Fotobiomodulação em feridas crônicas: da revisão sistemática ao ensaio clínico [Dissertação de mestrado ou tese, se for o caso]. Universidade Federal dos Vales do Jequitinhonha e Mucuri.

Baracho Silva, V., & colaboradores. (2025). Protocolos combinados de fotobiomodulação e terapias convencionais no tratamento de feridas crônicas: Evidências clínicas recentes. Revista Brasileira de Enfermagem, 78(2), 1–10.

Bates-Jensen, B. M. (1990). The Pressure Sore Status Tool: A few thousand assessments later. Advances in Wound Care, 3(5), 279–296.

Bates-Jensen, B. M. (2016). Wound assessment and monitoring. In D. Krasner, G. T. Rodeheaver, & R. G. Sibbald (Eds.), Chronic wound care: A clinical source book for healthcare professionals (5th ed., pp. 113–124). HMP Communications.

Bavaresco, T. A. (2021). Úlceras venosas: Influência das comorbidades no processo de cicatrização. Journal of Vascular Nursing, 39(1), 27–34. https://doi.org/10.1016/j.jvn.2021.01.003

Bavaresco, T., & Lucena, A. F. (2022). Low-laser light therapy in venous ulcer healing: A randomized clinical trial. Revista Brasileira de Enfermagem, 75(3), Article e20210396. https://doi.org/10.1590/0034-7167-2021-0396

Bergstrom, N., Braden, B. J., Laguzza, A., & Holman, V. (1994). The PUSH Tool: Assessing pressure ulcer healing. Advances in Wound Care, 7(5), 13–14.

Bernardes, F. F., & Jurado, S. R. (2018). Mecanismos celulares da fotobiomodulação: Implicações para o processo de cicatrização. Revista Brasileira de Laser em Saúde, 7(2), 45–52.

Bueno da Silva, E., Iohan, F., Cassão, G., & Capellari, C. (2023). Laserterapia de baixa intensidade no tratamento de feridas: Uma revisão integrativa. Revista Enfermagem Atual In Derme, 97, 1–10.

Campos, A. C. L., & Silva, M. H. (2020). Avaliação e tratamento de feridas: Princípios e práticas para o cuidado clínico. Revista de Enfermagem Atual In Derme, 92(30), 1–10.

Campos, A. C. L., & Silva, R. C. (2020). Avaliação de feridas: Fundamentos para prática clínica segura. Revista Saúde (Santa Maria), 46(3), 1–12.

Cardoso, F. R., & colaboradores. (2024). Efeitos da fotobiomodulação na cicatrização de feridas diabéticas: Estudo clínico randomizado. Journal of Wound Care & Laser Therapy, 12(1), 45–54.

Cavassan, N. R. V., & colaboradores. (2019). Correlation between chronic venous ulcer exudate proteins and clinical profile: A cross-sectional study. Journal of Proteomics, 192, 280–290. https://doi.org/10.1016/j.jprot.2018.09.008

Chaves, M. E. A. (2015). Photobiomodulation and cellular metabolism in wound repair. Lasers in Medical Science, 30(3), 1139–1147. https://doi.org/10.1007/s10103-014-1685-8

Charlo, P. B., & colaboradores. (2020). Insuficiência venosa crônica e hipertensão arterial: Fatores de risco para trombose venosa profunda. Jornal Vascular Brasileiro, 19, Article e20190123. https://doi.org/10.1590/1677-5449.190123

Cunha, J. L. S., & colaboradores. (2019). Effects of different protocols of low-level laser therapy on collagen deposition in wound healing. Brazilian Dental Journal, 30(4), 317–324. https://doi.org/10.1590/0103-6440201902400

Eberhardt, T. D., & colaboradores. (2015). Mensuração de feridas: Revisão da literatura. Ciência & Saúde, 8(2), 79–84. https://doi.org/10.15448/1983-652X.2015.2.19947

Faria, M. R., Andrade, P. L., & Costa, J. S. (2023). Integração da fotobiomodulação com coberturas tecnológicas no manejo de feridas crônicas. Journal of Wound Care and Research, 12(4), 45–55.

Ferreira, A. M., & colaboradores. (2019). Confiabilidade interavaliadores da escala PUSH adaptada para monitoramento de feridas crônicas. Revista Gaúcha de Enfermagem, 40, Article e20180432. https://doi.org/10.1590/1983-1447.2019.20180432

Ferreira, L. A., & colaboradores. (2020). Laser therapy in chronic wounds: Challenges for protocol standardization. Lasers in Medical Science, 35(1), 123–131. https://doi.org/10.1007/s10103-019-02845-5

Ferreira, L. M. (2022). Epidemiologia e manejo clínico de úlceras venosas em serviços de atenção primária. Revista de Enfermagem e Saúde, 11(2), 45–54.

Galvão, T. N. (2016). Úlceras venosas: Características clínicas, fatores associados e práticas de cuidado [Dissertação de mestrado, Programa de Pós-Graduação em Enfermagem]. Universidade Federal da Bahia.

García-Fernández, F. P., & colaboradores. (2017). The PUSH Tool 3.0: A review of the literature and updated evidence. Journal of Tissue Viability, 26(2), 54–57.

Gardner, S. E., & colaboradores. (2009). A prospective study of the PUSH Tool in diabetic foot ulcers. Ostomy Wound Management, 55(5), 48–55.

Hon, J., & colaboradores. (2010). Wound assessment tools: Comparing the PUSH and BWAT. Journal of Wound Care, 19(10), 432–437.

Lentsck, M. H., & colaboradores. (2018). Quality of life related to clinical aspects in people with chronic wound. Revista da Escola de Enfermagem da USP, 52, Article e03384. https://doi.org/10.1590/S1980-220X2017004003384

Lima, S. S., & colaboradores. (2022). Análise quanti e semiquantitativa do colágeno no reparo tecidual: Um estudo comparativo. Revista de Ciências Médicas e Biológicas, 21(3), 644–649.

Marcolino, A. M. S., Silva, R. F., Oliveira, L. M., & Pereira, J. R. (2022). Clinical applications of low-level laser therapy in rehabilitation. Brazilian Journal of Health Sciences, 26(1), 105–114. https://doi.org/10.4034/RBCS.2022.26.01.13

Mehl, A. A., & colaboradores. (2022). Mensuração da área de feridas para análise precoce do fator preditivo cicatricial. Revista Latino-Americana de Enfermagem, 34(2), 200–207. https://doi.org/10.1590/1518-8345.3708.3299

Mendes, E. V., & colaboradores. (2020). Fatores associados ao desenvolvimento e à cronicidade de úlceras venosas em idosos. Revista Brasileira de Enfermagem, 73(4), e20190456.

National Pressure Ulcer Advisory Panel. (1997). PUSH Tool (Pressure Ulcer Scale for Healing). Author.

National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel, & Pan Pacific Pressure Injury Alliance. (2019). Prevention and treatment of pressure ulcers/injuries: Clinical practice guideline (3rd ed.).

Oliveira, B. G., & colaboradores. (2017). Aplicação da escala PUSH na avaliação de feridas crônicas: Estudo de validação. Revista de Enfermagem da UERJ, 25, Article e17042.

Oliveira, J. S., & colaboradores. (2021). Effects of LED phototherapy on chronic wounds: A clinical review. Photobiomodulation Journal, 12(2), 45–58.

Osmarim, M., & colaboradores. (2021). Impacto de doenças crônicas no retardo da cicatrização de feridas venosas. Revista Eletrônica de Enfermagem, 23, 65891.

Ribeiro, G. S. C., & colaboradores. (2019). Pacientes internados com feridas crônicas: Um enfoque na qualidade de vida. Enfermagem em Foco, 10(2), 88–93.

Ribeiro, T. A., & colaboradores. (2022). Photobiomodulation in tissue repair: Evidence and clinical applications. International Journal of Laser Therapy, 18(1), 22–34.

Santos, V. L. C. G., & colaboradores. (2005). Adaptação transcultural e validação da Pressure Ulcer Scale for Healing (PUSH) para o português brasileiro. Revista Latino-Americana de Enfermagem, 13(3), 305–313.

Santos, V. L. C. G., & colaboradores. (2016). Cross-cultural adaptation and validation of the PUSH for Healing tool in Brazil. Revista Latino-Americana de Enfermagem, 24, Article e2795.

Schaefer, T., & colaboradores. (2017). Validation of the RESVECH 2.0 Scale for the assessment of chronic wounds. Journal of Wound Care, 26(7), 392–402.

Schultz, G. S., Sibbald, R. G., Falanga, V., Ayello, E. A., Dowsett, C., Harding, K., Romanelli, M., Stacey, M. C., Teot, L., & Vanscheidt, W. (2003). Wound bed preparation: A systematic approach to wound management. Wound Repair and Regeneration, 11(Suppl. 1), S1–S28. https://doi.org/10.1046/j.1524-475X.11.s2.1.x

Silva, L. M., & colaboradores. (2024). Efeitos sinérgicos da fotobiomodulação associada ao óleo de Helianthus annuus na regeneração tecidual: Estudo experimental e clínico. Photomedicine & Tissue Repair, 5(1), 22–33.

Silva, R. F., Oliveira, P. S., & Souza, M. T. (2023). Photobiomodulation and inflammatory modulation in wound healing. Revista de Enfermagem e Saúde, 12(2), 145–158.

Silveira, I. A., & colaboradores. (2013a). Avaliação de feridas: Importância da mensuração padronizada na prática clínica. Revista de Enfermagem da UFSM, 3(1), 92–100.

Silveira, I. A., & colaboradores. (2013b). Avaliação sistematizada de feridas: Impacto na qualidade da assistência. Revista Brasileira de Enfermagem, 66(4), 557–563.

Silveira, S. L. P., & colaboradores. (2013). Pressure ulcers assessment through the Pressure Ulcer Scale for Healing Application (PUSH). Revista de Pesquisa Cuidado é Fundamental Online, 5(2), 38–47. https://doi.org/10.9789/2175-5361.2013v5n2p38

Sociedade Brasileira de Estomaterapia. (2022). Práticas recomendadas para o cuidado com feridas: Prevenção e tratamento. https://sobest.com.br

Taha, A., & colaboradores. (2024). The effects of low-level laser therapy on wound healing and pain: A systematic review and meta-analysis. Lasers in Medical Science, 39, Article 45. https://doi.org/10.1007/s10103-024-03987-2

Weber, B., Marquart, E., Deinsberger, J., Tzaneva, S., & Böhler, K. (2022). Comparative analysis of endovenous laser ablation versus ultrasound-guided foam sclerotherapy for the treatment of venous leg ulcers. Dermatologic Therapy, 35(4), Article e15322. https://doi.org/10.1111/dth.15322