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The Use of Ozone Therapy in the Postoperative Period of Plastic Surgery

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Abstract

Background: Ozone therapy has emerged as a potential complementary approach to wound healing because of its antimicrobial, anti-inflammatory, antioxidant, and tissue-regenerative properties. Its application in the postoperative period of plastic surgery, however, remains insufficiently investigated.

Objective: To review the available scientific evidence regarding the use of ozone therapy in postoperative care following plastic surgery, with emphasis on its effects on wound healing, tissue regeneration, inflammation, infection control, and scar quality.

Methods: An integrative literature review was conducted using PubMed/MEDLINE, PubMed Central, and Google Scholar. Studies published in English or Portuguese addressing ozone therapy in wound healing, tissue repair, surgical wounds, or plastic surgery postoperative care were considered. Data were analyzed descriptively and comparatively, focusing on administration routes, therapeutic concentrations, treatment phases, and clinical outcomes.

Results: The available evidence suggests that ozone therapy may contribute to improved wound healing through enhanced tissue oxygenation, microcirculation, angiogenesis, fibroblast activity, collagen synthesis, and modulation of oxidative and inflammatory responses. Antimicrobial effects may also help reduce local microbial burden and postoperative infection risk. Clinical studies involving plastic and other surgical wounds have reported improvements in granulation, epithelialization, scar quality, pain, pruritus, and tissue viability. However, substantial heterogeneity exists regarding administration methods, ozone concentrations, treatment frequency, and duration.

Conclusion: Ozone therapy shows potential as an adjunctive treatment in the postoperative period of plastic surgery. Nevertheless, the limited number of plastic surgery-specific clinical studies and the absence of standardized therapeutic protocols prevent definitive conclusions regarding its efficacy and optimal application. Well-designed randomized clinical trials are needed to establish safe, effective, and reproducible protocols.

Keywords

Cutaneous wound healing, Ozone therapy, Medical ozone, Tissue regeneration, Oxidative stress, Angiogenesis, Collagen synthesis, Antimicrobial activity.

Background

Cutaneous wound healing is a complex and highly organized biological process involving sequential events: hemostasis, inflammation, cell proliferation, angiogenesis, extracellular matrix deposition, and tissue remodeling. Proper interaction between these phases is essential for restoring the skin's functional integrity and is influenced by local factors such as infection and tissue oxygenationand systemic factors, including age, chronic diseases, and nutritional status (WEN et al., 2022).

Ozone therapy has attracted growing scientific interest as an adjuvant therapy for wound treatment and tissue repair. Medical-grade ozone a mixture of oxygen and ozone at controlled therapeutic concentrations exhibits biological properties capable of modulating the healing process through various physiological mechanisms. Key effects include improved tissue oxygenation, increased local microcirculation, modulation of the inflammatory response, stimulation of angiogenesis, fibroblast activation, and promotion of collagen synthesis; these factors are directly linked to accelerated skin repair (FITZPATRICK; HOLLAND; VANDERLELIE, 2018).

In addition to its effects on tissue regeneration, ozone therapy demonstrates significant antimicrobial activity against bacteria, fungi, and viruses, thereby reducing the microbial load of lesions and lowering the risk of infections that could delay healing. Concurrently, stimulating the endogenous antioxidant system induces controlled oxidative stress, which activates cellular pathways responsible for protecting against oxidative damage and regulating the inflammatory response, thus facilitating the physiological progression of the various healing phases (SMITH et al., 2017).

The most recent scientific evidence demonstrates promising results, particularly regarding chronic wounds, diabetic foot ulcers, and hard-to-heal lesions. Systematic reviews and meta-analyses have observed a significant reduction in wound area, increased granulation tissue formation, accelerated epithelialization, and improved quality of tissue repair when ozone therapy was used as an adjunct to conventional management. However, despite these favorable results, the authors highlight the existing heterogeneity among the clinical protocols employed, underscoring the need for randomized clinical trials with greater methodological rigor to consolidate the available evidence (WEN et al., 2022; MODENA et al., 2022).

In the context of plastic surgery, proper postoperative management plays a decisive role in the quality of recovery and final aesthetic outcomes. Surgical trauma triggers a physiological inflammatory cascade characterized by increased vascular permeability, edema formation, ecchymosis, pain, and intense cellular recruitment for the tissue repair process. Although these events are expected, their exacerbation can foster the development of complications such as delayed healing, dehiscence, seromas, infections, tissue necrosis, and fibrosisthereby compromising both functional recovery and the aesthetic outcome of the surgery (NELIGAN et al., 2024).

Against this backdrop, ozone therapy has been proposed as a complementary therapeutic strategy in the postoperative period of plastic surgeries due to its anti-inflammatory, antioxidant, antimicrobial, and biostimulatory properties. The application of medical-grade ozone induces a controlled oxidative stress capable of activating endogenous antioxidant systems such as superoxide dismutase, catalase, and glutathione peroxidase thereby modulating the inflammatory response without inhibiting the physiological mechanisms essential for tissue repair. Concurrently, improvements in local microcirculation, increased oxygen delivery to tissues via elevated erythrocyte 2,3-diphosphoglycerate, stimulation of angiogenesis, and enhanced cellular metabolic activity are observed factors that directly contribute to more efficient healing (BOCCI, 2011; SMITH et al., 2017).

Another relevant aspect concerns ozone therapy's ability to stimulate fibroblast proliferation and collagen synthesis, thereby promoting better organization of the extracellular matrix and facilitating scar remodeling. Experimental studies also demonstrate increased expression of growth factors such as vascular endothelial growth factor (VEGF) and transforming growth factor-beta (TGF-β) both of which are fundamental to new blood vessel formation and tissue regeneration (ELVIS; EKTA, 2011).

In plastic surgery, these mechanisms are particularly important in procedures involving extensive tissue undermining such as liposuction, abdominoplasty, mammoplasty, rhytidoplasty, and combined body contouring surgeries where transient hypoperfusion, edema, and an intense inflammatory response can delay recovery. The improved tissue perfusion and local oxygenation provided by ozone therapy can help reduce edema, facilitate the resolution of ecchymosis, optimize healing, and lower the risk of complications related to compromised tissue vascularity (WEN et al., 2022).

Ozone's recognized antimicrobial activity represents a potential additional benefit in the postoperative period; its oxidative action inactivates Gram-positive and Gram-negative bacteria, fungi, and viruses, reducing the local microbial load without the conventional resistance mechanisms associated with standard antimicrobials. This characteristic can aid in preventing and controlling superficial surgical wound infections when used as an adjuvant therapy alongside good surgical practices (SMITH et al., 2017).

Although the biological mechanisms of ozone therapy are well-documented and evidence regarding chronic wounds is consistent, there is still a limited number of controlled clinical trials concerning its specific application in the postoperative period of plastic surgery. Most available publications consist of experimental studies, case reports, and research involving various types of wounds, indicating promising results regarding accelerated healing, reduced inflammatory response, and improved tissue repair quality. Thus, the use of ozone therapy in the postoperative setting should be viewed as a complementary therapy grounded in solid physiological principles; however, robust clinical studies are still required to establish standardized protocols and strengthen the level of scientific evidence for this specific patient population (FITZPATRICK; HOLLAND; VANDERLELIE, 2018; WEN et al., 2022).

Methodology

This study is an integrative literature review, a method that enables the gathering, synthesis, and critical analysis of available scientific evidence on a specific topic, allowing for the inclusion of diverse methodological designs to broaden the understanding of the phenomenon under investigation. The literature search was conducted using the PubMed/MEDLINE, PubMed Central (PMC), and Google Scholar databases, as these are widely used in the health sciences and cover relevant national and international publications. Controlled descriptors (MeSH) and free keywords were employed combined using the Boolean operator "AND" including the following terms: “ozonotherapy”, “plastic surgery”, “postoperative care”, “ozonioterapia”, “cirurgia plástica”. Inclusion included articles published in Portuguese or English, available in full text, that addressed the use of ozonotherapy for wound healing, tissue repair, or postoperative care following plastic surgery procedures. Excluded were experimental studies, research conducted solely on animal models, duplicate articles, publications without full-text access, studies that did not address the healing process or the context of plastic surgery, and works lacking sufficient information for critical analysis.

The data obtained were organized descriptively and comparatively, enabling the identification of key evidence regarding the effects of ozonotherapy on the healing process and its application as a complementary therapy in the postoperative period of plastic

Author	Study Type	Route of Administration	Concentration	Healing / Postoperative Phase	Main Findings
Bocci (2011)	Reference book on ozone therapy	Bagging, ozonated water, and ozonated oil	**60–80 µg/mL**	Initial phase of contaminated or infected wounds	Predominant antimicrobial effect and reduction of microbial load.
Bocci (2011)	Reference book	Bagging, ozonated water, and ozonated oil	**20–40 µg/mL**	Proliferative phase (granulation)	Stimulation of angiogenesis, fibroblast proliferation, granulation tissue formation, and collagen deposition.
Bocci (2011)	Reference book	Bagging, ozonated water, and ozonated oil	**5–20 µg/mL**	Epithelialization and remodeling phase	Enhanced epithelialization and improved collagen organization.
Franzini et al. (2024)	Post-surgical wound case series	Bagging, ozonated water, ozonated oil, and, in selected cases, major autohemotherapy	**20–40 µg/mL**	Granulation and active healing phase	Reduced inflammation, improved granulation, accelerated epithelialization, and microbiological control.
Cinto et al. (2022)	Clinical study in orthopedic surgical wounds	Bagging	**40 µg/mL**	Surgical wounds undergoing healing	Twenty-minute applications, five times per week for six weeks, resultingin significant improvement in wound healing.
Ruiz-Val et al. (2025)	Clinical study in breast plastic surgery	Topical ozonated oil	**Not reported**	After suture removal	Improved scar quality, reduced pain and pruritus, and enhanced aesthetic characteristics of the scar.
Alp et al. (2025)	Clinical study in secondary rhinoplasty	Major autohemotherapy	**Not reported**	Immediate postoperative period (three sessions)	Reductio n in necrosis, skin compromise, and infection.

surgery, as well as existing gaps in the literature concerning the standardization of therapeutic protocols.

Results and Discussion

The literature search identified a limited number of studies specifically addressing the use of ozone therapy in the postoperative period of plastic surgery. Most available evidence focuses on studies involving chronic wounds, ulcers, and surgical wounds across various specialties, whereas publications directed exclusively at the plastic surgery context remain scarce. Overall, the analyzed studies demonstrate that ozone therapy has been administered via various routes including topical insufflation in a closed system (bagging), ozonated oil, ozonated water, and major autohemotherapy with the choice of modality depending on lesion characteristics, the healing phase, and therapeutic goals. The concentrations most frequently described for stimulating tissue repair range from 20 to 40 µg/mL, particularly during the proliferative phase of healing a period characterized by granulation tissue formation, angiogenesis, and intense fibroblast activity. However, few studies present detailed protocols, which limits the clinical reproducibility of the results. Table 1 summarizes the key studies included in this integrative review, highlighting the authors, methodological design, route of ozone therapy administration, concentrations used, the healing or postoperative phase during which it was employed, and the main clinical outcomes observed.

Among the few published clinical studies, Ruiz-Vall et al. (2025) evaluated the use of ozonated oil in patients undergoing breast surgery. Following suture removal, the product was applied topically to the scar daily throughout the recovery period. The authors observed significant improvement in scar quality characterized by reduced pain and itching, as well as better scar texture, thickness, and coloration compared to conventional treatment. Although the study demonstrates promising results, specific ozone concentrations in the oil used were not reported, hindering the protocol's reproducibility.

Another relevant publication is a case series presented by Franzini et al. (2024) involving patients with complex surgical wounds resulting from various procedures, including plastic and reconstructive surgeries. The authors employed individualized protocols combining different ozone therapy application methods, such as topical insufflation via a closed system (bagging), ozonated water, ozonated oil, and in selected cases major autohemotherapy. Topical concentrations ranged from 20 to 40 µg/mL, adjusted according to the lesion's clinical progression and the healing stage. Results showed reduced local inflammation, improved granulation tissue formation, accelerated epithelialization, and satisfactory microbiological control of the wounds.

In facial plastic surgery, Alp et al. (2025) investigated the effect of ozonated major autohemotherapy on patients undergoing secondary rhinoplasty. The protocol involved three postoperative sessions; a lower incidence of skin compromise, infection, and tissue necrosis was observed compared to the control group. However, the study did not specify the ozone concentration used during the procedure, limiting the clinical standardization of the technique.

Although they do not specifically involve plastic surgery patients, studies conducted in other surgical fields contribute to an understanding of the most frequently employed therapeutic parameters. Pasek et al. (2022), evaluating patients with orthopedic surgical wounds, used closed-system topical insufflation ("bagging") at a concentration of 40 µg/mL corresponding to a mixture containing approximately 2.86% ozone and 97.14% oxygen. The protocol consisted of 20-minute applications, five times a week for six weeks, resulting in significantly improved healing compared to conventional treatment.

Classic recommendations described by Bocci (2011) a leading international authority on medical ozone therapy suggest that concentrations should be adjusted according to the stage of the healing process. For highly contaminated or infected wounds, concentrations between 60 and 80 µg/mL are initially recommended,

with a predominantly antimicrobial objective. As the infection is controlled and the proliferative phase begins, intermediate concentrations of 20 to 40 µg/mL are indicated to stimulate angiogenesis, fibroblast proliferation, and granulation tissue formation. In later stages of healing, lower concentrations between 5 and 20 µg/mL may be used to promote epithelialization and tissue remodeling.

Despite the favorable results described in the literature, significant heterogeneity is observed among studies regarding application methods, concentrations used, session frequency, and treatment duration. Furthermore, few studies provide detailed descriptions of their therapeutic protocols, hindering clinical replication and the comparison of published results. To date, no randomized clinical trials have been identified for procedures such as liposuction, abdominoplasty, mastopexy, or rhytidoplasty (facelift) that establish standardized protocols for ozone therapy concentration, route of administration, and the optimal number of sessions. Thus, although biological mechanisms and preliminary results suggest a potential benefit of ozone therapy for postoperative recovery in plastic surgery, its use should still be considered a complementary therapy based on emerging evidence. The lack of standardized protocols and robust clinical studies highlights a significant scientific gap, underscoring the need for randomized clinical trials capable of defining safe, effective, and reproducible therapeutic parameters for this population.

Conclusions

The study demonstrated that ozone therapy shows potential as an adjuvant therapy in the postoperative period of plastic surgery, owing to its anti-inflammatory, antimicrobial, and antioxidant effects, as well as its ability to biostimulate tissue repair. Its mechanisms of action operate across various stages of wound healing, promoting tissue oxygenation, angiogenesis, fibroblast proliferation, and collagen deposition processes essential for proper tissue recovery. Given that the postoperative period in plastic surgery involves physiological changes that can lead to complications such as persistent edema, infection, dehiscence, delayed healing, necrosis, and fibrosis, ozone therapy shows potential as a complementary strategy in managing these conditions, provided it is used in conjunction with conventional treatment and appropriate clinical monitoring. However, the scarcity of specific studies in plastic surgery and the lack of standardized protocols regarding concentrations, routes of administration, and optimal timing of application highlight the need for controlled clinical trials to strengthen the scientific evidence base and support its safe, evidence-based use.

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