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HBOT application at cases of gingival inflammation

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Abstract
The treatment of periodontal diseases, mainly of their origin, with the most common clinical manifestation in form of gingival inflammation, is manifold and powerful, including: mechanical therapy, antibiotic, antiseptic and various approaches to treatment, which are recommended to be used within a short period of time. New therapeutic approaches have been proven as alternative treatment to conventional therapy, or in combination with conventional therapies, to reduce the number of periodontopathic pathogens in gingival sulcus.

HBOT has a detrimental effect on periodontal microorganisms, as well as beneficial effects on the healing of periodontal tissue, increasing oxygen pressure in gingival pockets. Our study is aimed at reviewing the current published literature on hyperbaric oxygen therapy and focuses on role of HBOT as a therapeutic measure for the individual with periodontal disease in general and for the impact on the recovery of gingival inflammation.

HBOT and parodontal treatment together, reduce up to 99% of the gram-negative anaerobic load of subgingival flora. HBOT, significantly reduces subgingival anaerobic flora. Clinical effects in 2 year follow-up of treated patients are sensitive. Reduction of gingival hemorrhage indexes, depth of peritoneum, plaque index, occurs in cases of combination of HBOT and detraction. Reduced load persists up to 2 months after therapy. The significant increase in connective tissue removal starts at the end of 2nd week, to achieve the maximum in week 3-6 of application. HBOT used for re-implantation, stimulates the healing of periodontal membrane, pulp, prevents root resorption, healing of periodontal lining tissues. HBOT, significantly reduces the hemorrhage index with 1.2 value difference, 0.7mm probe depth, reduces gingival fluid by 2. HGH exposure is increased by gingival blood flow, with a difference of 2 in measured value. The therapeutic effects of HBOT in the value of the evaluation index can be saved up to 1 year post treatment.

Keywords: hyperbaric oxygen, hyperbaric oxygen therapy, periodontal therapy, gingival inflammation

Introduction

Entry

The appearance of periodontal diseases is caused by the culmination of the interaction of modifiable risk factors. These factors, which when faced with the environment, prescribed by the patient itself, of poor oral hygiene tend to exhibit various clinical stages of periodontal diseases [1, 2, 3, 4]. Specific bacteria create oral flora with interactions individual, expressed in various virulence, whether or not caused by periodontal diseases. The key to the appearance or not is the level of individual patient immunity [5, 6, 7, 8, 9]. The presence of presumed periodontal pathogens present in the gingival sulcus is not sufficient to initiate and promote the gingival inflammation process. The relative increase of the proportions of these bacteria plays a decisive role in causing visible tissue damage [9, 15].

Treatment of gingival inflammation begins with local therapies of oral hygiene, both professional and individual, and then the treatment protocol involves local or systemic application of antibiotics or the application of alternative therapies. One of these therapies, backed up by literature, is treatment with hyperbaric oxygen [15, 23]

Hyperbaric Oxygen (HBO2) has been successfully used in several medical fields. The therapeutic effect is related to increased partial oxygen pressure in the tissue. Self-pressure exacerbates oxygen solubility in the interstitial fluid. HBO2 affects angiogenesis, bone metabolism and bone turn-over. Various studies have been conducted to analyze the effects of HBO2 therapy on periodontal disease. HBO2 boosts the distribution of local oxygen, especially at the periodontal pocket bed, which inhibits the growth of anaerobic bacteria and allows ischemic tissues to obtain sufficient oxygen content to rapidly cure cell metabolism [23, 28].

HBOT (hyperbaric oxygen therapy) is evidenced to promote the highest level of oxygen distribution in the gingival pocket which is detrimental to periodontal pathogens, particularly for anaerobic microorganisms [1, 7, 13]. Cultivation of microorganisms present in [2] HBOT increases the production of free oxygen radicals, which oxidize the membrane proteins and lipids, damage the deoxyribonucleic acid and inhibit the functions of the bony bacterial bacterium (90%). bacterial metabolic. It also alleviates the oxygen-peroxidation system with which leukocytes kill the bacteria. HBOT improves the oxygen-dependent transport of some antibiotics into the walls of bacterial cells [1, 6, 29, 34]. Thus, HBOT results in stopping bacterial growth in the gingival sulcus [28, 33]

Any HBOT attending physician should take full medical history of treatment with the patient before treatment with HBOT, as some medications inhibit the HBOT application and effect, and vice versa. Here you can: high doses of prednisolone (or cortisone-like medicines), morphine, or alcohol, insulin within 8 hours of treatment. Such drugs should be replaced by another drug, if possible. Patients will be instructed to get a powerful nutritional regimen that contains vitamin E and other antioxidants during a full cycle of HBOT [3, 10, 18, 23]

Hyperbaric oxygen therapy is a unique intervention, with a very unobtrusive mechanism of action, but based on frequent literature data, very successful supportive therapy for gingivitis inflammation.

Gingivitis, also as a precedent of periodontitis, is a multifactorial disease caused by pathogenic microorganisms but is modified and somewhat controlled in its continuity, from host response and environmental factors. Most of the microorganisms responsible for the parodontal tissue destruction are obligatory or optional anaerobic [5, 7, 12, 23] HBOT (hyperbaric oxygen therapy) can be defined as 100% therapeutic administration of 100% oxygen at ambient pressure higher than an atmosphere absolute (ATA). Administration involves placing the patient in an airtight chamber, increasing the pressure in that room and giving 100% oxygen to breathing. In this way, it is possible to provide a much higher partial oxygen pressure in the lungs, blood and tissues [5, 6, 9, 13]. An absolute atmosphere is the atmospheric pressure at sea level and is equal to 14.7 psi, or 101.3 kPa (one paska equals a force of 1 Newton, per 1 square meter). The important measures considered during HBOT are the atmospheric pressure of the room and the number of treatment sessions during the treatment [6]. Hyperbaric oxygen therapy (HBOT) includes the 100% under pressure oxygen therapy therapeutic, which has a harmful effect on the microorganisms anaerobes responsible for periodontal disease [23, 33]

HBOT is evidenced to promote the highest dispersal of oxygen in the gingival pockets which is detrimental to periodontal pathogens, particularly for anaerobic microorganisms [1] Cultivation of the microorganisms present in the bacterial plaque from the active chronic periodontal regions reveals high percentage of anaerobic bacterial species (90%) [2].

Materiale dhe metoda

The study is of a review type with the aim of finding the advantages and disadvantages of treating gingivitis inflammation with hyperbaric oxygen therapy. Electronic search is conducted to find articles, mainly using MEDLINE and PubMed, in the period 1970 to 2018.

First stage

Includes finding the main terms, derived from articles that have been talking about hyperbaric oxygen therapy for the treatment of clinical pathologies with indications for this treatment protocol. These terms, in the MES database at the "PubMed" site, were:

1. Hyperbaric Oxygenation (11635)
2. Hyperbaric Therapy (13806)
3. Gingival Inflammation (16786).

Second stage

When trying specifically to talk about possible indoor healing, using oxygen therapy therapy, it was noted that there were about 26 articles, with coverage and repetition, specifically specified as follows:

1. HBO and Periodontal Treatment (6)
2. HBO and gingival treatment (7)
3. HBO and Periodontal Status (8)
4. HBO and therapeutic effect on periodontitis (1)
5. HBO and Detainees (3)
6. HBO and Periodontal Microbiology (1).

Third Stage

Specific terms of the second stage were applied to google, to further extract even more articles on the preferred theme (in total 42).

1. HBO and parodontal treatment (24)
2. HBO and gingival treatment (16)
3. HBO and Periodontal Status (8)
4. HBO and therapeutic effect on periodontitis (1)
5. HBO and Detainee (16)
6. HBO and Periodontal Microbiology (2).

After analyzing abstracts and articles collected up to the third stage, criteria for inclusion and non-inclusion were analyzed. 38 articles were selected at this stage. The inclusion criteria in the analysis were all items that directly evaluate HBOT's influence on gingival inflammation. The non-inclusion criteria were:

1. Studies that do not directly mention both key words, simultaneously: HBOT and periodontal inflammation.
2. Studies aimed at the effects of HBO therapy on systemic diseases that did not have or affect oral health.
3. Experimental studies carried out in various parts of the body of the animals involved, not in oral cavity.

Analysis of 38 items for obtaining valuable study information. In order to categorize the data, the included studies were analyzed on the basis of the analysis and evaluation model as well as on the basis of the size of the patient's sample, using the following data:

Valuable and scientifically and clinically based:

- Review of randomized clinical specimens
- Two or more randomized samples
- A randomized sample and 2 or more prospective studies.(33)

Below are the 38 selected items: 2 articles talk about the microbiological assessment of the effect of hyperbaric therapy:

1. By the Klimek H *et al* [34] were the first in 1970, evaluated microbiologically influence of therapy with hyberbaric oxygen in the periodontal bacterial flora.
2. In 2007, it is an article that places emphasis on the influence on periodontal microbial load. Signoretto C *et al* [35] performs the microbial evaluation of hyperbaric oxygen in periodontal diseases, with emphasis on gingival inflammation.

16 articles were written at different time periods, on clinical evaluation in patients, the effect of HBO therapy on gingival inflammation:

1. Matveeva AL *et al* (36) in 1970 evaluated the influence of some physical therapeutic methods in the treatment of periodontitis at the level of oxygen concentration in human gingiva.
2. Guentherman RH et.al. (37) in 1972, emphasized the increased concentration of oxygen in the blood, for the reduction of periodontal diseases.
3. Belchikov EV *et al*. (38) in 1975, again in Russia, published the article on treatment of periodontal diseases with hyperbaric oxygen.
4. Ivanov VS et. al. (39) in 1979, already in Bulgaria, treated some forms of inflammatory dystrophic periodontitis with hyperbaric oxygen.
5. Gotsko EV et. al. (40) in 1980, in Russia, began to report for the first time on experience in the application of hyperbaric oxygen for the treatment of periodontitis.
6. Sumachev VI et. al. (41) published in 1983 clinical data on the application of combined therapies of hyperbaric oxygen for periodontal inflammatory diseases.
7. Belkevich AM (42) in 1987, in Russia, published an article on the application of hyperbaric oxygen as the only therapy for the treatment of gingival inflammation.
8. Epstein J *et al*. (43) in the article published in 1997, emphasized the recurrence of treatment of necrotized areas with hyperbaric oxygen, to be fully related to the activity of periodontal diseases.
9. Ali A *et al* (44) in 1997 evaluated the effects of hyperbaric oxygen therapy on implants placed in the oral cavities.
10. Chen F et. al. (45) in 2000, published clinical data on the treatment of periodontal tissue in permanent teeth, after treatment with hyperbaric oxygen.
11. Chen TL *et al*. (46) in 2003 emphasized the effects of hyperbaric oxygen therapy in cases of aggressive periodontitis.
12. Guo YH *et al*. (47) published in 2004, pronounced results on the application of hyperbaric oxygen, combined with supra and subgingival detara.
13. Agrillo A et. al. (48) in 2006, stressed the introduction of a new protocol for the treatment of periodontal lesions, stressing that between therapeutic selections of periodontal inflammation treatments, hyperbaric oxygen therapy should be supportive therapy.
14. Andriani A. et. al. (49) in 2012, in their retrospective study on the treatment of osteonecrosis of the jaws of a predetermined group of patients, emphasized the fact that hyperbaric oxygen therapy should accompany gingival dating procedures.
15. In 2012, Tie-Lou Chen *et al*. (50) published clinical data on patients on the effects of hyperbaric oxygen therapy, expressed in visible changes in clinical parameters.
16. Ottria L et. al. (51) in 2018 published data on improved clinical outcomes evaluated by appropriate periodontal parameters in cases of hyperbaric oxygen treatment.

In total, there are 10 review articles, published over the years, with the aim of collecting published clinical data on the effect of hyperbaric oxygen therapy in inflammatory gingival areas:

1. Bazhanov NN et. al. (52) in 1980 published a review article about the use of hyperbaric oxygen in dentistry.
2. Beumer J et. al. (53) in 1984, is actually an article that emphasizes the fact of combining therapy with hyperbaric oxygen, or surgical interventions with hyperbaric oxygen. In this article, the emphasis is put on the combination of two protocols of treatment, as hyperbaric oxygenation is the supportive therapy of the two other methodologies, with the aim of achieving the highest results.
3. Myers RA *et al*. (54) in 1990, light up on post-treatment postoperative treatment with hyperbaric oxygen.
4. Perrier M et. al. (55) in 1994, emphasized the fact that hyperbaric oxygen therapy is an effective therapeutic treatment, but also preventive technique.
5. Konter U *et al*. (56) in 1995 published an article stating that hyperbaric oxygen significantly reduces the proportion of periodontal dental complications and is therefore indicated as a prophylactic pre and postoperative measure.
6. Urade M. (57) in 2007, evidence of delayed osteonecrosis occurring, when periodontal surgery was applied, where treatment with hyperbaric oxygen would not be effective.
7. Koga DH. et.al. (58) in 2008, again emphasize that hyperbaric oxygen therapy is a supportive therapy and an addendum to basic treatment therapy.
8. The M (59) in 2009, as a continuation of the 2007 article, recreated the refreshed data of the foregoing article, highlighting the role of oral hygiene, patient education, and deployment of treatment stages, in support of the stages clinical periodontal disease.
9. Zheng M et. al. (60) in 2014, stressed the role of hyperbaric oxygen therapy in the treatment of periodontal diseases, manifested in implants.
10. Bayetto *et al*. (61) in 2017 emphasized the essential role of hyperbaric oxygen therapy, particularly in the treatment of necrotizing complications of odontogenic inflammatory infections.

The analyzes performed on experimental samples are another set of summarized articles. There are 4 items in this sample:

1. Shannon MD *et al*. (62) experimented with rats, the effect of oxygen at high atmospheric levels. Periodontal healing occurred after 12 weeks of treatment (1988).
2. Hayakumo S *et al*. (63) in 2014 published the article on the in vitro experiment in humoral cells on the reduction of perio-odontogenic bacteria. The number of porphyrone and actinomycin colonies is significantly reduced, due to hyperbaric oxygen therapy.
3. Chang H *et al*. (64) in 2016 published an article on hyperbaric oxygen therapy experiment. It was emphasized that the level of angiogenesis was higher in cases of the use of hyperbaric oxygen therapy as an adjunctive therapy.
4. Gajendrareddy PK *et al*. (65) in 2017, highlighted the effect of hyperbaric oxygen therapy in an experimental sample of periodontal indicated by tight ligature in tissue structures.

Case-reports are few studies in the number of selectively selected ones. This group includes **6** items:

1. Galler C *et al*. (65) in 1992, in the case report, featuring data from 3 clinical cases, highlighted the proposal that in the periodontal treatment the application of chlorhexidine and hyperbaric oxygen are important elements of the treatment

protocol of gingival inflammation.

2. Edwards JD *et al*. (66) presented in 2004 the clinical case of a 44-year-old patient with a necrotic adenovirus of odontogenic origin, pointing out that the best treatment is the combination of surgery, therapies, antibiotics medications and hyperbaric oxygen.
3. Soileau KM (67) in 2006, referred to the case of a 69-year-old patient with a history of breast cancer metastases, with pain in the upper left quadrant and periodontal pockets of more than 6mm. The recovery of the patient was slow, only with the help of hyperbaric oxygen therapy.
4. Picarella *et al*. (68) published in 2009 a clinical trial of a patient with necrotizing infections originating from periodontal infections. There are high-frequency mortality infections. Even in this article, the role of hyperbaric oxygen therapy was emphasized as a very efficient treatment.
5. Lu PC et.al. (69) in 2015, presented the case of a 50-year-old patient with mandibular osteomyelitis and lower lobe paresthesia. Only with the treatment of hyperbaric oxygen as additional therapies after surgical intervention, it was noticed that the total recovery in the form of periodontal structures occurred after 4 years.
6. In 2016, Nishimoto K *et al*. (70) published an article on the case of a 48-year-old patient with epistaxis episodes associated with poor oral hygiene and engrossed smokers, reports development of necrosis of tissue lips and alveolar bones of the periodontitis. The wound was treated with necrotomy, administration of atibiotics, prostaglandin and hyperbaric oxygen.

Results and discussions

The processing results of the collected data are presented in the tablesbelow.

Table 1: The table lists the selected items, organized on basis of year of publication and the type of item.

Type of article	Year of publication 1970-1989	Year of publication 1990-2009	Year of publication 2010-2018
Microbiological evaluation	1	1	0
Clinical evaluation in patients	7	6	3
Case report	0	4	2
Review	2	6	2
Experimental	1	0	3
Total	11	17	10

Clinical evaluation in patients with large samples, or case report type, is expressed on the basis of applied methodology and the type of study with control group, retrograde, prospective, cross-sectional.

Table 2. Separation of the items collected depending on the type of the article, based on the sample of patients.

Type of study No. of patients	Grup controll	Retrograd	Cross-seksional	Prospektiv, longitudinal study
No. not assigned of patients	2	-	-	2
Small samples 1-10 cases	-	-	4	8
Large patient samples	4	3	1	1

• With an unspecified number of patients, it refers to cases where samples of tissue blocks have been taken by patients and clinical assessments have been carried out on them. These samples may be 1 for each patient, but also for a few for 1 patient, as determined by inclusion criteria in the study.

Table 3: Studies on the positive effect of hyperbaric oxygen therapy, as the only application therapy for gingivitis inflammation.

No.	Author	Sample of people involved in the study	Type of study	Results
1	Beumer J *et al*. [53]	The population involved in the study of indefinite patients, evaluating the effect of HBOT on periodontal diseases at the sample level 19/83 affected areas.	Control group	Conventional therapy is more applicable to initial lesions in the fixed mucous membrane, while the combination with HBOT is more effective for deeper lesions.
2	Shannon MD *et al*. [62]	Experiment on mice.	Control group	After histologic analysis, periodontal tissue repair occurs documented after 3 to 6 weeks maximum, with 2.4A atmosphere.
3	Galler C *et al*. [66]	3 patients with osteoradiopathy, from active areas with periodontal inflammation.	Case report	Successful combination of the use of HBOT chloramidine chlorhexidine use.
4	Perrier M *et al*. [55]	Analysis of articles on osteoradiocrosis caused by dental and periodontal pathologies.	Review	Some authors emphasize that treatment with hyperbaric oxygen is a successful therapeutic and preventive technique.
5	Konter U et. al. [56]	Osteoarthritis treatment, caused by periodontal pathologies.	Review	Preventive prevention of complications.
6	Epstein J *et al*. [43]	26 patients on their evaluation of the effect of osteoradionectose recurrence caused by periodontal inflammation.	Retrograde	Successful hyperbaric oxygen therapy in cases of combination with surgery. Success is indicated by the success of periodontal disease activity.
7	Ali A *et al*. [44]	Show of 10 patients with 42 implants in both jaws.	Cross seksional	HBOT successful in rehabilitating tissue-bearing tissues.

8	Chen F *et al.* [45]	138 permanent teeth, extracted from alveola	Control group	Successful HBOT in reimplanting the luxurious tooth, as it helps in the recovery and recovery of dental structures.
9	Chen TL *et al.* [46]	30 patients with periodontitis, evaluated by periodontal indexes, evaluation by: ▪ gingival indexes ▪ the hemorrhage index ▪ depth of the probing ▪ The atashment loss.	Control group	HBO with a good therapeutic effect on peridontitis, effects lasting more than 1 year. Significant differences in the reduction of index values pre and post HBOT.
10	Guo YH *et al.* [47]	Patients with periodontitis treated according to three treatment protocols, including HBOT	Control group	At the 3 different treatment methods of parodontitis, HBOT combined with supra and subgingival scaling has the maximum visible assessment.
11	Adriani A *et al* [49]	51 patients treated for osteonecrosis with HBOT (16/51)	Retrograde	Successful, scaling accompanied with HBOT. Osteonecrosis after dental extractions before treatment with biophosphonates should have continuous periodontal health.
12	Hayakumo S *et al.* [63]	Sample of tissue blocks evaluates the effect on periodontopathy bacteria.	In vitro - experimental	HBOT destroys bacterial / non-toxic tissues, supplementary therapy in periodontology.
13	Lu PC *et al.* [70]	Patient 50 years old, clinical case of HBOT treatment	Longitudinal Follow up 4 year old	HBOT increases vascularization in periodontal tissues. It is thought of as a good supplement therapy in periodontology.
14	Chang H *et al.* [64]	Experiment on 28 mice, over the 4 week histological evaluation of additional therapy with HBOT.	Control group	HBOT therapy is successful in bone resorption. Estimated by histometric analysis.
15	Bayetto K *et al.* [61]	672 patients in the period 2006-2015 with necrosis fascitis	Retrograde	Successful HBOT as additional therapy.
16	Ottria L *et al.* [51]	Eight patients with 30-50 years of age evaluated by periodontal indexes underwent cyclic therapy with HBOT.	Longitudinal	In all patients treated with HBOT, the improvement of periodontal indexes is improved.
17	Tie-Lou Chen *et al.* [50]	60 patients with divided aggressive periodontal in 2 groups to control the effect of treatment with HBOT.	Control group	HBOT combined with detraction has the maximum effect on the value of periodontal indexes.

Table 4: HBOT effect when applied to periodontal lesions alone or in conjunction with other treatment protocols.

Type of article	Periodontology	Surgery / Periodontology	Implantology / Periodontology	Radiotherapy/ Periodontology
Microbiological evaluation	2	-	-	-
Clinical evaluation in patients	6	2	1	1
Case report	2	2	-	4
Review	1	4	1	2
Experimental	2	-	-	-
Total	13	8	2	7

Table 5: This table summarizes the articles that are considered most relevant to the conclusions of this study.

No.	Authors	Purpose of the study	Type of study	Results
1	Signoretto C *et al.* [35]	Evaluation of the effect of HBOT on a population with chronic periodontitis, compared to other treatment protocols.	Microbiological evaluation of bacterial flora at gingival sulcus, as it varies in flora.	According to microbiological data, HBOT and Detaine together reduce up to 99% of the gram-negative anaerobic load of subgingival flora. Reduced load persists up to 2 months after therapy.
2	Shannon MD *et al.* [62]	According to microbiological data, HBOT and Detaine together reduce up to 99% of gram-negative anaerobic load of subgingival flora. Reduced load persists up to 2 months after therapy.	Exposure 90 min every day to HBOT at 40 mice with control group.	Significant increase in connective tissue, beginning at the end of the 2nd week, to achieve the maximum in week 3-6 of the application.
3	Chen F *et al.* [45]	In order to analyze the effects of HBOT treatment in the treatment of periodontitis in young permanent dentures.	HBOT treatment at 025MPa pure 40x2min oxygen every day for 10 days.	HBOT used for reimplantation, stimulates the healing of periodontal membrane, pulp, prevents peeling of the root, healing of periodontal toothpaste tissues.
4	Chen TL *et al.* [46]	The therapeutic effects and the effective duration of HBOT treatment of agonized parodontitis in humans.	HBOT applied with 0.25MPa. Patient-controlled study is evaluated by periodontal bleeding, bacterial, and depth probe indexes.	HBOT significantly reduces the hemorrhage index with a 1.2 margin difference, 0.7mm probe depth, reduces gingival fluid by 2. H2O exposure is increased by the gingival blood flow with the 2nd difference in the measured value. The therapeutic effects of HBOT in the value of the evaluation index can be saved up to 1 year post treatment.
5	Guo YH *et*	To evaluate the clinical effects of	Patients with parodontitis divided into	According to the presence index of aminotransferase

	al. [47]	HBOT combined with supra and subgingival cytotoxicity, for the treatment of periodontal inflammation.	3 groups depending on the treatment protocol: group 1 treatment, group 2 treatment with HBOT and group 3 detraction treatment and HBOT.	presence in the gingival fluid, the best treatment results were combined with detara- tion and HBOT.
6	Ottria L et.al. [51]	The purpose of the study is to test the effect of HBOT on healing of periodontal structures, assessed effects in 8 patients with HBOT with 2.5ATA.	Periodontal status assessment of patients according to periodontal indexes, before and after HBOT.	Results in all patients treated with HBOT speak for a very positive reaction with a marked improvement in clinical and instrumental parameters.
7	Tie-Lou Chen *et al*. [50]	Purpose of the study to evaluate the effects of HBOT on cases of aggressive periodontal, and specifically subgingival bacterial flora.	60 patients divided into 2 groups: group 1 treated with HBOT and detraction and group 2 control group. Comparison of the value of the Bacteroides melaninogenicus anaerobic flora and fauna index.	HBOT significantly reduces subgingival anaerobic flora. Clinical effects in the 2 year follow-up of treated patients are sensitive. Reduction of gingival hemorrhage indexes of plate depth seal depths in combination of HBOT and detraction.

For at least the last 40 years, hyperbaric oxygen therapy has been a recommended treatment alternative and used for a variety of systemic medical conditions, often without adequate scientific or efficacy validation or safety. HBOT has shown that promotes angiogenesis, bone turnover at the turnover level. It is worth mentioning here, the positive effect of HBOT in reducing and partly eliminating the negative influence of radiation at the level of osteointegration. (72) In this perspective, HBOT plays an important role in implant osteointegration, affecting metabolism of bone cells and capillary angiogenesis on various implant surfaces, whether or not, induced by the agents implicated in this direction of osteogenic orientation over the implant surface. (10) HBO therapy as a prophylactic treatment aid with the supra and subgingival detachment is highly indicated for the treatment of moderate and agitated periodontitis. The subgingival flora in the cases of HBOT application has already been significantly reduced. Even the significant improvement of periodontal health is already documented, but we all still need more research, technology advancements, to introduce HBOT as a routine procedure in surgical treatment. (15) Although HBOT has no side effects, most of specialists in this field consider it an element of risk for patients who receive therapy as well as in health conditions for which HBOT is not fully indicated. (10) Table 6, is a summary of some of the conclusions derived from the articles above.

Table 6: Summary of HBOT Dental Complications. (73)

Dental complications	Clinical condition	HBOT mode of action
Osteoradionekrosis	Reduction of oxygen tension, hypotension, hypovascularity	Oxygen stress increases in the affected region and promotes angiogenesis and healing of the wound
Osteomielitis	Chronic, unresponsive wound infection caused by dominant bacteria	Host response increases favoring the action of inflammatory cells
Radiated bones implants	Implants placed on radiated bones, go to implant failure, due to the possibility of bone-borne infections and formation	Stimulates host reaction by favoring immune defense mechanisms
Periodontitis	Their microorganisms and toxins, which affect and affect periodont significantly	Prevents the growth of mandatory anaerobes of subgingival and optional anaerobes and promotes healing of obesity structures

Conclusions

According to microbiological data, HBOT and scailing together, reduce up to 99% of the gram-negative anaerobic load of subgingival flora.

HBOT, significantly reduces subgingival anaerobic flora. Clinical effects in the 2 year follow-up of treated patients are sensitive. Reduction of gingival hemorrhage indexes, depth of peritoneum, plate index, in case of combination of HBOT and detachment.

Reduced loads of bacteria persist until 2 months after therapy. The significant increase in connective tissue recovery starts at the end of the 2nd week, to reach the maximum in week 3-6 of the application. HBOT used for reimplantation, stimulates the healing of periodontal membrane, pulp, prevents root resorption, healing of periodontal lining tissues.

HBOT, significantly reduces the hemorrhage index with 1.2 value difference, 0.7mm probe depth, reduces gingival fluid by 2. HGH exposure is increased by the gingival blood flow, with a difference of 2 in the measured value. The therapeutic effects of HBOT in the value of the evaluation index can be saved up to 1 year post treatment.

It is recommended to apply HBOT and scailing procedures, according to non-surgical periodontal protocols, as according to the aspartate-aminotransferase presence index in the gingival fluid, better treatment results were followed by the combination of scailing and HBOT. Results in all patients treated with HBOT speak for a very positive reaction, with significant improvement in clinical and instrumental parameters.

Supplementary Materials

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Thanksgiving belongs to our family. Henri and Hera are our pushes, and further in the field of scientific research.

Author Contributions

Literature research was conducted by Dr. Saimir Heta. It was his insistent work that made it possible to reach the conclusions in this article.

Conflicts of Interest

We declare that there is no conflict of interest between the authors and the material presented in this article.

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