

**Ozone therapy in the healing of chronic wounds of the lower limbs: a case series***Ozonoterapia en la cicatrización de heridas crónicas de miembros inferiores: serie de casos**A ozonioterapia na cicatrização de feridas crônicas de membros inferiores: uma série de casos***Camila Mendonça de Moraes<sup>1</sup>**

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Armada de Oliveira**Submission:** 03-10-2022**Approval:** 04-06-2022**Abstract**

The aim was to carry out a descriptive report of a series of clinical cases on the effects of using ozone therapy as an adjuvant in the healing process of chronic wounds in adult patients undergoing outpatient treatment with a nursing professional. This is an experience report of a series of clinical cases that took place in a city in the State of Minas Gerais between March 2020 and July 2021. During the data collection period, 52 patients were treated in that office. Of these, 03 adult patients with lower limb wounds were selected to describe and report the cases and who agreed to participate in the study. The 03 patients analyzed were female, one was 82 years old, one was 58 years old and one was 30 years old. The type of lesions was 1 (33.3%) arterial lesion, 1 (33.3%) venous lesion with erysipelas, 1 (33.3%) necrotizing fasciitis. Ozone applied to skin lesions can favor the healing process, especially if associated with clinical care by a qualified professional with expertise in wound care; however, more studies that are robust are needed.

**Descriptors:** Ozone Therapy; Wounds and Injuries; Healing; Wound Closure Techniques; Complementary Therapies.**Resumen**

El objetivo fue realizar un reporte descriptivo de una serie de casos clínicos sobre los efectos del uso de la ozonoterapia como coadyuvante en el proceso de cicatrización de heridas crónicas en pacientes adultos en tratamiento ambulatorio con un profesional de Enfermería. Este es un relato de experiencia de una serie de casos clínicos que ocurrieron en una ciudad del Estado de Minas Gerais entre marzo de 2020 y julio de 2021. Durante el período de recolección de datos, 52 pacientes fueron atendidos en ese consultorio. De estos, se seleccionaron 03 pacientes adultos con heridas en miembros inferiores para describir y reportar los casos y que aceptaron participar en el estudio. Los 03 pacientes analizados eran del sexo femenino, uno de 82 años, otro de 58 años y otro de 30 años. El tipo de lesiones fue: 1 (33,3%) lesión arterial, 1 (33,3%) lesión venosa con erisipela, 1 (33,3%) fascitis necrosante. El ozono aplicado a las lesiones de la piel puede favorecer el proceso de curación, especialmente si se asocia con la atención clínica de un profesional calificado con experiencia en el cuidado de heridas, sin embargo, se necesitan estudios más sólidos.

**Descriptoros:** Terapia de Ozono; Heridas y Lesiones; Cicatrización; Técnicas de Cierre de Heridas; Terapias Complementarias.**Resumo**

Objetivou-se realizar o relato descritivo de uma série de casos clínicos sobre os efeitos da utilização da Ozonioterapia como adjuvante no processo de cicatrização de feridas crônicas em pacientes adultos que realizam tratamento ambulatorial com profissional de Enfermagem. Trata-se de um relato de experiência de uma série de casos clínicos ocorrida em uma cidade do Estado de Minas Gerais entre março de 2020 e julho de 2021. No período de coleta de dados, foram atendidos 52 pacientes no referido consultório. Destes foram selecionados 03 pacientes adultos, portadores de feridas de membros inferiores, para realizar a descrição e o relato dos casos e que aceitaram a participar do estudo. Os 03 pacientes analisados eram do gênero feminino, uma paciente com 82 anos, uma com 58 anos e uma paciente, com 30 anos. O tipo das lesões foi: 1(33,3%) lesão arterial, 1 (33,3%) lesão venosa com erisipela, 1 (33,3%) fascite necrosante. O ozônio aplicado em lesões cutâneas pode favorecer o processo de cicatrização, especialmente se associado ao cuidado clínico por profissional habilitado e com expertise no tratamento de feridas, contudo estudos mais robustos são necessários.

**Descriptoros:** Ozonioterapia; Ferimentos e Lesões; Cicatrização; Técnicas de Fechamento de Ferimentos; Terapias Complementares.

## Introduction

Chronic wounds significantly burden the health system and negatively and progressively affect the lives of patients with them, reaching 3.33% of the population worldwide. The prevalence of chronic wounds in the lower limbs is growing every day, and many patients live with the problem for several years. Ozone therapy has been proposed as an adjuvant treatment for the treatment of chronic wounds, potentially acting on tissue healing, avoiding oxidative stress and promoting bactericidal and fungicidal action<sup>1-3</sup>.

Chronic wounds are defined as any break in the skin that needs a period of time to heal greater than 3 months<sup>4,5</sup>.

Wound healing involves a reparative process that includes the following phases: inflammatory, angiogenesis (proliferative), matrix deposition (collagen synthesis) and epithelialization. Each wound has a healing time that involves several factors, including wound type (vascular insufficiency, arterial insufficiency, neuropathy, rheumatoid arthritis, diabetes, tumors, chronic osteomyelitis, trauma, burns, hematological diseases, infection, pressure, etc.); patient's clinical conditions (age, comorbidities); patient hygiene conditions; type of treatment; financial condition, among others<sup>5</sup>.

The Nurse is the professional who interacts day by day with patients with lesions, and they are healthy references with regard to the clinical evolution of different types of patients and their respective skin lesions. In this sense, this profession advances every day in the health area, in the development of studies that can support its practices and guarantee high quality care that is accessible to most patients.

Normative Opinion No. 001/2020 of the Federal Nursing Council regulates Ozone Therapy as a Nurse's practice in Brazil and guarantees the Ozone Therapist Nurse as capable of acting and prescribing a Nursing intervention care plan to promote a better quality of life and safety of care provided<sup>3</sup>.

Ozone is a gas composed of 3 oxygen atoms with a cyclic structure, it was initially discovered as an oxidant and disinfectant in 1834, exerting an important effect in the treatment of amputations in soldiers during the First World War. Since then, numerous researchers have studied the effects of ozone in the treatment of skin wounds, among other conditions, with satisfactory improvement in healing results<sup>1,3,7,8</sup>.

Ozone, being a potent oxidant, improves blood oxygenation, the flexibility of erythrocytes is increased, facilitating their passage through the capillaries, ensuring a better supply of tissue oxygen, reducing platelet adhesion, acting as an analgesic, anti-inflammatory and stimulant of the granulation tissue growth system, and when in contact with organic fluids, it promotes the formation of reactive oxygen molecules, improving blood flow, which influence biochemical events of cellular metabolism, which provides benefits to tissue repair, facilitating the epithelial tissue growth, inhibits bacterial growth, in addition to the antimicrobial effect<sup>8,9</sup>.

Ozone applied to skin lesions can favor the healing process, especially if associated with clinical care by a qualified professional with expertise in wound care. In this sense, several study groups around the world have provided evidence that recommends its use<sup>1-8</sup>.

A systematic review with meta-analysis, gathered 9 studies with a total of 453 patients and pointed out significant improvement in wound closure with the advent of ozone therapy, and compared with conventional care, ozone therapy as an advanced treatment of wound care can improve the proportion of chronic wounds that heal in a shorter amount of time<sup>8</sup>.

Preliminary results of another meta-analysis in progress, whose primary outcome is the proportion of participants with completely healed wounds and as secondary outcomes the incidence of adverse events, amputation, quality of life, length of hospital stay and cost, with a detailed description of its systematization suggests a growing body of evidence related to the theme with successful results<sup>1</sup>.

Other research indicates that the treatment of chronic wounds with ozone therapy can be clinically valid and financially economical, however, new studies, better designed and in new contexts are needed to reinforce the existing evidence on the subject.

In Brazil, ozone therapy has been gaining strength exponentially in several professions. The Brazilian Association of Ozone Therapy (ABOZ) created in 2011 in Brazil, enables the development of research related to the various applications of ozone therapy, including by nurses who work in the treatment of wounds. In the meantime, there is little clinical evidence in our country, considering the specificities of our population on the implication of the use of Ozone in the treatment of chronic wounds as an adjuvant therapy in the care process of the Nurse who works in the wound healing process.

Thus, we started the development of this study, in order to serve as a basis for conducting studies with a more robust design. The present research also aims to contribute to the improvement of the clinical practice of nursing professionals and others who contribute to the care of patients with chronic wounds.

The objective of this study is to carry out a descriptive report of a series of clinical cases on the effects of using ozone therapy as an adjuvant in the healing process of chronic wounds in adult patients undergoing outpatient treatment with a Nursing professional.

## Methodology

This study is an experience report of a series of clinical cases.

The studies that characterize a "case series" consist of the careful and detailed description, by one or more specialist professionals, of the diagnosis and evolution of the disease in a small number of patients. It is the most basic type of clinical study and has a long tradition in medicine. This type of study serves to elucidate the mechanisms of diseases and treatments, from highly detailed and methodologically sophisticated clinical and laboratory



studies of a patient or a small group of patients. They are of good quality if based on a set of cases, where there is uniformity of treatment<sup>10,11</sup>.

Studies of a series of cases do not provide information for comparison between treatments; however, they can be seen as the first link in a chain of evidence to be obtained. Opinions on etiology, prevention and therapy, often found in the conclusions of these articles, should be seen as the first link in a chain of evidence to be obtained<sup>12,13</sup>.

The population of this study comprises adult patients, seen at a Nursing Office and followed up for outpatient treatment, for the care and treatment of chronic wounds of the lower limbs.

The Nursing office in which the study was developed is located in a city in the southern region of Minas Gerais, and consists of a reception room, an evaluation and care room and an area for reprocessing materials. The consultations were carried out by a nurse qualified to practice and prescribe Ozone Therapy and with expertise in the treatment of patients with injuries and chronic and degenerative diseases.

Patients were followed up and their cases were described in detail from the first day of follow-up until complete wound healing.

The included patients signed the Free and Informed Consent Term confirming their agreement to participate, and they were free to withdraw from participation at any time, without prejudice to their treatment, thus being excluded from the study.

Data were collected in the Wound Patient Care Form, which continues data on patient characterization, description of wound characteristics (intralesional and extralesional tissue, wound size, presence of exudate), type of treatment clinical, and coverage, adverse events, and patient-specific reports.

Data collection took place between March 2020 and July 2021.

All patients were treated according to the stage of healing and the need for wound care, and in all care sessions a Bag (sealed latex-free plastic bag) with a mixture of oxygen-ozone gases at a concentration of 60mcg was used,

with a time of 20 minutes every 48 hours or according to the specificity and need of each patient.

Cases were described according to data from the first consultation and subsequent evolution until complete wound closure.

The present study complied with the ethical-scientific precepts of Resolution No. 466 of December 12, 2012 for research involving human beings, is included in the scope of studies developed by ABOZ, and registered in the Plataforma Brasil for evaluation by the National Committee on Ethics and Research (CONEP).

### Experience Report

During the data collection period, 52 patients were seen in the aforementioned office. Of these, 03 adult patients with lower limb wounds were selected to describe and report the cases and who agreed to participate in the study.

The 03 patients analyzed were female, one was 82 years old, one was 58 years old and one was 30 years old. The type of lesions was 01 (33.3%) arterial lesion, 01 (33.3%) venous lesion with erysipelas, 01 (33.3%) necrotizing fasciitis. All injuries were chronic with a time of existence that ranged from 01 to 12 years and are described below.

### Case 1

Female patient, 58 years old, with rheumatoid arthritis and venous insufficiency, with chronic venous lesions, sequelae of erysipelas infection, in right leg for 12 years. She performed home care, after numerous attempts at specialized care without improvement. The skin of the entire limb was very fragile, because of contact with the moist wound exudate, the swollen limb and with a 2+/4+ locker. Patient reported pain when standing for long periods, which made his job as a clerk unfeasible.

At the first evaluation, on September 23, 2020, the lesions located in the middle third, anterior face of the right leg, presented thick yellowish devitalized tissue (dry slough and fibrin) and well adhered, dimensions respectively 1.5 x 1.5 cm and 7 .0 x 5.0 x 0.4cm in depth.

Figure 1. Sequence of photos of the evolution of the treatment of Case 1. Guaxupé, MG, Brazil, 2021





Treatment: Cleaning with warm water and degerming chlorhexidine, mechanical debridement of adhered slough + Bag O3 60mcg for 20 min 3 times a week. The coverages varied according to the need for wound care, ozonized oil 600ppm was used in the periwound region and throughout the limb.

In the first month of treatment, the skin characteristic of the entire limb was much better, hydrated and shiny. Wound care involved mechanical debridement by the professional until all devitalized tissue was eliminated. It was observed great ease of removal of slough and the total elimination of biofilm. The wound was 0.4 cm deep and the tissue restructuring increased the healing period. However, each week it was observed a decrease of up to 0.5 cm<sup>2</sup> in the area of the largest wound. The complete treatment ended on December 11, 2020, with a total duration of 3 and half months (Figure 1).

### Case 2

Female patient, 82 years old, with a chronic lesion with arterial involvement, located in the lower lateral third of the left leg.

The patient had undergone several types of treatments without success for 5 years and stopped performing her activities of daily living due to severe pain.

At the first evaluation on April 26, 2021, the patient reported extreme pain, especially when elevating the limb. Wound measuring 11 cm x 9.0 cm, with biofilm and soft tissue adhered, pale and sensitive perilesional tissue in the external malleolar region of the left foot.

Treatment: Cleaning was performed with warm water and degerming chlorhexidine, careful mechanical debridement of slough + Bag O3 60mcg for 20 min 3 times a week. Coverages varied according to the need for wound care and healing phase.

Week-to-week evolution showed clear improvement in wound tissue size and characteristics, elimination of biofilm and slough, progressive decrease in pain and growth of granulation tissue and subsequent epithelialization. The complete treatment ended on August 26, 2021, with a total duration of 4 months until wound closure, patient without pain, with return to usual activities (Figure 2).

Figure 2. Sequence of photos of the evolution of the treatment of Case 2. Guaxupé, MG, Brazil, 2021



FONTE: Fotos de acervo pessoal com autorização da paciente.

### Case 3

A 28-year-old female patient with lupus erythematosus presented with a chronic lesion resulting from necrotizing fasciitis secondary to a surgical procedure for closure after trauma from a car accident, corrected with

surgery on the right foot. After the 1st surgery, there was necrosis of the sutured tissue that led to the 2nd surgery for surgical debridement.

Figure 3. Sequence of photos of the evolution of the treatment of Case 3. Guaxupé, MG, Brazil, 2021



FONTE: Fotos de acervo pessoal com autorização da paciente.



After the 2nd surgery there was no continuity of professional treatment, the patient treated the lesion at home for more than a year and a half, with progressive worsening of pain, odor, edema and exudate, to the point that she was unable to move around in such pain.

At the first evaluation, 4+/4+ foot edema, hyperemic and sensitive periwound skin, wound with cellulitis, fibrin and granulation points were observed. Patient reported intense pain, making it difficult to care for and clean the wound.

Treatment: Cleaning with warm water and degerming chlorhexidine, mechanical and chemical debridement of fibrin and slough + Bag O3 60mcg for 20 min, once a week.

The coverings varied according to the need for wound care, initially with chemical debridement and later covering to protect the granulation tissue.

The evolution of this patient was spectacular. After the first session, granulation tissue growth was visible. From one session to another, the size of the lesion reduced by half. The treatment took just under 2 months until the lesion was completely closed, and the patient resumed his work activities, without pain and without edema (Figure 3).

## Discussion

Three cases were described in this study, of patients with chronic wounds, submitted to different types of treatment for long periods, without satisfactory evolution and without success.

In all cases, even though wounds with different characteristics, as well as considering the particularity and comorbidities of each patient, the professional who conducted the treatment was able to perceive the decrease in the biofilm of the wounds, the decrease in the report of pain and improvement in color and tissue characteristics, which may have been caused by the pro-oxidative therapy, improving oxygenation, promoting bactericidal action and positively favoring the healing process.

There were no reports of pain or discomfort, or any other intercurrent during the topical use of Ozone in Bag. International systematic reviews have pointed to significant improvement in wound closure with the advent of ozone therapy, and compared with conventional care, ozone therapy as an advanced wound care treatment can improve the proportion of chronic wounds healed in a shorter amount of time<sup>1,8</sup>.

Even considering that Nursing care for patients with chronic wounds is essential, as well as the correct

assessment of the need for the tissue and the adequate choice of coverage to favor the healing process, the use of technology in these cases proved a differential, especially with regard to wound closure time. Clinically, it was possible to observe that the advent of ozone therapy in the patients described favored tissue oxygenation and contributed to better perfusion of granulation tissue and later neo-epithelialization.

The healing time in patients with chronic wounds is a factor that directly interferes with their quality of life. Studies show that the presence of skin lesions has negative effects on well-being, regardless of the place of care, being directly associated with the emotional response to the physiological conditions of health-related aspects, in addition to the stigma of having the lesion, leading them to develop problems related to social isolation<sup>5,14</sup>. The importance of differentiated strategies to reduce the impact caused by clinical factors on wounds is emphasized, since these are aspects that can be mitigated or avoided by health professionals by evaluating the lesion and choosing the appropriate treatment<sup>14,15</sup>.

Other patients treated by the same professional, with the same care in favoring the healing process, did not have such a short healing time without the use of ozone therapy. Especially in cases of lesions with infections or arterial compromise. In these cases, the difference in tissue oxygenation resulting from the pro-oxidative therapy was clinically visible.

Studies of the "Case Series" type (case series) do not provide information for comparison between treatments, however they can be seen as the first link in a chain of evidence to be obtained<sup>12</sup>.

Thus, the purpose of carrying out this study is that it serve as a basis for conducting more robust studies in Brazil, considering the particularities of our population, types of injuries, climate, as well as lifestyles.

## Final Considerations

Ozone applied to skin lesions can favor the healing process, especially if associated with clinical care by a qualified professional with expertise in wound care; however, more studies that are robust are needed.

The present research also aims to contribute to the improvement of the clinical practice of nursing professionals, encouraging the use of ozone therapy as an adjuvant therapy for the care of patients with chronic wounds.

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