SCOPING REVIEW

Efficacy of Hyperbaric Oxygen Therapy in Systemic Lupus Erythematosus Patients Undergoing Maxillofacial Surgery

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Article Info

Article history:
Received 07-08-2023
Revised 10-10-2024
Accepted 18-10-2024
Published 31-01-2025

Keywords:
Systemic Lupus Erythematosus
Hyperbaric Oxygen Therapy
Human & health
Wound Healing

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ABSTRACT

Background: Systemic Lupus Erythematosus (SLE) is a common multifactorial autoimmune disease that carries a high risk of osteoporosis and fractures. The delivery of oxygen to the body's tissues through hyperbaric oxygen treatment (HBOT) promotes the healing of wounds and shortens the typical recovery time for patients. The way tissues react to illnesses and injuries can be altered by HBOT. **Objective:** This article aimed to determine the use of hyperbaric oxygen therapy (HBOT) post-maxillofacial surgery in SLE patients. **Materials and Method:** This research used a scoping review approach, accessing electronic databases like PubMed, Scopus, Science Direct, Elsevier, and Google Scholar. **Discussion:** SLE is characterized by producing various autoantibodies that interact with endogenous antigens, favoring widespread inflammatory injury. SLE impacts the immune system, diminishing its ability to defend against infections. Hyperbaric oxygen therapy refers to administering 100% oxygen to a patient inside a pressurized chamber with a pressure higher than one atmosphere at sea level. The surgical placement of the implant into the mandible or maxilla allows it to be retained during functional loading, as the bone integrates with the implant during growth. **Conclusion:** HBOT can improve the host response by activating inflammatory cells and ensuring optimal oxygen tension in people with SLE. This can help with osteogenesis and neovascularization, which fill empty spaces with new blood vessels or bone tissue.

How to cite:
Wibowo, E.M., Anugraha, G., Wardhana, A.S. 2025. Efficacy of Hyperbaric Oxygen Therapy in Systemic Lupus Erythematosus Patients Undergoing Maxillofacial Surgery. Majalah Biomorfologi-Biomorphology Journal, 35(1): 69-80

***Majalah Biomorfologi* (Biomorphology Journal)** p.ISSN:0215-8833, e.ISSN: 2716-0920
doi: 10.20473/mbiom.v35i1.2025.69-80

Highlights

1. SLE is the most common autoimmune disease that requires management after maxillofacial surgery.
2. Hyperbaric oxygen therapy is a treatment that can help accelerate recovery in patients.

BACKGROUND

Systemic Lupus Erythematosus (SLE) is a multifaceted autoimmune disorder that predominantly affects young women and has the potential to involve multiple organ systems, including the cardiovascular, musculoskeletal, renal, and skin systems. Patients with SLE face heightened risks of osteoporosis and bone fractures due to factors such as systemic inflammation, hormonal imbalances, and long-term use of corticosteroids (Drew, et al., 2018; Werdiningsih, et al., 2020; Tian, et al., 2023)

Oral and maxillofacial symptoms of SLE are common. These include a butterfly rash on the cheeks and nose, recurring infections, and different oral lesions like mouth ulcers and jaw osteonecrosis. These complications necessitate careful dental and surgical management. Diagnostic tools for SLE include the antinuclear antibody (ANA) test and comprehensive blood testing (Malavika, et. al., 2023)

Corticosteroids, the cornerstone of SLE treatment, effectively suppress the immune system but pose risks such as osteoporosis, hypertension, and increased susceptibility to infections (Setianingtyas, et al., 2018; Benli, et al., 2021). Consequently, SLE patients undergoing surgeries, including maxillofacial procedures, are at significant risk for delayed wound healing and infection.

Hyperbaric oxygen therapy (HBOT) offers a potential adjunctive treatment by enhancing oxygen delivery to tissues, which is crucial for wound healing and recovery. HBOT involves administering high oxygen concentrations at pressures exceeding normal atmospheric levels, typically within a hyperbaric chamber (Gunturu, et al., 2024). This therapy has shown promise in promoting tissue repair and modulating immune responses, making it a valuable option for improving outcomes in SLE patients with impaired wound healing (Re, et al., 2019).

OBJECTIVE

This review aimed to evaluate the efficacy of hyperbaric oxygen therapy in supporting the recovery of SLE patients following maxillofacial surgery, focusing on its impact on wound healing and the overall therapeutic benefits.

MATERIAL AND METHOD

This study used electronic databases such as PubMed, Scopus, Science Direct, Elsevier, and Google Scholar for research screening. This study employed specific keywords such as hyperbaric oxygen therapy, systemic lupus erythematosus, the wound healing process in systemic lupus erythematosus patients, the impact of hyperbaric oxygen therapy on the wound healing process, the effects of hyperbaric oxygen therapy on autoimmune disease patients, and the effects of hyperbaric oxygen therapy on systemic lupus erythematosus patients. The paper was then filtered through a qualitative and quantitative selection.

Inclusion Criteria

The study was obtained based on literature studies in the form of journals and textbooks in the last eleven years (2013-2024). The literature review encompassed research results and article reviews, describing the theory and establishing its connection to a framework that subsequently led to ideas and innovation. The inclusion criteria deliberated human studies, in vitro and in vivo research, and reports. The publications that were off-topic were excluded from the analysis. Afterward, the publications were categorized according to the surgical process and the study design.

Selection of the Studies

Independently qualified and expert reviewers screened the study data and analysis. After a primary check on the research title, every abstract of the identified papers was assessed as the first screening level. The full text of the included papers was obtained. Furthermore, they were classified for qualitative synthesis. The electronic database research has identified a total of 138 manuscripts. Fifty-six duplicates have been deleted from the screening, and 82 papers have been considered for the full-text evaluation.

Twelve full texts were not found, and 61 were out of topic and should be excluded. Finally, nine papers in all have been incorporated into the analytical synthesis.

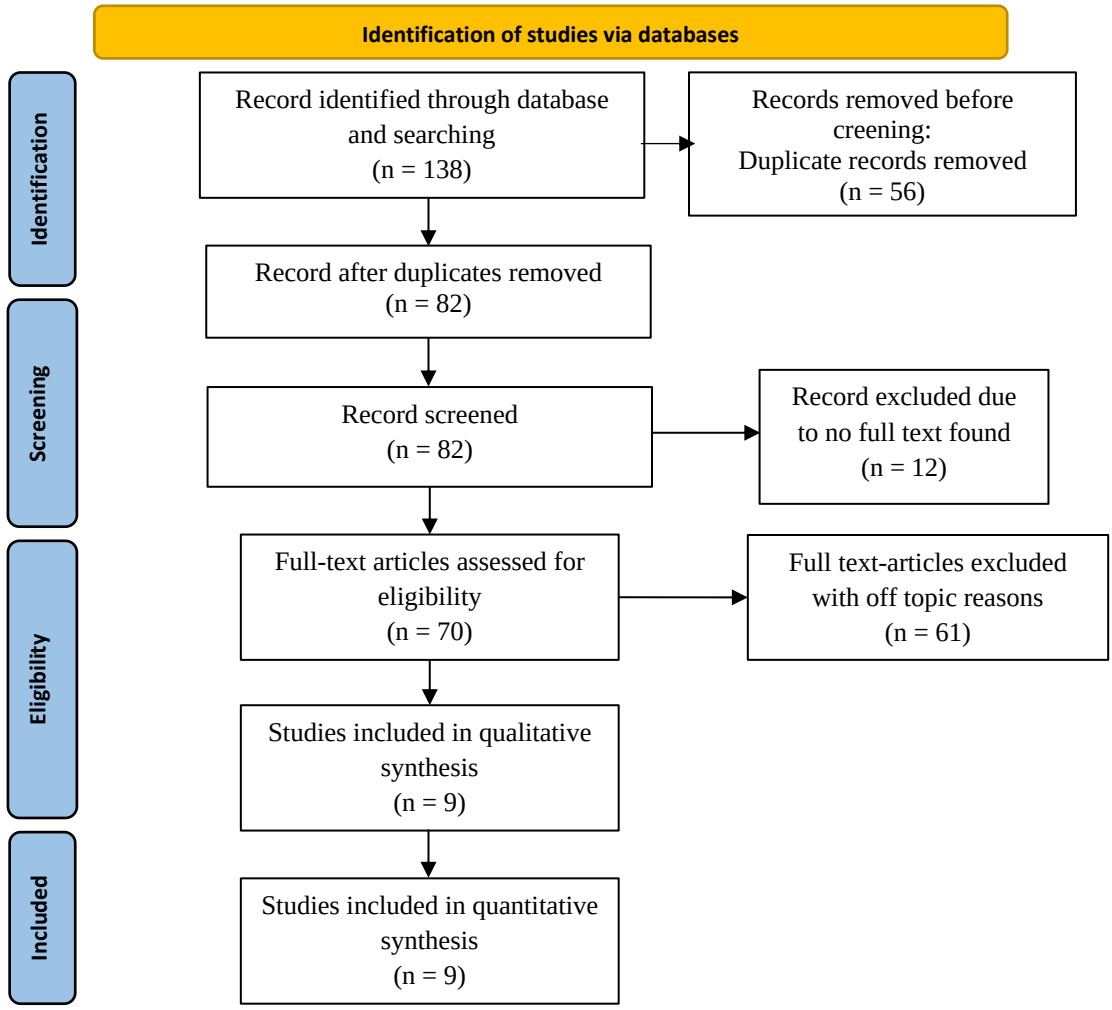

Figure 1. ScR PRISMA flowchart of the study design and manuscript-selection process.

RESULT

The table below schematically shows and summarizes the main effective results of hyperbaric oxygen therapy after maxillofacial surgery (Table 1).

Table 1. Effectiveness of hyperbaric oxygen therapy post maxillofacial surgery.

Reference	Clinical Indication	Sample	Method	Result
Yamamoto, et al., (2014) https://www.joms.org/article/S0278-2391(14)00779-4/abstract.	Osteomyelitis jaws	39 patients	Combination surgery and hyperbaric oxygen therapy.	A success percentage of 83.9% was attained when surgery and HBO treatment were used together. HBOT is a viable supplemental treatment option for jaw osteomyelitis.

Drew, et al., (2018) doi: 10.1563/aaid-joi-D-18-00046.	Leg chronic ulcer associated with SLE.	A woman with SLE presented with chronic, non-healing ulcers that did not respond to conventional treatments.	The patients experienced hyperbaric oxygen therapy under 2.4 atm absolute pressure, and each session lasted for 90 minutes. This treatment plan was given to the individuals daily, resulting in twenty sessions. The patient was also maintained on her regular SLE medication regimen.	The combination of maintaining the patient's regular SLE medications, alongside the HBOT sessions, underscore the comprehensive approach to managing her condition and the specific challenge of treating her intractable skin ulcers.
Altug, et al., (2018) doi: 10.1590/1678-7757-2018-0083.	Dental Implant (Animal Study)	12 rabbits	The animals categorized under HBO underwent a series of 10 sessions involving HBO treatment. Each session lasted 90 minutes, during which the subjects were exposed to 2.5 ATM of entirely uncontaminated oxygen. Maintaining the patient's regular SLE medications alongside the HBOT sessions underscores the comprehensive approach to managing her condition and the specific challenge of treating her intractable skin ulcers.	In the fourth and eighth weeks, histological analyses showed that all the samples successfully integrated with the host bone, leaving only a few inflammatory tissues behind. The newly formed bone tissue grew into more organized and developed structures.
Eldisoky, et al., (2023) doi: 10.1186/s12903-023-02801-w.	Mandibular Defect Regeneration (Animal Study)	16 rats	HBOT was started 24 hours postoperatively, and animals were placed in specially-made plastic boxes with oxygen cylinders. The animals received 90 minutes of HBO therapy at 2.4 ATA for five consecutive days over a period of three weeks.	The results demonstrated the effectiveness of HBOT in boosting bone growth and the development of new blood vessels in mandibular defects.
Oliveira, et al., (2013) doi: 10.1007/s10006-013-0390-9.	Mandibular reconstruction (Case report)	A 29-year-old woman was diagnosed with solid ameloblastoma	The hyperbaric oxygen therapy plan employed includes ten sessions before the reconstructive surgery and 40 sessions after.	After six months, it becomes possible to observe the preservation of the mandibular form and pleasing facial aesthetics. This is achieved through the process of mandibular

				reconstruction. A The panoramic view demonstrated the successful placement of the bone graft and maintenance of its volume.
Huang, et al., (2021) doi: 10.7150/ijms.57360.	Maxillofacial Bone Cyst	85 patients	The HBOT was conducted within a hyperbaric chamber (HAUX, Karlsbad-Ittersbach, Germany).	HBOT reduces the postoperative infection rate after enucleation of the jaw cysts by replacing bone and increases the bone repair rate.
Re, et al., (2019) doi: 10.4103/2045-9912.260651.	Osteoradionecrosis	It does not specify the exact number of patients with SLE treated with HBOT for each condition.	Each session of hyperbaric oxygen therapy, conducted under 2.4 atm absolute pressure, lasted for 90 minutes.	The therapy's role in reducing post-operative infections, promoting wound healing, and supporting tissue regeneration is particularly beneficial for patients with compromised healing abilities, such as those with SLE.
Kimura, et al., (2024) doi: 10.7759/cureus.69226.	Osteonecrosis jaw of the Mandible	Three patients, two with stage 3 MRONJ and one with stage 2 MRONJ, had a history of osteoporosis and were treated with bisphosphonates and/or anti-RANKL antibodies	The patients underwent HBOT sessions in a hyperbaric chamber, where they breathed 100% oxygen at pressures greater than sea level. The specific protocol typically involved multiple sessions, with each session lasting about 90 to 120 minutes, depending on the individual patient's condition and treatment plan. Patients were treated both before and after any surgical interventions to enhance healing and recovery.	The findings indicated that HBOT significantly improved outcomes for older patients with medication-related osteonecrosis of the jaws (MRONJ). Patients experienced reduced pain levels and improved quality of life following HBOT. The combination of HBOT with conventional treatments resulted in successful management of MRONJ, enabling some patients to avoid extensive surgical procedures.
Lin, et al., (2020) doi: 10.22462/04.06.2020.10.	Osteonecrosis of the jaw	64-year-old female with osteoporosis and MRONJ	The patient was referred for hyperbaric oxygen therapy (HBO2) at the NYU Kimmel Hyperbaric Wound Center. Following allergy	A follow-up CT scan revealed no signs of osteonecrosis and showed improved bone remodeling compared to a prior

	testing in consultation with an infectious disease specialist, she began treatment with amoxicillin/clavulanate 875 mg during HBO2 therapy. The patient completed 40 sessions of HBO2, each lasting 90 minutes at 2.0 atmospheres absolute, in September 2018.	scan. The patient remained asymptomatic, with unremarkable clinical findings, and expressed satisfaction with her results during an eight-month follow-up.

DISCUSSION

Systemic lupus erythematosus (SLE), another name for lupus, is an intricate autoimmune condition with a protracted relapsing-remitting history and various symptoms ranging from mild to life-threatening. Genetic predisposition interacts with environmental, immunological, and hormonal factors to cause SLE in people, with a strong preference for women of childbearing age (Basta, et al., 2020). Systemic lupus erythematosus (SLE) is an autoimmune disease marked by nuclear autoantibodies. These can cause immune complex formation and organ inflammation. Despite improvements in treatment, SLE is still linked to early mortality. According to estimates, the usual death rate for SLE is 2.4-5.9% (Lou, et al., 2022).

Systemic lupus erythematosus (SLE) is a long-term systemic autoimmune disease with varying severity and progression, characterized by a tendency for flare-ups. SLE involves both innate and adaptive immune responses. The interplay between genes and environmental factors results in various immunological changes that lead to persistent immune reactions against the body's nucleic acids. This, in turn, causes tissue damage in organs such as the kidneys, heart, blood vessels, central nervous system, skin, lungs, muscles, and joints, resulting in significant morbidity and higher mortality rates (Ganapathy, et al., 2017; Fanouriakis, et al., 2021).

A combination of immunological and hormonal factors, environmental triggers, and genetic predisposition is required for SLE to manifest clinically. It loses its ability to fight off self-antigens and proinflammatory chemicals like type 1 interferons and other cytokines when the environment is too open to them (Durcan, et al., 2019). Autoimmune illness is caused by issues related to the clearance of apoptotic debris, altered lymphocyte biology, interferon pathways, neutrophil extracellular traps, immune complexes, and neutrophil extracellular traps. The higher family risk and monozygotic twin concordance of 11–50% suggest a genetic predisposition. A higher risk of getting lupus has been linked to several genes that make immunological parts, such as HLA, IRF5, ITGAM, STAT4, BLK, and CTLA4 (Fava, et al., 2019).

Studies have revealed new details regarding systemic lupus erythematosus (SLE) and the interleukins 17, 23, and 33. In SLE patients, IL-17 production is abnormally high, and there is a positive association between IL-17 levels and the SLE Disease Activity Index (SLEDAI) score. Patients with lupus have greater serum levels of IL-17 than healthy individuals. However, the SLEDAI 2000 score does not correlate with these interleukin levels. The relationship between IL-23 and the IL-17 axis is essential for the inflammatory response in SLE. Serum levels of IL-17 and IL-23 are elevated in SLE patients, and the lack of a connection between these cytokines suggests distinct regulatory mechanisms. Although IL-33 does not contribute directly to the disease, it plays a role during the acute stage and affects platelets and red blood cells (Alduraibi, et al., 2023).

Patients with SLE are treated to reduce drug adverse effects, promote remission and maintenance, and prevent recurrence while avoiding disease flare-ups. SLEDAI scores of zero indicate total remission or the absence of any active inflammation; scores of 1–5 indicate mild disease activity; scores of 6–10 indicate moderate disease activity; scores of 3 or more indicate a flare-up of the disease; and scores of 3 or more indicate a response to treatment. The scoring systems significantly influence the selection of medications and their efficiency in treating disease (Ameer, et al., 2022).

Table 2. Clinical domains and criteria for systemic lupus erythematosus (Ameer, et al., 2022).

Clinical Domain	Criteria	Weight
Constitutional	Fever	2
Hematologic	Hemolytic anemia	4
Hematologic	Leukopenia	3
Neuropsychiatric	Seizures	5
Neuropsychiatric	Psychosis	5
Mucocutaneous	Alopecia	2
Mucocutaneous	Oral ulcers	2
Serosal	Pleuritis	5
Serosal	Pericarditis	5
Musculoskeletal	Arthritis	6
Renal	Proteinuria	8

Treatment aims to achieve complete symptom relief and disease remission, enhance patient long-term outcomes, prevent end organ damage, and improve patient quality of life. People with SLE who have antimalarial SLEDAI scores of 3 or less, PGA scores of 1 or less, and prednisone doses of 7.5 mg or less are thought to be in remission (Ameer, et al., 2022). Therefore, antimalarial medications, the most popular of which is hydroxychloroquine, are the primary line of treatment for the SLE maintenance phase. Prednisolone is administered intravenously during the acute phases; depending on the severity of the disease, prednisolone may then be gradually tapered off and replaced by an immunosuppressant or an antimalarial (Trindade, et al., 2021).

Table 3. Immunological domains and criteria for systemic lupus erythematosus (Ameer, et al., 2022).

Immunological Domain	Criteria	Weight
Autoantibodies	Anti-dsDNA	6
Autoantibodies	Anti-Sm	6
Autoantibodies	Antiphospholipid	2
Complement Proteins	Low C3	4
Complement Proteins	Low C4	4
Other Biomarkers	Elevated ESR	1

Treatment for SLE patients should be multi-layered and start as soon as possible after diagnosis to minimize disease progression, recurrence, damage, and comorbidities. Indeed, the likelihood of controlling the disease with a manageable drug regimen in a fair amount of time increases with earlier treatment. From a therapeutic standpoint, verifying the ideal dosages and delivery methods for the existing medications, including glucocorticoids, through RCTs would be advantageous, given the well-known risks of overtreatment (Gatto, et al., 2022). One possible treatment for SLE patients is hyperbaric oxygen therapy.

Hyperbaric oxygen therapy (HBOT) involves exposure to elevated quantities of pure oxygen (O2) in atmospheric pressure. Hyperbaric oxygen therapy (HBO) is an effective supplementary therapy in disturbed normal healing conditions. Oxygen can move the nitrogen stored in the tissues when inhaled at extremely high pressure (Růžička, et al., 2021). Decompression sickness can be treated faster by using hyperbaric oxygen. The fundamental goal of HBOT therapy is to deliver 100% pure oxygen under high pressure in a room that is at least 2 ATA in size (Ortega, et al., 2021). Hyperoxia and oxidative stress were brought on by hyperbaric oxygen therapy.

There are 14 reasons why HBOT might be used. These include cyanide poisoning that is complicated by carbon monoxide poisoning, severe thermal burns, air or gas embolisms, severe thermal burns, central retinal artery blockage, damaged grafts and flap crush injuries, compartment syndrome and other severe traumatic ischemia, clostridial myositis, and myonecrosis (gas gangrene). There are also

indications for delayed radiation damage (soft tissue and skeletal necrosis), decompression sickness, and a few problem areas, such as idiopathic abrupt sensorineural hearing loss, severe anemia, necrotizing soft tissue infections, and osteomyelitis, which show improvements in wound healing (Fu, et al., 2022). For HBOT, there are both absolute and relative contraindications. The only unequivocal contraindication is an untreated pneumothorax (Kirby, et al., 2019). Respiratory tract infections, chronic obstructive pulmonary disease, high fever, epilepsy, pregnancy, immobility, dysfunction of the Eustachian tube, claustrophobia, and prior surgical history are relative contraindications. HBOT can cause barotrauma, an imbalance in pressure between the air-containing area and the surroundings. Ear barotrauma is the most prevalent condition and can harm the lungs, middle ear, sinuses/paranasal, teeth, or gums (Gottfried, et al., 2021). Chest tightness, coughing, fatigue, headaches, vomiting, and a burning sensation in the chest are other adverse effects of HBOT. Complex interactions exist between HBOT and hemodynamics, oxygen transport, and immunity. The body can react as a result of a great therapeutic impact. Hyperbaric oxygen therapy has the potential to work as an antibacterial treatment since it can generate oxygen-free radicals that can oxidize proteins and lipid membranes, harm DNA, and hinder bacteria from performing their metabolic tasks (Sari, et al., 2023). Through the oxygen-dependent peroxidase system, HBOT aids leukocytes in killing germs and is also effective against anaerobes. The oxygen-dependent transport of several antibiotics across the bacterial cell wall is also known to be triggered by hyperbaric oxygen (Choudhury, 2018).

Individuals with immune diseases experience notably larger wounds and a considerably longer healing time than the general population (Avishai, et al., 2017). SLE is characterized by producing various autoantibodies that interact with endogenous antigens, favoring widespread inflammatory injury. SLE impacts the immune system, diminishing its ability to defend against infections. Many medications used to treat SLE also harm the immune system, making it harder for patients to fight infections (Pisetsky, 2023).

Hyperbaric oxygen therapy (HBOT) refers to the administration of 100% oxygen to a patient inside a pressurized chamber at a pressure greater than one atmosphere at sea level. HBOT is a systemic treatment in which the patient breathes pure oxygen under pressure for a specific duration. The therapeutic benefits of HBOT are achieved by increasing the amount of dissolved oxygen in both plasma and tissues, thereby enhancing oxygen delivery to tissues (De Wolde, et al., 2021; Marcinkowska, et al., 2022).

Hyperbaric oxygen therapy enhances healing by increasing oxygen concentration, effectively reversing hypoxic tissue injuries. This oxygen supply also aids neutrophils in their function. Additionally, hyperoxygenation leads to vasoconstriction in normal tissues, which proves beneficial in managing post-traumatic tissue edema. This effect is mainly utilized in treating compartment syndrome, crush injuries, and burns (Ortega, et al., 2021). Blood circulation is crucial in delivering oxygen and nutrients to the tissues and eliminating metabolic by-products, including carbon dioxide. The delivery of oxygen depends on its availability, arterial blood's capacity to transport oxygen, and tissue perfusion. This enhanced tissue oxygenation positively influences the healing process in inflammatory and microcirculatory disorders, particularly under ischemic condition (Sen & Sen, 2021).

In dentistry, hyperbaric oxygen therapy is utilized in osteomyelitis, osteoradionecrosis, dental implants, and mandible reconstruction (Re, et al., 2019). The treatment for osteomyelitis involves oral antibiotics to kill microorganisms in the soft tissues around the infection site and surgery to remove necrotic bone on a macroscopic level. However, HBOT can increase the host response by favoring the action of inflammatory cells. Also, the right amount of oxygen helps bone growth and new blood vessels grow to fill empty spaces with bone or blood vessel tissue (Monis, et al., 2021). The study shows that HBOT has a success rate of 80% with a treatment duration of 21 days. Therefore, HBOT is effectively utilized as a therapy following surgical treatment.

Before extraction, dental implants have become a popular option for tooth replacement. As the bone fuses with the implant during growth, it can remain stable throughout functional loading when surgically placed in the mandible or maxilla (Singh, et al., 2015). Proper osseointegration is essential for the implant to settle correctly. To achieve successful osseointegration, the implant material and jawbone must be reasonably biocompatible, the bone tissue must be of sufficient quality, the surgery must be performed precisely, and the implant's macro- and microstructure must be suitable (Pandey, et al., 2022). However, these implants may create fresh sites for biofilm bacteria to grow, potentially leading to infections that are difficult to treat with medications. Hyperbaric oxygen therapy (HBOT) is a well-

known, secure, and effective therapeutic alternative. For implant insertion, HBOT prepares the bone and surrounding tissue (Re, et al., 2019). According to Shandley, et al., (2012), the use of oxygen therapy at high concentrations is directly related to the development of healthier tissue and improved implant-bone integration.

Surgery to restore the oromandibular region after removing benign tumors, malignant tumors, osteomyelitis, or a radiation-induced necrotic mandible is still challenging for surgeons. Mandibular reconstruction is a difficult procedure that aims to enhance aesthetic, swallowing, speaking, and chewing abilities, among other tasks (Kumar, et al., 2016). According to a case report, an 84-year-old woman initially had cancer of the right oral mucosa. Following mandibular segment excision, titanium plates are chosen for use based on several risk factors. The center of the chin plate opens following surgery. Based on testing, HBOT is the only promising option. HBOT results in wound epithelial development (Maeda, et al., 2016).

In patients with osteonecrosis associated with systemic lupus erythematosus (SLE), hyperbaric oxygen therapy (HBOT) demonstrated therapeutic success. Despite prior use of conservative treatments yielding inadequate recovery, HBOT played a crucial role in mitigating postoperative infections, enhancing wound healing, and fostering tissue regeneration. This is especially advantageous for patients with compromised healing capabilities, such as those affected by SLE (Re, et al., 2019). The patient experienced decreased pain and improved jawbone health, as confirmed by subsequent imaging and clinical assessments that revealed substantial bone regeneration. Hyperbaric oxygen therapy (HBOT) plays a crucial role in healing the mucosa and reducing inflammation, which is essential in the treatment of jaw osteonecrosis (Biancardi, et al., 2021).

The results indicated that HBOT is effective for various conditions related to systemic lupus erythematosus (SLE) and maxillofacial procedures. When combined with surgical intervention, HBOT increased the success rate of treating jaw osteomyelitis to 83.9% (Yamamoto et al., 2014). In patients with chronic ulcers due to SLE, HBOT accelerates wound healing in cases unresponsive to conventional therapies (Drew et al., 2018).

In vivo studies and clinical cases show that HBOT promotes osseointegration, bone regeneration, and new blood vessel formation, yielding satisfactory aesthetic and functional outcomes in mandibular reconstruction (Altug et al., 2018; Oliveira et al., 2013). Additionally, HBOT reduces the risk of postoperative infections and supports bone repair in patients with bone cysts or osteoradionecrosis (Huang et al., 2021; Re et al., 2019). For elderly patients with medication-related osteonecrosis, HBOT improves quality of life by alleviating pain and promoting bone remodeling (Kimura et al., 2024; Lin, et al., 2020).

Overall, HBOT demonstrates excellent potential as an adjunctive therapy to enhance clinical outcomes in patients with SLE and those undergoing maxillofacial procedures.

Strength and limitations

This paper serves as a foundation for further research to validate the proposed theory. One limitation of the existing studies is their focus on hyperbaric oxygen therapy (HBOT) for enhancing healing processes in patients with systemic lupus erythematosus (SLE). Although the reviewed articles examine the efficacy of HBOT in treating osteonecrosis of the jaw (ONJ) and its general healing benefits, none specifically address clinical or animal models of SLE undergoing HBOT after maxillofacial surgery. With experimental animal models of SLE already developed, future research could leverage these models to explore the effects of HBOT on ONJ within the context of SLE. Such investigations would offer clearer insights into the interplay between HBOT, SLE, and post-surgical healing in maxillofacial conditions.

CONCLUSION

Hyperbaric Oxygen Therapy (HBOT) is a systemic treatment in which patients inhale pure oxygen at pressures exceeding one atmosphere for a specified duration. Systemic lupus erythematosus (SLE) is a chronic autoimmune disorder that leads to tissue damage across various organs, such as the kidneys, heart, blood vessels, central nervous system, skin, lungs, muscles, and joints. Individuals with autoimmune diseases typically experience larger wounds and slower healing rates than the general

population. By increasing the concentration of oxygen, HBOT can promote healing and reduce damage to hypoxic tissues. Furthermore, HBOT can enhance the immune response by stimulating the activity of inflammatory cells. In patients with SLE, an adequate supply of oxygen facilitates bone growth and the formation of new blood vessels, aiding in the replacement of dead tissue with healthy bone or vascular tissue.

Acknowledgment
The authors thank the Faculty of Dental Medicine, Universitas Airlangga, and the Faculty of Dentistry, Lambung Mangkurat University, for their support. Appreciation is also extended to colleagues, researchers, and families for their valuable contributions and encouragement.

Conflict of Interest
All authors have no conflict of interest.

Funding Disclosure
This research was self-funded by the authors.

Author Contribution
EMW contributes to conception and design, analysis and interpretation of the data, drafting of the article, provision of study materials or patients, administrative, technical, or logistic support, and collection and assembly of data. GA contributes to conception and design, critical revision of the article for important intellectual content and final approval of the article. ASW contributes to conception and design, critical revision of the article for important intellectual content, and final approval of the article.

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