

# What is the Best Therapeutic Alternative for Hair Transplant: Ozone Therapy or Hyperbaric Oxygen Therapy?

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## Abstract:

**Background:** In the healing process, typical of several lesions, recovery is supported by complementary resources. Hyperbaric chamber and ozone therapy are two methods that, using increased oxygenation of damaged tissues, can reduce inflammation, stimulate neovascularization, and prevent infection.

**Materials and Methods:** This study is a literature review of articles from PubMed, Lilacs, Google Scholar, and Scielo.

**Results:** Evidence for the two clinical practice techniques was provided through case study reports and scientific studies. Besides the critical increase of oxygen concentration in the tissues resulting from the application of the techniques, medical benefits contribute to therapeutic success.

**Conclusion:** The choice of the techniques depends on the patient's characteristics. Although the approaches are different, both have been studied and used to foster healing in post-surgical phases of hair transplantation.

**Key Word:** hyperbaric chamber; oxygen therapy; ozone therapy; hair transplantation surgery.

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## I. Introduction

The scar healing process happens in all kinds of wounds, surgical, traumatic, pathological and/or iatrogenic. It consists of a perfect and coordinated sequence of events composed of three phases: inflammatory, proliferative or growth of granular tissue, and remodeling or maturation, which end up with the tissue reconstruction. The late scar healing of a non-viable tissue fosters a microorganism prone environment. Therefore, treatments come about to complement the physiological demand. Through tissue repair, oxygenation, and vasodilation have minor influence on the evolution of the wound. By using complementary methods of oxygenation, such as ozone therapy and hyperbaric oxygen therapy, an increase of oxygen rates can be attained, which allows for reduction of inflammatory and proliferative events speeding up the process of scar healing and the closure of the wounds. In the ozone application sessions, whatever the technique, excellent results in tissue repair are obtained. First used in World War II, by German soldiers, for the treatment of gas gangrene, ozone is currently employed in post surgical hair treatment for instance. This treatment offers additional physiological benefits to the wound's hypoxia reversion and hypoperfusion. When applied correctly, it prevents ischemia and increases blood circulation besides acting as an antimicrobial. Hyperbaric oxygen therapy (HBOT) has similar mechanisms of oxygenation. Its methods include applying pure oxygen in a closed, individual or collective chamber. The excess of oxygen inflicted by this technique increases arterial blood, which is the cornerstone of many physiological treatments. Those two methods contain similar treatments but differ in terms of time: around 60 to 120 minutes for HBOT and 20 minutes for ozone therapy. Hence, individual evaluation of each patient is necessary. Therefore, the aforementioned study aimed at comparing and providing evidence for the two techniques with a complete description and argument for its benefits.

## II. Material And Methods

This study organizes a systematic bibliographic review of ozone therapy and hyperbaric oxygen chamber on post surgical hair transplant surgical. A selection of articles was carried out with the following keywords in Portuguese, ozônio terapia, câmara hiperbárica, terapias de cicatrização; and in English: hyperbaric chamber and oxygen therapy, ozone and hyperbaric chambre, hair transplantation surgery. Sixteen research articles were included in the review searched from PubMed, Lilacs, Google Academic, and Scielo. I selected only articles that approached the applicability of ozone and the hyperbaric oxygen chamber, with a preference for the most recent ones and discarding off-topic texts.

### **III. Result And Discussion**

Surgical wounds are classified as acute due to the fact of being intentional. They tend to regress within an expected time span. Healing is a multifactorial process related to several cell events. Hair transplant surgery is carried out in a careful way with a well-organized team to get good results and lower rates of complications. The healing process of wounds and wounds intentionally provoked in the transplanted area demands a more careful and observed post surgical period.<sup>9</sup>

The hair growth cycle involves a previously established tension of oxygen that avoids ischemia by hypoxia and tissue malnutrition. Alternative therapies, hyperbaric oxygen therapy, and ozone therapy are part of the discoveries that help increase oxygenation in the blood capillaries and speed up the healing process in defined areas, focusing on hair recuperation and therapy of wounds.<sup>8</sup>

In 1622, hyperbaric oxygen therapy (HBOT) came to be used for medical purposes by Doctor Henshaw. The XIX century expanded with Junod (1834) and Pravaz (1837) on treating diseases like tuberculosis, cholera, deafness, anemia, and hemorrhage. In 1965, the first application of HBOT in cutaneous wounds was registered. In 1995, the Brazilian Medical Council established the HBOT as an approved therapy.<sup>1</sup>

The Brazilian Society of Hyperbaric Medicine (SBMH) classifies the hyperbaric chamber as a closed system resistant to pressure that accommodates one or several patients; monoplace chamber pressurized with pure oxygen and multiplace chamber pressurized with compressed air. It consists in the administration of a fraction of pure oxygen (100%) in a pressurized environment 20 times as high as the sea level pressure inside of a hyperbaric chamber.<sup>13</sup>

The physiological and therapeutic effects are based on increased atmospheric pressure that increases arterial pressure and oxygenation in the tissue, helping in the scar healing process and weakening infections.<sup>13</sup> In 1840, ozone was found by a German researcher, Doctor Christian Friedrich Schoenbein. Later, German soldiers used it to treat wounds in the First World War. Current use of ozone started in 1940 overseas and experimentally in Brazil in the 1980's. Law 14,648, issued on August 14th, 2023, licenses ozone therapy nationwide. Ozone therapy is a gas mixture of 5% of ozone and 95% of oxygen which can be administered in several ways such as topical, subcutaneous, oral, rectal, and autohemotherapy.<sup>2</sup>

Concerning ozone therapy effects, blood, when exposed to ozone, reacts with plasma water and with unsaturated fatty acids present in the cell membranes that incite interleukin liberation, a substance that supports chemotaxis and attracts leukocytes to the tissues. Besides, it also stimulates tissue repair acceleration, cytokine liberation in the tissues and circulation, producing immune response activation. Oxygen is released along several days, which results in therapeutic effects like ischemia related disease, infection, delayed healing and oxidative stress.<sup>2</sup>

HBOT works by increasing considerably oxygen solubility in plasma (near 5mL/dL), even in ischemic tissue. Besides, hyperbaric therapy produces oxidative stress that reduces pro-inflammatory agents, acute stage protein, cytokine, and interleukin; it also increases growth factors that cause cicatrization and has bactericidal action on neutrophils, arteriolar vasoconstriction with consequential edema reduction and angiogenesis stimulation, but in some cases, it can have a temporary effect by restarting hypoxia in ischemic areas.<sup>11</sup>

Accordingly, based on these analyses, it can be concluded that both HBOT and ozone therapy are essential therapies. However, it is necessary to understand that the field of application is different in each case. In the hyperbaric chamber, the oxygen concentration increases during the procedure; this is why patients with chronic member ischemia have temporary therapeutic effects, and in about 2 hours, leaving HBOT, the area with ischemia returns. On the other hand, ozone therapy leads to a series of biological mechanisms that bring about the normalization of oxygen for many days with consequential therapeutic effects.<sup>6</sup>

On analyzing the effects at the capillary level of hyperbaric oxygen therapy, a reduction of the ischemia-reperfusion wound in the hair transplant can be found; Starting with its administration in 34 patients after the surgery, a better transplant hair follicle recuperation was observed with more noticeable regeneration and cicatrization. Furthermore, HBOT can reduce hair follicle infection and pruritus, which is common in post surgical care, and it has been an auxiliary therapy for hair transplant surgery.<sup>4</sup>

In addition, in another study, Craveiro and partners (2024), ozone therapy was used in a patient with capillary post-transplant necrosis using the FUE technique. This case report brought scientific evidence in favor of ozone therapy in wounds and tissue oxygenation benefits. The patient was submitted to 30 topic applications of ozone oil and 12 sessions with the ozone cap and subcutaneous applications of precise gas concentration.<sup>14</sup>

Through the cicatrization process, the complementary treatment with hyperbaric oxygen therapy (HBOT) reaches better cicatricial results than usual clinical care. Due to the local increase of oxygen, energetical demands are supplied and it leads to the production of oxygen-reactive species which work to modulate and synthesize growth-factors fostering scar healing.<sup>3</sup>

Ozone therapy in beauty treatment benefits patients before surgery, preparing tissue recuperation in the post surgical stages and improving cicatrization of surgical wounds. It can be used in a number of post surgical situations, such as surgical dehiscence, residual bruises/contusions, tissue repair retard, liposuction residual

fat/flaccidity, and postoperative infection. Ozone therapy in its many approaches has contributed significantly to beauty procedures, potentializing especially clinical results.<sup>5</sup>

A group of researchers conducted a study with adult Wistar rats exposed to a left back member degloving. They were separated into groups, and one had the hyperbaric chamber treatment – daily sessions of 30 minutes with a 100% oxygen environment under pressure of 2 ATA. Thus, oxygen hyperbaric therapy was considerably efficient in cicatrization and reduced the percentage of necrosis.<sup>16</sup>

Another research using ozone oil in the wounds of mice showed an increase in the action of fibroblast, and eventual more significant results of new tissue formation. Besides, its anti-inflammatory and cicatrization effects were practical, allowing for larger angiogenesis from increased vascular endothelial growth factors.<sup>12</sup>

Those two techniques were applied in the treatment of a cat that suffered an injury from a gun projectile developing *Acinetobacter* sp. proliferation and giving rise to inflammation in the member. The study showed that 20 hyperbaric oxygen sessions following four ozone therapy applications with oil in 12 to 12 hours were successful in fighting inflammation and infection, achieving better cicatrization and functionality recovery.<sup>10</sup>

Among the complementary and alternative medical methods in Turkey, ozone became mainstream in strengthening patients' immune systems by disinfecting and treating wounds. It has different applications and administration methods that do not lead to acute or chronic toxic effects when appropriately conducted. Moreover, if breathed, the ozone can cause irritations in the superior respiratory tract such as rhinitis, cough, headache, epiphora, nausea, and occasional vomiting, which highlights the importance of safe therapeutic procedure.<sup>15</sup>

In the analysis of patients treated with oxygen hyperbaric therapy, several adverse effects were found: barotrauma, central nervous system and pulmonary system toxicity by oxygen, claustrophobia, anxiety, and visual disorder. Other complications were – hypoglycemia, oxygen toxicity, dizziness, anxiety reactions, dyspnea, and thoracic pain - 0,5 – 1,5% of patients. It is clear that rigorous therapeutic protocols should be selected for patient safety.<sup>7</sup>

#### IV. Conclusion

In conclusion, those two therapies are essential, and it is important to recognize their different applications, benefits and specificity. Both treatments aim at fostering tissue development, cicatrization of wounds, and neovascularization, as well as antimicrobial action. Ozone therapy proved to be beneficial both in anti-inflammation and tissue recovery for wound treatment with important immune response. Likewise, hyperbaric therapy favored post surgical tissue recovery as demonstrated in hair transplant. Observational studies also make clear that ozone therapy outperforms hyperbaric chamber treatment in reducing health costs and adverse effects. The applicability of these technologies to hair transplantation treatment is recent and has shown promising results. However, new reports and studies with more evidence are necessary to demonstrate its validation. The literature about the benefits of acute wounds is still very limited and scarce regarding the inflammatory response and mechanisms connected with the cicatrization process. This literature review with no conflicts of interest aims at contributing to other professionals' expertise and learning in case they face similar situations at work.

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