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PRACTICAL USE OF OZONE IN WOUND: TREATMENT INTEGRATIVE LITERATURE REVIEW

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Abstract: Ozone therapy has emerged as a promising alternative for treating wounds. The aim of this study was to identify the scientific evidence regarding the efficacy of ozone in wound treatment. The methodology adopted was an integrative review literature, which involved formulating a guiding question, searching databases, applying inclusion and exclusion, criteria critically analyzing the selected studies and presenting the results and discussion. Fifteen articles were selected which revealed that despite variations in methods and dosages, ozone therapy has positive effects on wound healing and stands out as a viable and safe option for the treatment of chronic wounds. However, it suggests that more research is needed to deepen knowledge of its clinical applications and to establish evidence-based treatment protocols. Ozone therapy can thus make a significant contribution to improving healthcare and patients' quality of life.

Keywords: Wounds; Ozone; Ozone therapy.

INTRODUCTION

According to Silva (2012), skin lesions represent a serious public health problem in Brazil, affecting the epidermis and dermis and reaching deeper layers of the skin when there is a loss of skin integrity (Marchesini; Ribeiro, 2020). It is a health challenge that involves factors linked to the patient and the environment in which they live, causing discomfort and contributing to increased costs for the health system and the patient themselves (PAULA *et al.*, 2019).

In addition, due to the challenge that health professionals face when treating wounds and the complexity of the cellular and molecular processes involved in wound healing and the factors that can slow down this process, it is essential to select the most appropriate for the specific characteristics of the wound, considering its dynamic evolution and treatment (DABIRI, DAMSTETTER; PHILLIPS, 2018).

As a result, new therapies are emerging to accelerate the healing process, including ozone therapy, which consists of using a gas composed of three oxygen atoms (O₃). This treatment can be applied alone or in combination with other therapeutic approaches (FITZPATRICK; HOLLAND; VANDERLELIE, 2018).

As such, ozone therapy has stood out in the treatment of wounds, promoting the growth of granulation tissue and tissue repair. In addition to its bactericidal and antiseptic properties, ozone therapy helps to prevent oxidative stress, improve pain, increase tissue vascularization and control glucose levels (BATISTA *et al.*, 2021). According to Schwartz *et al.* (2010, p. 29), "ozone therapy is a valuable method for disinfecting infected wounds as well as in local".

In addition, Federal Senate Bill No. 227/2017 regulates the practice of ozone therapy in Brazil and authorizes its prescription as a complementary treatment within the scope of the Unified Health System (SUS) (BRASIL, 2017). And since 2018, ozone therapy has been recognized as one of the modalities of integrative and complementary health practices, as established by the National Policy for Integrative and Complementary Practices (PNPIC) in the Unified Health System (SUS) (LEMOS, 2018).

In addition, the Federal Nursing Council (COFEN), in 2020, approved the use of ozone therapy by nurses who have at least 120 hours of specialization, per through normative opinion N°001/2020. Nursing has made progress in the field of ozone therapy, achieving positive results especially in cases where conventional treatments have been ineffective.

Therefore, the use of ozone has been shown to be highly effective in the treatment of chronic wounds, ischemic lesions, necrosis and infections, with a positive impact on the disinfection and healing of chronic wounds. Ozone therapy has chemical properties that result in direct (mechanical) and indirect (anti-in-

flammatory), effects promoting greater tissue oxygenation and reducing pain (ANZOLIN; SILVEIRA-KAROSS; BERTOL, 2018; BARBOSA *et al.*, 2020).

Another fact is that according to Ramalho (2017), the use of ozone therapy can reduce the costs of surgery, dressings, medication and consultations, representing a form of financial savings. When it comes to pressure injuries, public health has a lot of expenses, and ozone proves to be highly effective from an economic point of view.

In addition, as pointed out by Kuroda *et al.* (2018), ozone therapy is beneficial to health, as it has almost no side effects and is low cost. This method has been the subject of increasing studies with the aim of contributing to the treatment of complex wounds (LEMOS *et al.*, 2018). Several studies have shown that ozone therapy provides positive results in tissue regeneration. Therefore, this therapeutic approach could be more widely used for the benefit of public health due to its benefits proven (OLIVEIRA *et al.*, 2021).

In Brazil, ozone therapy has been expanding rapidly in various professional areas. The Brazilian Ozone Therapy Association (ABOZ) promotes the development of research into the various applications of ozone therapy, including its use by nurses who treat wounds. However, the clinical evidence available in our country is limited, especially with regard to the particularities of our population and the use of ozone as an adjuvant therapy in the care of chronic wounds by nurses (MORAES; TEIXEIRA, 2022).

In view of this, this study aims to address the issue of the effectiveness of ozone therapy in wounds, in order to elucidate its beneficial importance in the treatment of, to fill the gap related to the effectiveness of ozone therapy in the treatment of wounds, in order wounds-being fundamental to identify the scientific evidence on its application and benefits in the treatment of wounds.

Thus, given that ozone therapy can be a promising alternative for treating wounds, this study was carried out according to the following guiding question: What is the scientific evidence in in the literature on the efficacy of ozone therapy wound ? healing The aim was to identify the scientific evidence regarding the efficacy of ozone in wound treatment based on an integrative review literature.

METHODOLOGY

An integrative literature review was carried out, using a research method for incorporating evidence in health and nursing. According to Mendes *et al.* (2008), this method aims to gather and synthesize research results on a specific theme or issue, in a systematic and orderly manner, contributing to a deeper understanding of the subject under investigation.

The process basically follows six phases: in the first phase, the guiding ; question was elaborated in the second phase, the search in electronic databases; in the third phase, criteria were applied; in the inclusion and exclusion the fourth phase, the critical analysis of the included studies; in the fifth phase, the discussion of the results; in the sixth phase, the presentation of the integrative review (SOUZA, 2010; TEIXEIRA SILVA; CARVALHO *et al.*, 2013).

In Phase 1: As an initial phase, the following question was formulated: What is the evidence scientific in in the literature on the efficacy of ozone therapy wound healing from 2019 to 2024? This question guided the bibliographic search, filtering out articles that were consistent with the object of the study.

Phase 2: The search was carried out in the following electronic databases: *Medical Literature and Retrieval System on Line* (MEDLINE), Latin American and Caribbean Sciences Literature Health (LILACS), Nursing Database (BDENF), all of which are in the Library Virtual Health and the *Scientific Electronic*

Library Online (SciELO). portalBased on the DeCS health terminology from the Virtual Health Library, the following were used in the searchdescriptors : Ozone, wound, Ozone therapy.

In the **3rd Phase**: Inclusion criteria were applied: Complete and available articles that contemplated the theme and objective of the research, which had relevance to the proposed theme of the work between the years 2014 to 2024. And the exclusion criteria: articles that charged a fee to be read and articles that related to other pathologies and not wounds, repeated articles,,publications only with abstracts, reflections reviews.

Stage 4: The articles were selected and analyzed according to the proposed theme. After selecting the indexed, articlesthe material obtained will be evaluated and analyzed to select what is of interest to the researchers, followed by a reading thorough so that important aspects are not missed to enrich the study and preparation of the the final draft of research. **Stage 5:** Discussion of the categories that emerged from the integrative review and **Stage 6:** Presentation of the integrative.review

RESULTS AND DISCUSSION

In Brazil, around 3% of the population has some kind of wound, regardless of gender, age or ethnicity, with chronic wounds being the most common. These injuries represent a significant challenge for health professionals in their clinical practice, as they can cause pain, immobility, disability and cause psychological and emotional changes that affect self-esteem and self-image. In addition, these conditions can result in social changes, such as hospitalization, social isolation and, in many cases, loss of employment (BRITO *et al.*, 2013; OLIVEIRA *et al.*, 2016).

In this scenario, the search for complementary therapies that are economically viable and effective has grown, and ozone therapy stands

out as a therapeutic approach that dates back to the 19th century, using ozone to treat various health conditions. Today, this practice is recognized and approved in several countries. was first used Ozone during gas the First World (BATINJAN War *et al.*, 2014).

Ozone therapy, which uses medical, ozone can be applied alone or in conjunction with other treatments, and is indicated for the management of various pathologies in humans, as well as being used in veterinary medicine. This therapy has been shown to be effective in the treatment of infectious diseases, both acute and chronic, as well as being used in aesthetic and dental procedures, the treatment of burns, psoriasis, shingles and complex lesions such as diabetic foot (SEVERO *et al.*, 2020).

Thus, the importance of the subject made it possible to carry out this integrative review, with the aim of identifying the scientific evidence regarding the efficacy of using ozone to treat wounds based on an integrative literature review. As a result, were 15 articles selected that answered the central question of the research, which are presented in Table 1, according to classification, title, authors/year and objective of the study. In addition, the research covered aspects such as the effectiveness of ozone therapy, factors and parameters related to the use and efficacy of ozone.

With regard to the research design, table 2 shows that three publishedcase reports and 12 literature review articles were. Of the 15 articles analyzed, five investigated the influence of ozone therapy on patients with diabetic foot. wounds

The presence of 12 literature review articles indicates a significant effort to compile and synthesize the existing evidence on ozone therapy. Literature reviews are valuable as they provide a comprehensive overview of the current state of knowledge, identifying gaps and suggesting directions for future research.

The three case reports provide detailed

Classification	Title	Authors/year	Objective
A1	The use of therapy ozone in the treatment of diabetic foot: reviewintegrative	Tanaka <i>et al.</i> (2020)	Evaluate the scientific evidence on national and international literature on the use of ozone therapy as a treatment for patients with diabetic foot, observing the routes of administration, doses and applications used for safe practice and their results.
A2	Influence of ozone therapy on ulcer healing diabetic foot	Mota <i>et al.</i> (2020)	Evaluating the influence of ozone therapy on patients with foot woundsdiabetic
A3	Ozone therapy performed by the Nurse in the immunomodulation of a patient with 'Craurosis vulvar': reportexperience	Melo <i>et al.</i> (2020)	To report the experience of a nurse in applying ozone therapy as a care practice and its contribution to the immunomodulation of a patient with vulvar.craurosis
A4	Effect of ozone therapy on the healing of wounds	Marchesini and Ribeiro (2020)	To verify the effect of ozone therapy on the healing of chronic wounds in patients with diabetes mellitus.
A5	Use of direct ozone ozonized injuriesin a bag and oil for chronic limb lower	Lescura and Bega (2020)	To carry out a literature review on the treatment of chronic wounds on the lower limbs with the use of direct in a ozone bag and oil ozonized, to verify the effectiveness of ozone (O ₃)
A6	Application of ozone therapy in the treatment of lesions of skin in the elderly	Xavier <i>et al.</i> (2021)	To identify in the scientific literature the beneficial effects of ozone therapy for the treatment skin lesions in seniors.
A7	Ozone therapy in the treatment of injuries: a systematic review	Santos <i>et al.</i> (2021)	To analyze the efficacy, safety and effects of ozone therapy in the treatment of injuries, seeking to evaluate effects its palliative therapeutic and.benefits in the field of health.
A8	Action of ozone therapy on foot ulcersdiabetic	Pinheiro and Barbosa (2021)	To investigate the effectiveness of ozone therapy in the treatment of ulcers in patients with diabetes, analyzing its action on the healing of chronic wounds and the reduction of infections.
A9	The use of ozone in wound care: scoping review	Nobre <i>et al.</i> (2021)	Identify the scientific evidence on the use of ozone in the treatment topical of skin in wounds humans
A10	The applicability and benefits of ozone therapy in wound: treatment an integrative review	Targino <i>et al.</i> (2022)	The study seeks to understand the applicability and benefits of ozone therapy in the treatment of wounds, with a focus on scientific evidence Brazilians.
A11	Ozone therapy in the healing of woundschronic limb lower: a seriescase	Moraes and Teixeira (2022)	To carry out a descriptive report of a series of clinical cases on the effects using ozone therapy as an adjuvant in the healing process of chronic wounds in adult patients undergoing outpatient treatment with a nursing professional.
A12	Ozone therapy for complementary ulcer treatment diabetic: a reviewfoot integrative	Miranda <i>et al.</i> (2022)	To analyze knowledge about the use of ozone therapy as a complementary treatment for ulcers diabetic foot.
A13	Ozone therapy as an option for treating skin lesions in humans: a review integrative literature	Lima <i>et al.</i> (2022)	Carry out an integrative review on ozone therapy as a practice complementary in the treatment of injuries in humans, looking for evidence on its effectiveness and applicability.
A14	The use of ozone in surface : an reviewdisinfectionintegrative	Simplicio <i>et al.</i> (2023)	Analyze the scientific evidence regarding the efficacy using ozone for ofdisinfecting surfaces from an reviewintegrative literature.
A15	Ozone therapy in wound healing process	Santos, Santos and Libório-Lago (2024)	Investigating the effects of ozone therapy in the process of regeneration and repair of tissues affected by wounds.

Table 1 - Summary of review articles in descending order according to year of publication

Source: Prepared by the authors (2024)

information on specific clinical experiences and the application of ozone therapy in particular situations. Although case can be useful for illustrating efficacy in individual contexts, they have limitations reports in terms of generalizing results.

The fact that five of the articles evaluated focused on the influence of ozone therapy on patients with diabetic foot wounds is significant, given that this condition is a common concern in clinical practice, especially among diabetic patients. This suggests that ozone therapy may have a potentially important role in this specific context, but also highlights the need for more rigorous studies to validate these findings and establish treatment protocols.

The predominance of reviews and case reports suggests a lack of randomized controlled that can provide more robust evidence on the efficacy studies of ozone therapy. Well-designed clinical trials are crucial to confirm the benefits of ozone therapy and to establish clear guidelines for its use in practice.

Thus, ozone therapy has emerged as a approach to promising treating wounds, especially in challenging clinical contexts such as diabetic foot wounds. With the increasing prevalence of chronic diseases such as diabetes, the search for effective therapies that promote healing and reduce infectious complications is becoming increasingly urgent. In this scenario, ozone therapy stands out for its antimicrobial, anti-inflammatory and healing, which can significantly contribute to patient recovery.

Therefore, the following topics (3.1, 3.2 and 3.3) will address fundamental aspects of ozone therapy in wound treatment. This integrative approach will allow for a more comprehensive the role of ozone therapy in wound management based on the findings of the understanding of articles selected in the study.

THE EFFECTIVENESS OF OZONE IN INHIBITING DIFFERENT MICROORGANISMS IN WOUNDS

In the research by Simplicio *et al.* (2023) ozone (O₃) was shown to be an effective agent in inhibiting a variety of pathogenic microorganisms in wounds. Studies indicate that ozone has bactericidal, fungicidal and virucidal properties and is capable of eliminating pathogens that often complicate wound healing. The integrative review suggests that the application of ozone can result in inhibition rates of over 90% for various microorganisms, which reinforces its potential as a disinfectant in contexts clinical (SIMPLICIO *et al.*, 2023).

In addition, the article by Simplicio *et al.* (2023) mentions several microorganisms that have been combated in studies on the efficacy of ozone. Among the microorganisms mentioned are: Viruses: Hepatitis B (HBV); Influenza A (IAV); Respiratory Syncytial Virus (RSV); SARS-CoV-2 (the virus responsible for COVID-19); and : *Bacteria Escherichia coli*; *Pseudomonas aeruginosa*; *Staphylococcus aureus*; *Salmonella enteritidis*; *Enterococcus faecium*. These microorganisms were used in experiments to evaluate the effectiveness of ozone as a disinfectant on surfaces and in wound, treatment demonstrating its potential for eliminating pathogens.

This is reinforced by Marchesini and Ribeiro (2020) who point out that ozone therapy has antimicrobial properties and is effective in inhibiting various microorganisms, including multidrug-resistant bacteria such as *Pseudomonas aeruginosa*. The application of ozone has shown a significant reduction in the count of colony-forming, units contributing to the disinfection of wounds and promoting an environment favorable to healing (MARCHESINI; RIBEIRO, 2020).

Miranda *et al.* (2022) point out that ozone therapy has significant and is effective in eliminating various types of microorganism-

ms, including antimicrobial properties gram-positive and gram-negative, bacteria such as *Pseudomonas aeruginosa* and *Escherichia coli*. The application of ozone to potentially contaminated and infected wounds helps to reduce the microbial load, promoting a more favorable environment for healing (MIRANDA *et al.*, 2022).

Fungicidal properties have also been cited. Mota *et al.* (2020) reports that ozone has bactericidal and fungicidal properties and is effective in disinfecting infected wounds. Ozone acts to eliminate pathogens, such as resistant bacteria helping to create an environment conducive to healing. The use of ozone can help reduce the colonization of microorganisms, preventing infections and facilitating the recovery of injuries (MOTA *et al.*, 2020).

Ozone therapy has bactericidal, fungicidal and virucidal properties and is effective in inhibiting various pathogenic microorganisms in wounds. Ozone acts to disinfect wounds, helping to prevent infections and promoting a favorable environment for healing. Studies cited in the article show that the application of ozone can reduce the microbial load in infected wounds, contributing to patient recovery (TANAKA *et al.*, 2020).

Research by Targino *et al.* (2022) reports that ozone therapy has been effective in inhibiting various pathogenic microorganisms in wounds. Due to its antimicrobial properties can act against bacteria, fungi and viruses, contributing to the disinfection of wounds and promoting an environment favorable to healing. The application of ozone can reduce the microbial load, which is crucial for the treatment of chronic and infected (TARGINO *et al.*, 2022).

The article by Lescura and Bega (2020) discusses that ozone has properties significant antimicrobial and is effective in inhibiting a variety of microorganisms that can infect wounds. The application of ozone, either

in gaseous form or in ozonized oil, has been shown to eliminate bacteria, fungi and other pathogens, which is crucial for the treatment of chronic wounds. This antimicrobial action helps to prevent infections and promote an environment conducive to healing (LESCURA; BEGA, 2020). These properties are attributed to ozone's ability to oxidize cellular components, leading to the destruction of pathogens present in wounds. The use of ozone, whether in gaseous form or in ozonated solutions, has shown positive results in reducing the microbial load in wounds, contributing to an environment conducive to healing (SANTOS *et al.*, 2021).

Since ozone therapy has antimicrobial properties that help inhibit the growth of various microorganisms in wounds, the application of ozone can reduce the bacterial load, contributing to the prevention of infections and promoting a more favorable environment for healing (SANTOS; SANTOS; LIBÓRIO-LAGO, 2024).

In this same vein, Nobre *et al.* (2021) mentions that ozone has antimicrobial properties that can inhibit a variety of microorganisms present in wounds. This inhibition capacity is one of the factors that contributes to its effectiveness in treating, helping to prevent infections and promoting an environment favorable to healing (NOBRE *et al.*, 2021).

Lima *et al.* (2022) point out that ozone therapy has antimicrobial properties and is effective in inhibiting various pathogenic microorganisms present in wounds. The application of ozone can help to reduce the microbial load, promoting a more environment favorable for healing. Studies cited in the article indicate that ozone can be a viable alternative for the treatment of wound infections, contributing to the recovery of injured tissue (LIMA *et al.*, 2022).

The article by Xavier *et al.* (2021) highlights that ozone therapy has a significant antimicrobial, being effective in inhibiting various microorganisms that can effectinfect wounds. Ozone acts to disinfect wounds, helping to reduce the microbial load and, consequently, promoting a more favorable environment for healing (XAVIER *et al.*, 2021).

Moraes and Teixeira (2022) point out that ozone therapy has antimicrobial that can inhibit the proliferation of various microorganisms in wounds. The properties application of ozone has been shown to be effective in reducing bacterial biofilms, which is crucial for the treatment of chronic wounds, as the presence of biofilms can hinder healing and increase the risk of infections (MORAES; TEIXEIRA, 2022).

Therefore, ozone therapy has antimicrobial, bactericidal and fungicidal and is effective in eliminating microorganisms present in wounds. The application properties ozone helps to reduce the bacterial load, which is crucial for the treatment of ulcers, especially in diabetic patients who are more susceptible to infections (PINHEIRO; BARBOSA, 2021).

Reaffirming the findings of the articles cited above, Santos *et al.* (2021) discusses that ozone has significant antimicrobial properties, being effective in inhibiting various microorganisms, bacteria, including fungi and viruses. These properties are attributed ozone's ability to oxidize cellular components, leading to the destruction of pathogens present in wounds. The use of ozone, either in gaseous form or in ozonized,solutions has shown positive results in reducing the microbial load in wounds, contributing to an environment conducive to healing (SANTOS *et al.*, 2021).

The factor related to this effectiveness is that ozone has a high oxidative power, which gives it the ability to inhibit the growth of various microorganisms. Ozone acts to inactivate fungi, bacteria and viruses, interfering with the integrity of membranes cell and hin-

dering viral replication this biocidal property of ozone is one of the factors that contributes to its use in wound treatment, promoting disinfection and preventing infections (MELO *et al.*, 2020).

We therefore note that the integrative approach proposed in this topic has allowed for a broader understanding of the role of ozone therapy in wound management, suggesting that although the results are promising, a greater number of rigorous studies are needed to validate these findings and establish clear guidelines for clinical practice. This highlights the importance of continuing research in this area in order to confirm the efficacy of ozone and explore its potential in different wound care contexts

FACTORS AND PARAMETERS RELATED TO THE USE OF OZONE ON WOUNDS

Santos *et al.* (2021) mention that the effectiveness of ozone in wound treatment can be influenced by several factors, such as the concentration of ozone, (gas, the form of application ozonized, oilozonized), water-the frequency of treatment sessions and the specific characteristics of the wound (type, depth, presence of infection). In addition, the patient's general condition, including factors such as diabetes and immunosuppression, can also impact the response to ozone treatment (SANTOS *et al.*, 2021).

Lescura and Bega (2020) point out that not only does the effectiveness of ozone in treatment wound depend on various factors and parameters, such as the concentration of ozonetime, the exposure and the form of application (directly in a "bag" or in ozonized oil), but the temperature ambient can also influence the stability of the ozone and, consequently, its effectiveness. It is important that these parameters are carefully controlled to maximize the benefits of the treatment and ensure patient safety (LESCURA; BEGA, 2020).

In the same, Simplício *et al.* (2023) point out that factors and parameters that influence the effectiveness of ozone in disinfecting wounds include the concentration of ozone used, the time of exposure to the gas, the temperature and relative humidity of the environment. The concentration of ozone can vary from 0.5 to 1000 ppm, and the exposure time can vary from 10 to 320 minutes. These variables are crucial for optimizing the effectiveness of treatment and ensuring patient safety (SIMPLÍCIO *et al.*, 2023).

It is also necessary to consider the patient's clinical condition, as the presence of comorbidities (e.g. *gdiabetes mellitus*) can also impact treatment. Personalizing the ozone therapy is essential protocol to optimize results (Marchesini; Ribeiro, 2020). Considering that the effectiveness of ozone in treatment of wound depends on several factors, such as the concentration of the gas, the method of application (e.g. local application or use of ozonized oil) and the environment in which ozone is used (such as in controlled microenvironments) (MOTA *et al.*, 2020).

We can see that various factors and parameters influence the effectiveness of ozone in wound treatment. This is reinforced in the study by Targino *et al.* (2022) who say that the concentration of ozone used, the method of application (such as insufflations, ozonized water or ozone gas), the frequency of applications and the duration of treatment, as well as the patient's clinical conditions such as the presence of comorbidities (the treatment results (TARGINO e.g. *gdiabetes*), can affect *et al.*, 2022).

Furthermore, the application of ozone must take into account various factors and parameters, such as the concentration of ozone, the route of administration and the duration of the treatment. The choice of application, routes such as rectal or topical insufflation, is important to ensure the effectiveness of the treatment and minimize discomfort for the

patient. In addition, the dosage and frequency of applications should be adjusted according to the patient's clinical response and the severity of the wound (MELO *et al.*, 2020). Reinforced by Santos; Santos and Libório-Lago (2024) who say that the concentration of ozone used, the frequency and duration of applications, as well as the type of wound and the general condition of the patient.

Lima *et al.* (2022) also point out that the effectiveness of ozone therapy depends on several factors, including the concentration of ozone used and the frequency and duration of applications. In addition, the patient's clinical condition and the type of wound are also considered important parameters that can influence treatment results. The article suggests that personalizing the treatment, taking these factors into account is crucial to maximizing the benefits of ozone therapy (LIMA *et al.*, 2022).

The factors and parameters related to the use of ozone on wounds include the concentration of ozone, the form of application (such as ozonated gas or water), the frequency of applications and the duration of treatment. And the adequacy of these parameters is crucial to maximize the benefits of ozone therapy and minimize possible adverse effects (XAVIER *et al.*, 2021).

Tanaka *et al.* (2020) also mention that the effectiveness of ozone therapy depends on several factors, including the route of administration, the concentration of ozone used, the frequency of applications and the duration of treatment. However, they also point out that the choice of the method of application (topical, insufflation, etc.) and the individualization of treatment according to the characteristics of the wound and the patient are essential to optimize results. The lack of standardization in treatment protocols is a point highlighted, indicating the need for more research to establish clear guidelines (TANAKA *et al.*, 2020).

The use of ozone on wounds is influenced by several factors, such as the concentration of, the form of application (for example, use of plastic bags with an mixture, transcutaneous immersion or use of ozonated water), the frequency of sessions, the condition patient's clinical and the condition of the injured tissue. It should be emphasized that personalizing the treatment, taking into account the specific characteristics of the wound and the 's patient-comorbidities, is fundamental to optimizing the results (MORAES; TEIXEIRA, 2022; PINHEIRO; BARBOSA, 2021).

In this same vein, Miranda *et al.* (2021) mention that the effectiveness of ozone therapy depends on several factors, such as the concentration of ozone used, the method of application (topical or systemic), the frequency of applications and the patient's clinical condition. Personalizing treatment, taking these parameters into account, is fundamental to optimizing results and ensuring patient safety (MIRANDA *et al.*, 2022).

Nobre *et al.* (2021) point out that the effectiveness of ozone in treating wounds depends on various factors and parameters, such as the form of administration (gas or oil), the concentration of ozone, the frequency and duration of treatment. However, many studies still lack precise details about these parameters, which limits the standardization and comparison of results (NOBRE *et al.*, 2021).

We can see, then, that there is a complexity to the use of ozone in wound treatment, highlighting crucial factors such as the concentration of ozone, application methods, frequency and duration of treatment, specific characteristics of the wound and the patient's clinical conditions. Personalizing the treatment is essential, as inadequate concentrations or methods inappropriate application can compromise the efficacy and safety of ozone therapy.

In addition, the patient, 's general condition-including comorbidities such as diabetes, can impact the response to treatment. The lack of standardization in ozone therapy protocols is a critical point, highlighting the need for more research to establish guidelines clear that guarantee the efficacy and safety of the treatment. In short, ozone therapy must be adapted to the individual needs of each patient and wound in order to optimize results.clinical

EFFICACY OF THE USE OF OZONE IN THE TREATMENT OF WOUNDS

Simplicio *et al.* (2023) in their review study point out that the efficacy of ozone in wound treatment is corroborated by several studies that show positive results in healing and reducing infections. The review concludes that, despite variations in the methods and parameters used, ozone stands out as a promising alternative compared to other disinfectants, contributing to improvement of wound treatment protocols and the clinical decision-making (SIMPLICIO *et al.*, 2023).

Thus, the efficacy of ozone in wound treatment is supported by several studies that show positive results in the healing of chronic, lesions as mentioned by Lescura and Bega (2020). Furthermore, ozone therapy not only speeds up the healing process, but also improves the quality of life of patients, especially those with conditions such as diabetes. The combination of its properties antimicrobial and ability to stimulate tissue regeneration make ozone a promising therapeutic option for the management chronic (LESCURA; wounds BEGA, 2020).

The article by Santos, Santos and Libório-Lago (2024) concluded that ozone therapy is effective in treating wounds, showing positive results in terms of healing and tissue regeneration. Ozone therapy has been shown not only to accelerate the process healing, but also to improve the quality of the regenerated tis-

sue, making it a option promising in clinical practice (SANTOS; SANTOS; LIBÓRIO-LAGO, 2024).

In this way, ozone therapy can be an effective practice for treating wounds, especially diabetic foot ulcers. Although ozone does not promote total healing ulcers in all cases, it can reduce the size of the lesions and speed up the process healing. Ozone therapy can therefore be a valuable alternative, especially when conventional treatments fail due to bacterial resistance (MOTA *et al.*, 2020).

The effectiveness of ozone in treating wounds is also highlighted in the article by Melo *et al.* (2020), which points out that ozone therapy can enhance healing and improve tissue oxygenation. Ozone stimulates blood circulation and the immune response, contributing to tissue. regenerationThe study suggests that although ozone therapy shows promising results, more research is needed to establish protocols clear and robust clinical evidence on its effectiveness in different types of wounds (MELO *et al.*, 2020).

Santos *et al.* (2021) point out that ozone therapy promotes more healing faster and effective compared to traditional methods. Studies cited show that the use ozone can result in a significant reduction in wound area and improved quality of scar. tissueIn addition, ozone therapy is considered an approach safe, with few reported adverse effects, which makes it a viable and promising option wound treatment (SANTOS *et al.*, 2021).

In the article by Xavier *et al.* (2021), the efficacy of ozone therapy in the treatment of wounds is addressed based on evidence from studies demonstrating promotion of healing, thereduction of inflammation and improvement in tissue. oxygenationThe article concludes that ozone therapy is a promising and safe alternative for the treatment of skin lesions, especially in elderly patients, due to its multiple beneficial effects (XAVIER *et al.*, 2021).

The article by Miranda *et al.* (2022) concludes that ozone therapy is an effective practice in the treatment of wounds, especially in diabetic patients. The therapy not only accelerates healing, but also improves local oxygenation and the formation of granulation tissue. Studies cited in the article report positive results, such as pain reduction, reduction edema and wound closure, when ozone therapy is used in conjunction with conventional (MIRANDA treatments *et al.*, 2022).

However, it is important to note that although there is evidence that ozone therapy can accelerate healing and promote tissue repair, there is still a lack of studies that conclusively validate its effectiveness compared to conventional treatments. Ozone therapy is considered a complementary therapy that can be beneficial, but more research is needed to consolidate these findings and guarantee its safety and efficacy on a large scale (PINHEIRO; BARBOSA, 2021).

In this vein, Nobre *et al.* (2021) point out that there is evidence of the effectiveness of ozone in the treatment of wounds, especially in its gaseous form and in oils. However, the authors point out that, due to the limited number of randomized clinical trials and the lack of methodologically robust, the results on the efficacy of ozone are still partial and studiesrequire further research to be consolidated (NOBRE *et al.*, 2021).

Furthermore, the efficacy of ozone therapy in treatment of wounds is addressed the positively in the article by Lima *et al.* (2022), with evidence that the practice can accelerate the healing process and improve the quality of regenerated tissue. However, the authors point out that, although the results are promising, there is still a need for more clinical studies to consolidate ozone therapy as a standard practice in treatment. wound The conclusion is that, although ozone therapy is proving to be effective, its adoption in practice clinical

must be accompanied by further research and evidence scientific (LIMA *et al.*, 2022), the effectiveness of ozone therapy in treating wounds is evidenced by the positive results observed in the study by Marchesini and Ribeiro (2020), which include accelerating the healing process and reducing the area of the lesion. However, although the results are promising, the article emphasizes that more studies are needed to confirm the efficacy of ozone therapy as an adjuvant treatment to conventional modalities, due to the limited number of samples and the need for statistically significant results (MARCHESINI; RIBEIRO, 2020).

Tanaka *et al.* (2020) point out that ozone therapy is a promising modality treating wounds, especially in cases of diabetic foot. The integrative review shows that the therapy can lead to a significant reduction in healing time and an improvement in the appearance of the lesions. However, the authors point out that, despite the positive results, there is still a need for more studies to validate the effectiveness and establish protocols consistent (TANAKA *et al.*, 2020).

The efficacy of using ozone to treat wounds is highlighted in the article by Targino *et al.* (2022) as being positive, with evidence that ozone therapy can speed up the healing process. The studies reviewed indicate that ozone therapy is a alternative viable and low-cost, especially for patients with chronic wounds such as venous ulcers and diabetic foot. The article concludes that, although the results are promising, more research is needed to deepen the understanding of ozone's mechanisms of action and to standardize treatment (TARGINO *et al.*, 2022).

Moraes and Teixeira (2022) pointed out that the effectiveness of ozone therapy in treating wounds is evidenced by the results observed in the patients in their study, who showed significant improvements in healing, such as a reduction in wound size, a reduction in pain and an improvement in the color and charac-

teristics of the tissue. The article concludes that, although the results are promising, more studies with more robust to confirm the effectiveness of ozone therapy and establish clear guidelines for its designs are needed use (MORAES; TEIXEIRA, 2022).

The topic covered the effectiveness of ozone therapy in wound treatment, highlighting positive results from various studies that show its ability to accelerate healing and reduce infections, especially in cases of resistant microorganisms. Ozone's antimicrobial properties, which include bactericidal, fungicidal and virucidal action, are fundamental to its effectiveness in disinfecting wounds.

However, customizing treatment protocols, taking into account the characteristics of the wound and the patient's health conditions, is essential to optimize results. In addition, ozone is proving to be a promising alternative to other disinfectants. However, the need for more research to establish clear and standardized guidelines for the use of ozone therapy is an point important consider in clinical practice.

FINAL CONSIDERATIONS

Research findings on ozone therapy therapeutic modality is effective in accelerating the healing process and reducing in wound treatment indicate that this infections, especially in chronic wounds and diabetic patients. The properties antimicrobial of ozone are highlighted as an important factor, offering a viable in a context of resistance alternative antibiotic

However, the existing studies have limitations, such as a lack of standardization and methodological rigour, highlighting the need for more randomized controlled trials to validate the results and establish clear guidelines for their application clinical. In summary, ozone therapy shows promise, but requires further research to consolidate its efficacy and safety in practice.

Furthermore, this study contributes to the advancement of knowledge about ozone therapy and its application in the treatment of wounds, by providing new evidence about its efficacy and benefits. In addition to clarifying how ozone therapy can be used effectively,

the research highlights the need for future investigations to validate the results and develop more standardized, as treatment protocols as well as encouraging the training of health professionals in this technique.

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