

Effects Of The Use Of Photobio-modulation In The Treatment Of Chronic Diabetic Foot Ulcers: A Case Study

Efeitos do Uso da Fotobiomodulação no Tratamento de Úlcera Crônica no Pé Diabético: Um Estudo de Caso

Efectos del Uso de la Fotobiomodulación en el Tratamiento de la Úlcera Crónica del Pie Diabético: Un Estudio de Caso

RESUMO

Objetivo: O diabetes mellitus (DM) é uma doença crônica global com alto impacto na saúde pública, cujas complicações incluem feridas crônicas do pé diabético (FCPD), associadas ao risco de amputação e altos custos para pacientes e sistemas de saúde. A fotobiomodulação, também conhecida como terapia a laser de baixa potência, tem se destacado como intervenção complementar para acelerar a cicatrização dessas lesões, atuando na rotina celular, síntese de colágeno, angiogênese e modulação inflamatória. **Método:** Este estudo apresenta um relato de caso clínico de uma paciente com úlcera crônica no hálux direito, submetida ao tratamento padrão associado à fotobiomodulação (laser 630 nm, 100 mW, 2 J/cm² por ponto), duas vezes por semana, por seis semanas. A avaliação utilizou instrumentos validados como a Classificação de Wagner, a Escala PUSH para cicatrização e a Escala Visual Analógica (EVA) para dor, além de avaliação fotográfica. **Resultados:** Os resultados mostraram redução progressiva da área da ferida (de 3,75 cm² a cicatrização completa) e do índice PUSH (7 para 0), acompanhados de redução da dor (EVA de 6 a 0). A aplicação da fotobiomodulação apresentou efeitos positivos visíveis na cicatrização e melhoria da qualidade de vida, confirmando evidências da literatura sobre sua eficácia no tratamento de feridas diabéticas.

Conclusão: Conclui-se que a fotobiomodulação pode ser uma opção promissora e segura como recurso terapêutico complementar em feridas crônicas do pé diabético, acelerando a cicatrização e impedindo a dor, reforçando a necessidade de protocolos padronizados e pesquisas ampliadas para validação definitiva.

DESCRIPTORIOS: Diabetes mellitus; Pé diabético; Terapia com Luz de Baixa Intensidade; Cicatrização.

ABSTRACT

Objective: Diabetes mellitus (DM) is a global chronic disease with a major impact on public health, and its complications include chronic diabetic foot ulcers (CDFUs), which are associated with a high risk of amputation and significant costs for patients and healthcare systems. Photobiomodulation, also known as low-level laser therapy, has emerged as a complementary intervention to accelerate the healing of these lesions by acting on cellular activity, collagen synthesis, angiogenesis, and inflammatory modulation. **Method:** This study presents a clinical case report of a patient with a chronic ulcer on the right hallux who underwent standard treatment associated with photobiomodulation (630 nm laser, 100 mW, 2 J/cm² per point), applied twice a week for six weeks. The evaluation used validated instruments such as the Wagner Classification, the PUSH Tool for wound healing, and the Visual Analog Scale (VAS) for pain, in addition to photographic assessment. **Results:** The results showed a progressive reduction in wound area (from 3.75 cm² to complete healing) and in the PUSH score (from 7 to 0), accompanied by a decrease in pain (VAS from 6 to 0). The application of photobiomodulation demonstrated clear positive effects on healing and improved the patient's quality of life, supporting existing evidence in the literature regarding its effectiveness in the treatment of diabetic wounds. **Conclusion:** It is concluded that photobiomodulation may be a promising and safe option as a complementary therapeutic resource for chronic diabetic foot wounds, accelerating healing and reducing pain, reinforcing the need for standardized protocols and further research for definitive validation.

DESCRIPTORS: Diabetes mellitus; Diabetic foot; Low-Level Light Therapy; Wound healing.

RESUMEN

Objetivo: La diabetes mellitus (DM) es una enfermedad crónica global con alto impacto en la salud pública, cuyas complicaciones incluyen las heridas crónicas del pie diabético (HCPD), asociadas al riesgo de amputación y a ele-

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vados custos para los pacientes y los sistemas de salud. La fotobiomodulación, también conocida como terapia con láser de baja potencia, se ha destacado como una intervención complementaria para acelerar la cicatrización de estas lesiones, actuando en la actividad celular, la síntesis de colágeno, la angiogénesis y la modulación inflamatoria. **Método:** Este estudio presenta un reporte de caso clínico de una paciente con úlcera crónica en el hallux derecho, sometida al tratamiento estándar asociado a la fotobiomodulación (láser de 630 nm, 100 mW, 2 J/cm² por punto), dos veces por semana, durante seis semanas. La evaluación utilizó instrumentos validados como la Clasificación de Wagner, la escala PUSH para cicatrización y la Escala Visual Analógica (EVA) para el dolor, además de evaluación fotográfica. **RESULTADOS:** Los resultados mostraron una reducción progresiva del área de la herida (de 3,75 cm² hasta la cicatrización completa) y del índice PUSH (de 7 a 0), acompañadas de disminución del dolor (EVA de 6 a 0). La aplicación de la fotobiomodulación presentó efectos positivos visibles en la cicatrización y en la mejora de la calidad de vida, confirmando evidencias de la literatura sobre su eficacia en el tratamiento de heridas diabéticas. **Conclusión:** Se concluye que la fotobiomodulación puede ser una opción prometedora y segura como recurso terapéutico complementario en las heridas crónicas del pie diabético, acelerando la cicatrización y reduciendo el dolor, lo que refuerza la necesidad de protocolos estandarizados y de investigaciones ampliadas para su validación definitiva.

DESCRIPTORES: Diabetes mellitus; Pie diabético; Terapia con luz de baja intensidad; Cicatrización.

RECEIVED: 12/19/2025 APROVADO EM: 01/05/2026

How to cite this article: Rosa TP, Peres GLM, Diniz JS. Effects Of The Use Of Photobio-modulation In The Treatment Of Chronic Diabetic Foot Ulcers: A Case Study. *Saúde Coletiva (Brazilian Edition)* [Internet]. 2026 [cited year month day];17(104):19052-19069. Available from: DOI: 10.36489/saudecoletiva.2026v17i104p19052-19069



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INTRODUCTION

Diabetes mellitus (DM) is a chronic disease characterized by persistent hyperglycemia resulting from dysfunction in insulin production or action, affecting millions of people globally. According to a study by The Lancet, the global prevalence of diabetes in adults increased from 7% to 14% between 1990 and 2022, affecting more than 800 million people today⁽¹⁾. In Brazil, the prevalence of DM was estimated at 9.2%, with regional variations from 6.3% in the North to 12.8% in the Southeast⁽²⁾.

The World Health Organization (WHO) points out that the increase in the prevalence of diabetes is related to

factors such as rapid urbanization, epidemiological changes, physical inactivity, poor diets, obesity, and population aging⁽³⁾. One of the most frequent complications of diabetes is diabetic foot, defined by the *International Working Group on the Diabetic Foot* as a combination of infection, ulceration, and destruction of deep tissues, associated with neurological changes and varying degrees of peripheral arterial disease. According to the International Diabetes Federation, between 9.1 and 26.1 million people with DM develop foot ulcers each year⁽⁴⁾.

It is estimated that the lifetime incidence of foot ulcers among people with diabetes varies between 19% and 34%, with an approximate annual incidence

of 2%. Even after complete closure of the lesion, recurrence rates remain alarming, reaching approximately 40% within one year and 65% within three years, highlighting the chronic and recurrent nature of this condition. These data reinforce that prevention, early diagnosis, and proper management are essential to reduce complications, preserve function, and lower costs resulting from hospitalizations, prolonged treatments, and surgical interventions⁽²⁾.

Photobiomodulation (PBM), especially through low-level laser therapy (LLLT), has been described as a promising adjuvant resource in the treatment of diabetic foot ulcers. Clinical evidence reinforces this potential:

in the meta-analysis by Huang et al. (2021)⁽⁵⁾, which included 13 randomized clinical trials involving 413 participants, LLLT was shown to significantly increase the rate of complete healing, reduce the ulcerated area, and decrease the time required for complete closure of the lesion when compared to conventional treatment. Despite the heterogeneity in the parameters used among the studies analyzed, the authors conclude that LLLT represents an effective intervention in the management of diabetic ulcers, although they recommend

Prevention and proper treatment of diabetic foot lesions are essential. When prevention is not sufficient, a multidisciplinary approach becomes indispensable, in which the physical therapist plays a fundamental role in applying therapeutic interventions. Among these interventions, photobiomodulation stands out, which has shown positive effects on the healing process⁽⁶⁾.

This case report aims to present the application of FBM in a chronic diabetic foot ulcer, investigate the effect of FBM on the healing process of chronic diabetic foot ulcers and its impact on the patient's pain and quality of life, which may represent a complementary resource in the treatment of chronic diabetic wounds.

METHODOLOGY

This study was developed in the form of a clinical case report, observational and descriptive in nature, with a mixed approach (quantitative and qualitative). The research was approved by the Research Ethics Committee of the State University of Minas Gerais (UEMG), with Opinion number: 7.788.124.

The study was conducted at a Basic Health Unit (UBS) in the municipality of Divinópolis, Minas Gerais. H. M. F., a 57-year-old female patient, retired, married, and mother of one child, par-

ticipated in the study. She has had type 2 diabetes mellitus for approximately 10 years and uses insulin continuously for glycemic control. She reports a predominantly sedentary lifestyle, a factor that contributes to a higher risk of metabolic and vascular complications. She has a history of recurrent skin lesions over the last decade, all located on her lower limbs. In several episodes, the wounds healed slowly, requiring prolonged follow-up.

The current episode involves an injury to the right big toe, which, according to the patient's report, was caused by a "foot bug" (*Tunga penetrans*). This is a tiny flea that lodges in the skin, especially in the foot region, causing an infection called tungiasis. This condition causes pain, itching, and inflammation, and can also act as a gateway for other infections when not treated properly. H. M. reports that she tried to remove it, but was unable to remove it completely, which led to local inflammation. The inflammation progressed, resulting in the appearance of the wound. The patient also states that she received two conflicting medical opinions: one doctor recommended amputation of the segment due to the risk of worsening; another suggested suturing the wound (giving stitches) as a way to accelerate closure. The conflicting approaches generated uncertainty and confusion as to the best management. The benefits, risks, and discomforts that could occur were explained to the patient. The volunteer agreed to participate in the study and signed the Free and Informed Consent Form (FICF) – Annex E.

It was emphasized that exposure of the eyes to the beam could cause damage and, therefore, protective eyewear would be mandatory throughout the procedure. The patient was informed that photobiomodulation is safe but could cause a slight increase in local temperature or a tingling sensation. She was instructed to immediately report any adverse effects, which would

be evaluated by those responsible, and if they persisted, treatment would be suspended. It was emphasized that all safety and irradiation protocols would be strictly followed to avoid technical risks.

The patient had been undergoing conventional treatment for three months without success, performed by the nursing team, which included debridement only in the first session. She underwent photobiomodulation treatment in conjunction with standard wound treatment (cleaning, dressings, and home care). In subsequent sessions, care consisted of washing the wound with soap of adequate pH and covering it with sterile gauze. At the same time, after conventional treatment, photobiomodulation was applied, in which the laser tip was positioned directly over each point of the wound, covering its entire contour until the circumference of the lesion was completed. The average application time was approximately 20 minutes per session, following a standardized protocol applied uniformly by the two researchers. To ensure biosafety, the laser tip was previously sterilized and wrapped in plastic film. The patient attended the health unit three times a week, with two sessions dedicated to photobiomodulation and one exclusively to conventional treatment performed by the nursing team.

The treatment was performed twice a week for six consecutive weeks, totaling 12 sessions until complete wound healing. During each session, local hygiene was performed, the laser was applied according to the parameters, and standardized photographic records were taken to monitor progress. The equipment used was a low-power laser from MMOptics, portable model RECOVER, provided by the researchers. In addition, all safety equipment (mask, alcohol gel, and goggles) for laser application was provided by the researchers. The parameters used for the application are described in Table 1.

Table 1: Photobiomodulation parameters

Irradiation parameters - LASER	Value Used
Energy density	2 J/cm ²
Power	100 mW
Wavelength	630 nm
Beam area	3 mm ²
Distance from skin	Direct contact
Time per point	10 seconds

Source: Own work (2025).

Standardized instruments were used to assess the wound and clinical response: Wagner Classification to determine the degree of ulceration, Pressure Ulcer Scale for Healing (PUSH), Visual Analog Scale (VAS) for pain, and photographic records in all sessions. These instruments allowed us to assess the evolution of the healing process and the impact of photobiomodulation.

Wound Assessment

Wagner Classification

The Wagner Classification is a widely used system for assessing the severity of diabetic foot ulcers, assisting in diagnosis, prognosis, and treatment definition. Divided into six grades, this classification ranges from 0 (intact skin, but at risk of ulceration) to 5 (extensive gangrene, often requiring amputation). The system considers the depth of the lesion, the presence of infection, and the extent of tissue necrosis, and is essential for guiding clinical and therapeutic approaches in diabetic patients with foot complications (7, 8).

PUSH Index (Pressure Ulcer Scale For Healing)

The PUSH Index, developed by the *National Pressure Ulcer Advisory Panel (NPUAP)*, is a tool that monitors the healing of pressure ulcers over time. The scale assigns a score from 0 to 17, based on three main criteria: ulcer area (cm²), amount of exudate (none, little, or much), and predominant tissue type (epithelial to sloughy necrosis). This in-

dex allows for an objective assessment of wound progression and treatment effectiveness and is widely used in clinical practice⁽⁸⁾.

Functional Assessment and Quality of Life

Wound image collection with photography

Wound images were collected before the first session, repeated at each laser application, and at the end of the last session. The objective was to macroscopically monitor the evolution of the wound in an illustrative and qualitative manner, detecting possible changes such as necrosis points, exudate characteristics, and lesion area.

SF-36 questionnaire

The SF-36 (Short Form Health Survey – 36 items) is a widely used questionnaire for assessing health-related quality of life, measuring the impact of diseases and treatments on individuals' daily lives. It consists of 36 questions, divided into eight domains: functional capacity, physical aspects, pain, general health, vitality, social aspects, emotional aspects, and mental health. Each domain is scored from 0 to 100, with higher scores indicating better quality of life. Applied in various areas of health, the SF-36 is useful for monitoring patients with chronic diseases, such as diabetic foot ulcers, as well as assessing the effectiveness of treatments such as FBM, allowing a detailed analysis of patients' physical and emotional well-being and assisting in therapeutic decision-making⁽⁸⁾.

Visual Analog Scale (VAS)

The Visual Analog Scale (VAS) is a widely used tool for quantifying pain intensity and other subjective perceptions, such as fatigue and discomfort. It consists of a 10 cm straight line, where one end represents "no pain" (0) and the other "unbearable pain" ⁽¹⁰⁾, allowing the patient to mark the point corresponding to their perception of pain. The VAS is categorized into mild pain (1-3 cm), moderate pain (4-6 cm), and severe pain (7-10 cm), and is used in clinical settings to monitor the effectiveness of analgesic treatments, physical therapy rehabilitation, and scientific studies. Its use is especially relevant in assessing pain in patients with diabetic foot ulcers, in addition to enabling the measurement of response to therapies such as FBM⁽⁸⁾.

Clinical monitoring

Throughout the follow-up period, clinical monitoring of the wound was performed, including visual inspection, analysis of the amount and appearance of exudate, signs of infection, and photographic documentation. The data were recorded on standardized clinical follow-up forms.

RESULTS

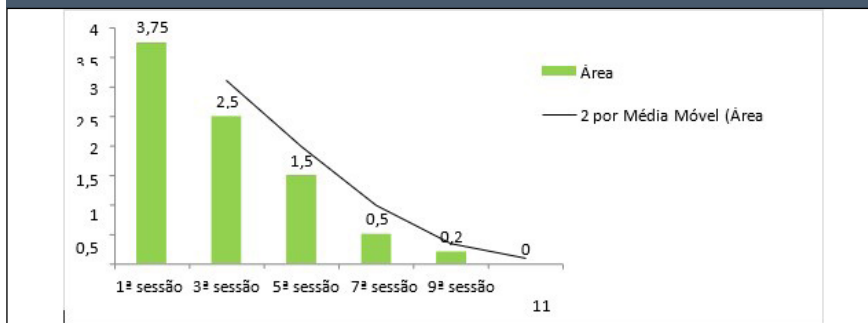
Quantitative results

The initial area was calculated based on the measurements recorded in the medical record (2.5 cm × 1.5 cm = 3.75 cm²) on August 4, 2025. The initial PUSH score recorded was 7/17. The other measurements of area, PUSH, and VAS (pain) were quantified in this analysis based on the clinical descriptions and sequential images present in the progress report. When there was no explicit numerical measurement in the medical records, the values were conservatively estimated based on the clinical descriptions. Table 2 shows the values used for weekly analysis and graph construction.

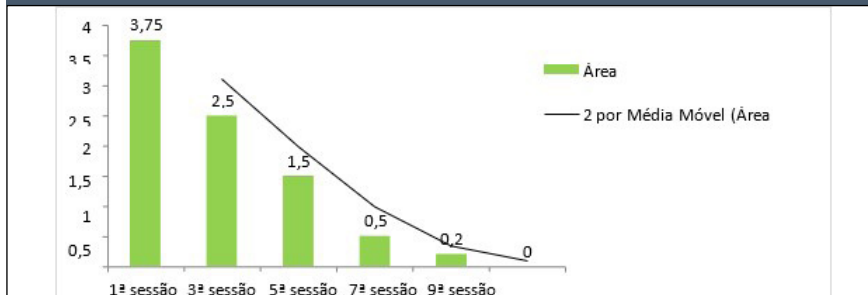
Table 2 - Indices evaluated in each laser session.

Session/Date	Area (cm ²)	PUSH index (0–17)	Pain VAS (0–10)
1st session (08/11/2025)	3.75	7	6
3rd session (08/25/2025)	2.50	5	4
5th session (09/01/2025)	1.5	3	2
7th session (09/08/2025)	0.5	1	1
9th session (09/15/2025)	0.20	1	0.5
11th session (09/22/2025)	0.00	0	0.0

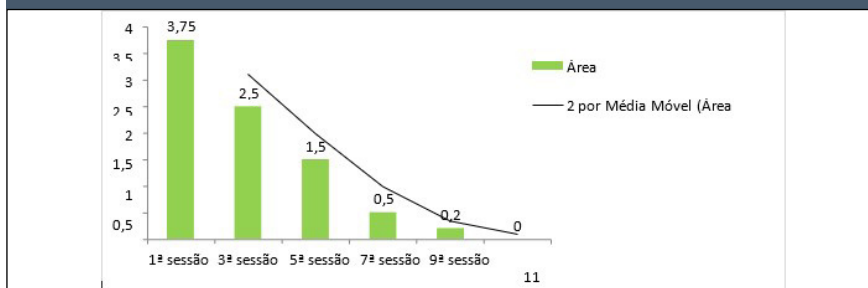
Fonte: Autoria própria (2025).

Figure 1 – Evolution of wound area (cm²).

Source: Own work (2025).

Figure 2 – Evolution of the PUSH index (0–17).

Source: Own work (2025).

Figure 3 – Pain evolution (VAS 0–10).

Source: Own work (2025).

The results obtained throughout the therapeutic protocol demonstrate significant and continuous clinical improvement of the plantar ulcer located on the right big toe, showing structural, functional, and symptomatic changes over the six weeks of follow-up. Weekly, on Mondays, the variables cm², VAS, and PUSH were evaluated. It was decided not to perform the reassessment on Wednesdays due to the short interval between sessions, which made it impossible to observe significant clinical changes. Thus, the measurements recorded on Mondays more reliably reflected the evolution of the condition and the response to treatment. The choice of this follow-up method ensured greater data reliability, allowing for consistent analysis of wound progression throughout treatment. The quantitative, qualitative, and descriptive data on scar progression are presented below, as well as an objective analysis of each instrument used.

In the initial assessment of the wound, performed on August 11, 2025, a chronic ulcer was found, approximately three months old, located in the distal and medial region of the right big toe. The clinical characteristics indicated a lesion approximately 2.5 to 3 cm long by 1 to 1.5 cm wide, with a total area of about 3.75 cm², presenting an elongated, irregular shape with raised, thickened, and partially detached edges. The wound bed presented bright red granulation tissue, present in about 70% of the area, associated with approximately 30% yellowish fibrin and discrete points of adhered superficial necrosis. The exudate was moderate, serosanguineous in color, with a moderate to strong odor. The perilesional skin was hyperemic, slightly desquamative, without pustules or vesicles, while the patient reported stabbing pain and a burning sensation, characteristics compatible with neuropathic pain and peripheral vascular dysfunction.

In addition, significant edema was observed in both feet, with a purplish, shiny, and tense appearance, indicating

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a full-thickness wound, consistent with a chronic neuropathic or ischemic ulcer with a moderate risk of worsening without adequate intervention. During the sessions, the patient also reported having been previously advised to undergo surgical procedures, including hallux amputation or other procedures.

According to the literature, chronic ulcers may present different characteristics depending on their etiology, such as irregular location, raised edges, granulation tissue, and fibrin, as well as signs of vascular dysfunction. The initial assessment also included the classification of wound severity using specific instruments, such as the PUSH index, which scored a total of 7 points, indicating an active granulation phase with barriers to healing (Wagner classification identified the wound as Grade 2), deep, reaching the subcutaneous tissue, without bone exposure or systemic signs of infection.

Weekly clinical evolution showed progressive improvement. In the first week, the wound presented with an extensive inflammatory halo, moderate seropurulent exudate, hardened and irregular edges, with a mixed bed of initial granulation and adhered fibrin, in addition to moderate pain intensity (VAS 3/10). After interventions such as cleaning with saline solution, conservative debridement, photobiomodulation (630 nm, 100 mW, 2 J/cm², 10 seconds per point), and occlusive dressing, a significant reduction in the condition was observed in the second week, with a decrease in hyperemia, exudate, and improved perfusion noted by a pinker color. In the following weeks, there was continuous improvement, with a reduction in the ulcer area, predominance of healthy granulation tissue, absence of pain at rest, and decreased edema, culminating in complete healing at the last evaluation, with an area of 0.00 cm², absence of pain, complete epithelialization, and no signs of residual inflammation, as shown in Figure 4.

The quantitative comparison be-

tween the initial SF-36 assessment (open wound) and the final assessment (closed wound) shows an overall and

consistent improvement in quality of life in all domains assessed (Table 3).

Table 3 – Comparison of initial and final scores on the SF-36 questionnaire

Domain	Initial assessment	Final assessment	Variation (%)
Functional capacity	5.0	70	+1300
Physical aspects	0.0	25.0	+25.0
Emotional Aspects	0	33	+33.3
Vitality	55	85.0	+54.5
Mental Health	64	80.0	+25
Social Aspects	25	50	+100
Pain	32.5	77.5	+138.5
Overall Health	50	55	+10

Source: Own work (2025).

QUALITATIVE RESULTS

Qualitatively, the analysis of the second SF-36 demonstrates an overall and consistent improvement in quality of life after wound closure, reflecting positive changes in both physical and emotional and social domains. Compared to the initial assessment, there was a significant reduction in functional limitations and the impact of pain on daily performance, which is consistent with the healing process and the reduction of discomfort associated with the wound.

Items related to functional capacity showed better performance, indicating greater ease in performing light and moderate physical activities. This suggests progressive recovery of mobility, reduced movement restriction, and improved overall physical performance. The domain of limitation due to physical aspects, which previously showed significant disability, now points to less interference of the clinical condition in usual activities, which reinforces functional recovery.

There was also a noticeable improvement in the “Pain” domain. Pain ceased to be a limiting factor and became less intense and less disruptive

to daily activities. This evolution is expected after wound closure and is consistent with evidence that tissue healing reduces sensitivity, inflammation, and chronic discomfort.

The domains of “*Vitality and Mental Health*” showed improvement, indicating increased energy, reduced fatigue, and improved emotional state. This pattern is often observed in patients who have spent long periods living with pain, motor limitation, or tissue impairment and experience relief after the condition is resolved.

“*Social Aspects*” also showed significant improvement, evidencing a resumption of social participation, interactions, and social activities. This result reinforces the idea that pain and physical limitations had negatively impacted social interaction and that, with recovery, there was a progressive return to normal activities.

Finally, scores for emotional limitations show significant improvement, indicating that negative emotional states (such as worry, frustration, or compromised self-image) began to interfere less with daily routines after the wound closed.

PHOTOGRAPHIC DOCUMENTATION

Figure 4: Treatment progress, images from the first (A) to the last session (B).



Figure 5: Post-treatment, image taken 1 month after the last session.



DISCUSSION

The pathophysiology of diabetic foot ulcers is widely recognized as the result of multifactorial interaction between peripheral neuropathy, vascular insufficiency, and immunoin-

flammatory dysfunction. This set of changes comprises the chronic and difficult-to-heal environment characteristic of these patients. The Guidelines of the Brazilian Society of Angiology and Vascular Surgery⁽⁹⁾ describe that diabetes compromises both microcir-

ulation and inflammatory response, reducing tissue oxygenation, repair capacity, and resistance to infections.

The initial findings in this case, which are burning pain, significant edema, purplish discoloration, moderate exudate, and the presence of devitalized tissue, accurately reflect the typical pathophysiological picture of an inflammatory process. As pointed out in recent reviews, it is emphasized that dysregulated inflammation and reduced perfusion are determining factors in the chronicity of these lesions^(10,11).

FBM emerges as an intervention capable of modulating cellular processes essential for tissue repair. Its mechanism of action is based on the absorption of light by intracellular chromophores, especially cytochrome-c oxidase in the mitochondrial respiratory chain. This interaction triggers increased energy production, metabolic activation, and stimulation of cell proliferation. These events are extensively described by Kaviani et al. (2011)⁽¹²⁾ and Veras et al. (2022)⁽¹³⁾. The combination of these photochemical responses contributes to accelerating the stages of granula-

tion, epithelialization, and remodeling, precisely the phases most compromised in diabetic wounds.

In addition to mitochondrial activation, FBM exerts fundamental angiogenic effects on ischemic wounds. Studies demonstrate increased VEGF expression and new capillary formation after therapy, resulting in significant improvement in tissue perfusion. In the present case, this action manifested clinically in a change in the color of the wound, from purplish and poorly perfused to pink and well vascularized, and in the rapid filling of the lesion with live granulation tissue^(12, 14).

Another essential point is the influence of FBM on the proliferative phase of healing. Kajagar et al. (2012)⁽¹⁵⁾ show that the therapy stimulates the migration and activity of fibroblasts and keratinocytes, promoting more efficient wound closure and proper organization of the edges. This effect was clearly observed in this study, in which the wound evolved from an irregular and deep pattern to regular margins, homogeneous tissue, and rapid reduction of the ulcerated area, with epithelialization already evident between the third and fourth week.

The findings of this clinical case consistently converge with the available evidence on the use of FBM in diabetic ulcers. Kaviani et al. (2011)⁽¹²⁾ point to a significant acceleration in healing when FBM is combined with conventional care, a result similar to that observed here, where there was early reduction in exudate, visible improvement in granulation, and progressive decrease in depth. Similarly, Kajagar et al. (2012)⁽¹⁵⁾ report a significant decrease in the ulcerated area and shorter average healing time in patients treated with laser, a finding that closely resembles the evolution of this case, in which advanced epithelialization occurred between the third and fourth week.

National studies by Porto Feitosa et al.^(14, 16) also corroborate the results

found, demonstrating that FBM not only accelerates wound closure but also improves the quality of repaired tissue, with greater collagen organization and a lower probability of hypertrophic scars. These aspects were observed in the present case, whose final healing presented uniform coloration, complete epithelialization, and absence of fragile areas, indicating adequate structural repair and lower risk of recurrence.

It should be noted that, during the course of the injury, the patient received two medical recommendations: amputation of the hallux and suture. These procedures could have significant and permanent functional impacts. The literature describes that the hallux plays a fundamental role in the biomechanics of gait, especially during the propulsion phase, being responsible for approximately 40 to 60% of the load transmitted to the forefoot at the moment of push-off⁽¹⁷⁾.

Amputation of the hallux is associated with changes in gait pattern, reduced speed, decreased stability, increased energy expenditure, and increased risk of falls, as well as compensatory overload on other joints of the lower limb. These changes directly affect the individual's functionality and autonomy, negatively impacting their quality of life. In this context, the favorable clinical evolution obtained through conservative treatment associated with photobiomodulation highlights the importance of preserving the hallux, not only for tissue healing, but also for maintaining functional gait, independence in activities of daily living, and overall improvement in the domains assessed by the SF-36 questionnaire^(18, 19).

Thus, when analyzing the observed clinical evolution and the available scientific evidence^(14, 15, 20) together, it is clear that the results obtained reinforce the role of FBM as an effective, safe, and biologically based intervention in the management of diabetic

foot ulcers. Complete healing in six weeks, accompanied by significant improvement in pain, tissue, and perfusion parameters, confirms that FBM stands out as a valuable strategy for optimizing the treatment of these complex lesions.

CONCLUSION

At the beginning of treatment, the patient had significant functional impairment, requiring assistance to perform all activities of daily living, including personal hygiene, household chores, and walking short distances. She attended the health center with the affected limb protected by a plastic bag, without wearing shoes, highlighting the significant impact of the injury on her functionality and autonomy. Throughout the follow-up, progressive improvement in her functional status was observed, reflected in the gradual resumption of these activities and greater independence of the patient. Corroborating these clinical findings, the results of the SF-36 questionnaire showed improvement in all domains, indicating not only physical progress but also benefits in emotional and social aspects and in the overall perception of quality of life, reinforcing the effectiveness of the treatment instituted.

In the case presented, FBM was associated with complete healing of the ulcer in about six weeks, accompanied by a progressive reduction in the PUSH score and pain. Although the limitations inherent in the case study design prevent broad generalizations, the results observed are consistent with the available evidence on the use of FBM in the management of diabetic foot ulcers, reinforcing its therapeutic potential and the need for more robust clinical investigations.

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