University J Dent Scie 2026; Vol. 12, Issue 1

Laser Vs Ozone As An Adjunct to Periodontal Therapy: A Systematic Review

Abstract:

Introduction: Periodontal disease is characterized by chronic inflammatory processes that are caused by the triggering of the host response by specific pathogens, progressive destruction of alveolar bone, and apical migration of connective tissue and epithelial attachments. Some authors have suggested the development of new treatment modalities, such as lasers, ozone, as an adjunct to periodontal therapy.

Aim: To compare the efficacy of Laser and Ozone as an adjunct to periodontal therapy.

Method: Electronic databases, including
MEDLINE via PubMed, Cochrane Central Register of Controlled Trials and Cochrane Oral Health Group Trials, and EMBASE, were searched from january 2010 till january 2025 to collect relevant data and write a systematic review. Result: Laser was found to be slightly better than ozone in terms of anti- inflammatory property

Conclusion: Laser was found to be slightly better than ozone in terms of anti-inflammatory property whereas ozone was slightly better for wound healing thanlaser. This review has supported the use of laser and ozone as adjuncts to conventional periodontal therapy.

Key-words: .....

Introduction:

Periodontal disease is characterized by chronic inflammatory processes that are caused by the triggering of the host response by specific pathogens, progressive destruction of alveolar bone, and apical migration of connective tissue and epithelial attachments.[1,2,3] Chronic periodontitis is defined as an infectious condition that causes inflammation in the supporting tissues of the teeth, increasing attachment loss and bone loss. Scaling and root planing is a non surgical therapy that aims to remove dental calculus and plaque and smoothen bacteria contaminated irregular root surfaces.

However, mechanical periodontal therapy alone may be not be sufficient to completely remove the pathogenic bacteria, because of their location within the gingival and dental tissues or in other sites that can not be accessed easily by periodontal instruments.[2,3] Therefore, different treatment modalities have been sought that primarily aim to suppress or eliminate periodontal pathogens and control their overgrowth.[4–6] One of these treatment modalities is the use of adjunctive antimicrobial therapy. The adjunctive antimicrobial therapy depends upon the systemic and local application of antibiotics.

Although systemic and local antibiotics are occasionally administered into periodontal pockets to promote disinfection, the risk of developing resistant microbial species increases with the frequent use of antibiotics.[7]

[1]SRISHTI WADHWA, [2]C.S BAIJU, [3]N. D GUPTA, [4]KARUNA JOSHI, [5]MEENU TANEJA BHASIN, [6]ARUNIMA CHOUDHARY, 7SHIVAM KHANNA

[1,2,4-7]Department of Periodontology and Oral Implantology, Sudha Rustagi College of Dental Sciences
[3]Department of Periodontology and Oral Implantology, Dr. Z.A. Dental College, Aligarh Muslim University

Address for Correspondence: Dr. Arunima Choudhary
MDS IInd year :
Department of Periodontology and Oral Implantology, Sudha Rustagi College of Dental Sciences
Email: choudhary.arunima97@gmail.com

Received : 27 Jan., 2025, **Published :** 31 March, 2026

Access this article online

Website:
www.ujds.in

DOI:
https://doi.org/10.21276/ujds.2026.12.1.27

How to cite this article: Arunima. (2026). Laser Vs Ozone As An Adjunct To Periodontal Therapy: A Systematic Review. UNIVERSITY JOURNAL OF DENTAL SCIENCES, 12(1).

Also, Periodontal treatment may require involvement of phase II therapy or surgical procedures like gingivectomy, gingivoplasty, free gingival graft, depigmentation, etc, following which fastening of wound healing becomes essential. The site of surgery after procedures like gingivectomy and gingivoplasty heals by secondary intention and takes about thirty two days for complete epithelialization and about forty nine days for connective tissue maturation. Multiple local and systemic factors can effect one or more phases of wound healing leading to impaired tissue healing. Some of the local factors that can delay wound healing are wound hypoxia, infection, foreign body and lack of vascularity. Oxygenation plays a key role in wound healing as it facilitates cellular proliferations and prevents infections. During the initial stages of wound healing there is profuse oxygen consumption owing to the high rate of metabolism.

Optimal oxygen levels will benefit a healing wound. [8] herefore, some authors have suggested the development of new treatment modalities for the elimination of specific periodontopathogens, such as lasers, ozone, and to promote wound healing after surgical periodontal therapy. [9]

Ozone is used over the hundred years in medicine and dentistry. Dr. Fisch (1899- 1966) was the first dentist to employ ozonated water in his dental practice. Then by the year 1935 another author, Dr Payr, a german surgeon, followed him and began its application in surgeries. He announced his findings at the 59th Congress of the German Surgical Society in Berlin (1935). [10] Ozone is a naturally occurring compound consisting of three oxygen atoms. Ozone has various beneficial effects such as antimicrobial activity, elevates partial pressure of oxygen in tissues, improves metabolism of inflamed tissues, facilitates proper oxygen metabolism, increased circulation and oxidation of biomolecules.

Ozone is one of the most important oxidants present in nature, and it is highly reactive with organic compounds.[11,13] A survey of the literature shows that Ozone has applications in different dental treatments and specifically in periodontal treatment because of its antibacterial activity. There are various modes of ozone application like aqueous and gaseous Ozone, and are effective in treating periodontitis as adjuncts to various periodontal treatment procedures to aid in wound healing, etc.[14]

Another treatment modality that has emerged as an efficient treatment choice is Laser. Laser is an acronym for Light Amplification by Stimulated Emission of Radiation.[15] In 1917 Albert Einstein gave a theory on stimulated emission on radiation. The term laser was first used in 1957 by Gordon Gould. Maiman developed the first ruby laser in 1960. Different types of Laser are gas (CO2 laser), solid crystal (Nd: YAG, Er: YAG), solid-state semiconductor (diode laser) and liquid (not used in dentistry). [16]

Laser application is done in two modes: Contact mode in which the tip of the laser is held in direct contact with the tissue and non contact mode where the laser unit is held 2–3 mm away from the tissue. The proposed mechanism of action of lasers when used in contact mode is mainly ablation and when used in non-contact mode it is mainly attributed to bio-stimulation.[17] Laser treatment therapy coagulate blood vessels, seal lymphatics, and sterilize wounds during ablation while maintaining a clear and clean surgical field.[18] A laser can stimulate mitochondrial activity which results in biomodulation of inflammatory processes by mitigating prostaglandin E2 release; hence, they are recommended in the treatment of gingival inflammation. [19,20]

A study conducted by Pejcic et al. showed low-level laser as an adjunct oral treatment resulted in the reduction of tissue inflammation which has been evaluated by clinical as well as histopathological changes of the gingival tissue.[21,22]

Until now studies were conducted that focused on evaluating the effectiveness of either ozone or low-level laser as an adjunct to periodontal therapy; Though both of these treatment modalities, laser and ozone has proven some place in the modern periodontal therapy, its individual role has not been discussed in detail.

Thus, a systematic review on this topic to summarize or critically analyze its individual roles will be beneficial for research purposes.

Hence, this systematic review is first of its kind effort to throw light on the topic of laser and ozone in periotherapy.

Therefore, this systematic review aims to compare the therapeutic effect of Laser and ozone as an adjunct to periodontal therapy.

Materials and Methods

Focus Question:

The Preferred Reporting Items for Systematic Review and meta analysis (PRISMA) guidelines were followed, and a focused question was developed. The addressed PICO (Population, Interventions, Comparisons, and Outcomes) question was: In terms of therapeutic effect which is better among ozone and laser when used as adjunct in periodontal therapy?

Search strategy:

Electronic databases, including MEDLINE via PubMed, Cochrane Central Register of Controlled Trials and Cochrane Oral Health Group Trials, and EMBASE, were searched from

january2010 till january 2025. The literature search was conducted using the combinations of the following MeSH and text words: laser therapy, ozone therapy, periodontal therapy.

Screening methods and data abstraction :

Titles and abstracts of studies that fulfilled the inclusion criteria were screened and assessed. Data were extracted from the included studies based on the following parameters: author/country, study design (RCT), patients (sample size, mean and age range in years), clinical and biochemical parameters, study groups, study outcome, follow ups, and therapeutic modalities of laser and ozone.

Inclusion criteria :

1) studies comparing the therapeutic effect of ozone therapy and laser therapy in periodontal procedures
2) Randomized control trials
3) Studies done on human subjects
4) studies published in last 15 years
5) studies published in english language
6) studies with minimum 5 participants
7) studies having minimum follow up period of minimum 10 days
8) studies in which full text is accessible
9) Studies which included participants of both gender
10) Studies which included participants in the age group 10 to 70 years

Exclusion criteria :

1) studies which did not directly compare the therapeutic effect of ozone vs laser
2) studies which included subjects that have undergone periodontal therapy or antimicrobial treatment in past 6 months
3) Studies in which participants were suffering from any systemic condition/disease
4) Studies in which the effect of ozone vs laser was not seen in periodontal therapy

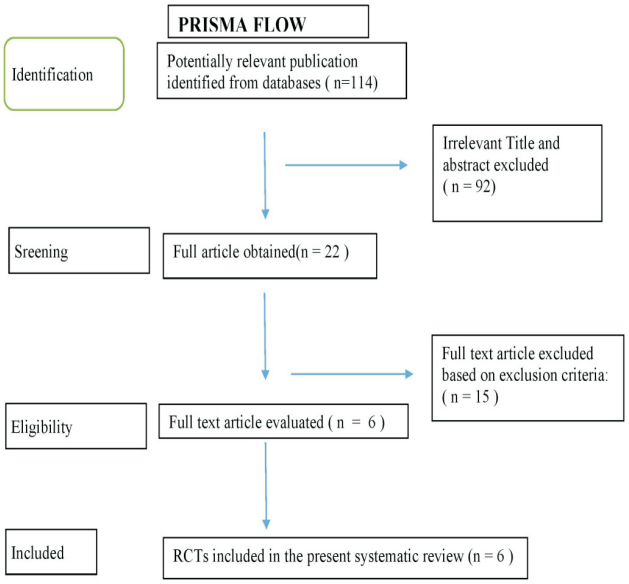

TABLE SYSTEMATIC REVIEW: Comparitive analysis of ozone and laser as an adjunct in periodontal therapy: A systematic review

Title of study	Evaluation of the Clinical and Antimicrobial Effects of the Er:YAG Laser or Topical Gaseous Ozone as Adjuncts to Initial Periodontal Therapy	Effects of Laser Photobiomodulation and Ozone Therapy on Palatal Epithelial Wound Healing and Patient Morbidity.	Evaluation of the effects of photobiomodulation therapy and ozone applications after gingivectomy and gingivoplasty on postoperative pain and patients' oral health- related quality of life	Comparison of laser therapy and ozonated water on gingival inflammation in orthodontic patients with fixed appliances	Effects of ozonated olive oil and photobiomodulation using diode laser on gingival depigmented wound : A randomized clinical study	Comparative Evaluation of the effects of Low level laser therapy and ozone application on wound healing after Gingivectomy and Gingivoplasty
Author & Year	Yilmaz.S et al 2013	Sila C I et al, 2018	Mustafa O U, 2020	Sandra V.K et al 2021	Tualzik T et al 2021	Pujitha G., 2023
Study design	RCT	RCT	RCT	RCT	RCT	RCT
No. Of subjects	30	36	36	30	7	45
Study groups	Group 1: SRP+laser Group 2: SRP + ozone Group 3: SRP alone	Control group (no intervention) Group 1(LLLT) Group 2 (Ozone)	Control group (monotherapy) Test Group 1 (PBM) Test Group 2 (Ozone)	Control side(upper right quadrant)- ozone water irrigation Experimental side(upper left quadrant)-laser	Group 1: Laser depigmentation + ozonated oil Group 2: Laser depigmentation +PBM	Control group (no intervention) Test Group 1 (ozone water) Test group 2 (LLLT)
Therapeutic Property compared	Anti-microbial Anti inflammatory	Wound healing	Wound healing	Anti inflammatory	Wound healing	Wound healing
Parameters taken	Clinical parametrs : PI,SBLPD and CAL Microbial assesment on agar plate	Clinical Parameters: PI, GI, PD, BOP, Palatal wound remaining area and VAS	VAS, Quality of life assessment (OHIP), Wound healing (H_2O_2)test, Total amount of painkillers taken	Clinical parameters: PI,GI,GBI Biochemical marker level(MCP-1)	Clinical parameters : HI, VAS , wound epithelialization	Wound surface area, Wound healing index, Quality of life index, Plaque index, sulcus bleeding index,VAS, oral health impact profile (OHIP)
Follow up period	90 days	28 days	28 days	28 days	15 days	21 days
Result	1)after 90 days All three groups (SRP alone, SRP + ozone, SRP + Er:YAG laser) showed statistically significant improvements in:Probing Depth (PD)Clinical Attachment Level (CAL)Plaque Index (PI)Gingival Index (GI) 2)Er:YAG Laser + SRP group showed thesignificant clinical improvement in:Greater PD reductionGreater CAL gain Compared to both SRP alone and SRP + ozone groups ($p < 0.05$) 3)Total bacterial counts and proportion of obligate anaerobic microorganisms decreased in all groups. No statistically significant differences in microbial reduction between the three groups.	1) At day 14, significantly smaller wounds were observed in ozone group as compared to control group using digital image analysis. 2) The mean VAS score exhibiting postoperative discomfort was observed to be significantly higher in the Control group compared with the laser group and Ozone group at day 7. 3)Intergroup comparison of laser vs ozone of remaining wound area did not show any significant differences	1)VAS level of control group was higher than PBM group on 3rd day and higher than both Ozone group and PBM group on 7th day. 2) Total OHIP-14 score of the Control group on 7th day was higher than PBM group. 3) Mean score obtained from third question of OHIP-14 at 7th and 14th day of PBM group was found lower than the Control and Ozone group	1)For all the clinical parameters and MCP-1 levels derived from GCF, a significant reduction was observed with both subgingival irrigation with ozonated water and laser irradiation during all time points. 2)In addition, there was a statistically significant difference among experimental(laser) and control(ozone) sides for all the parameters evaluated at all study points with laser irradiation showing better results as compared to subgingival ozone irrigation	1)On the 3rd day, Group 1 (ozonated olive oil) exhibited a significantly better HI compared to Group 2 (PBM therapy). 2)By the 7th and 15th days, both groups showed similar HI scores 3) Both groups experienced a reduction in postoperative pain over time, with no significant differences between them at time point	1) At all time intervals, the ozone group and LLLT group showed significantly higher reduction of WSA compared to control group. 2) Between 2 test groups, the LLLT group showed a significantly higher WSA reduction on day 3 and day 21. 3) WHI score was significantly higher in control group than test groups on day 3. 4) Between test groups, ozone group showed a significantly higher score on day 3. However on day 7 and 21 all groups showed similar WHI.
Conclusion	It was concluded that there was a better resolution of infection In the SRP + laser group however, microbial properties were satistically not significant for both laser and ozone (ozone has an antimicrobial effect equivalent to that of laser	Adjunctive Ozone therapy could have a significantly beneficial effect on the acceleration of palatal wound healing following FGG procedures. Both PBM and Ozone therapy reduced postoperative discomfort during wound healing.	PBM group provided a better wound healing after gingivectomy. Also, it was observed that PBM application after scalpel and gingivectomy improves patient comfort. In total, from the results of this study, it is concluded that PBM and Ozone application have a beneficial effect on quality of life of the patient.	Clinical parameters and the mean concentration of MCP-1 in GCF were reduced more significantly using diode laser irradiation when compared to treatment with ozonated water irrigation in patients receiving orthodontic therapy with fixed orthodontic appliance	The study concluded that ozonated olive oil is more effective in promoting initial wound healing in gingival depigmented areas compared to PBM therapy. However, both treatments are equally effective in reducing postoperative pain and achieving comparable healing outcomes by the 15th day post-procedure.	Ozone therapy is safe and effective in promoting wound healing during the 1st 3 weeks post-surgery. Ozone therapy and LLLT application enhanced wound healing after gingivectomy and gingivoplasty procedures, accompanied by better quality of life and reduced pain.

Discussion:

Periodontitis is caused due to accumulation of different types of bacteria in the subgingival pocket. Mechanical methods are used for the removal of subgingival microorganisms. The aim of initial periodontal therapy is to remove biofilm from the surface of teeth. At times, it may become difficult to access the biofilm beneath the gingiva due to the irregular structure of the root and furcation areas. Therefore, it is not possible to achieve complete removal of bacterial using mechanical

methods. Hence adjunctive therapies like laser and ozone have been suggested to help in the removal of plaque and bacteria.

Various controlled clinical and microbiological studies and case reports have concluded that laser and ozone when used as an adjunctive to initial periodontal therapy leads to significant gains in attachment levels and reductions in subgingival bacteria.this finding are in accordance with the study by cobb[23].

Also in recent years, ozone has been proposed as a new adjunctive treatment stratergy in the management of periodontal disease. It is known that ozone has several physicochemical properties such as immunostimulant and analgesic, anti-hypoxic and detoxifying, antimicrobial, bioenergetic and biosynthetic, by activating the metabolism of carbohydrates, proteins, and lipids[23].

Also Low level Laser Therapy (LLLT) is a noninvasive treatment modality that has been used for medical conditions since the 1960s. The main applications of LLLT, which has been used for more than two decades, include musculoskeletal pain relief as well as the promotion of wound healing through the reduction of the inflammatory process, the modulation of growth factors and increased angiogenesis[23]. This treatment modality results in the modulation of growth factors and myogenic regulatory factors and effectively promotes sciatic nerve regeneration. The low-level lasers are absorbed by chromophores, which lead to a modulation of pathophysiological processes. Additionally, bacterial growth inhibition at low level doses has been reported in vitro.

To explore the potential benefits of ozone and laser therapy, as adjuncts to conventional periodontal therapy, this systematic review was taken up with focus on the comparison of therapeutic effect of laser and ozone in periodontal treatment.

In this systematic review the initial search from two database yielded 114 articles. The tittles and abstracts excluded a total of 92 articles with some reasons such as articles that were not relevant, duplicate articles, articles that could not be accessed and literature review, systematic review and meta analysis. Full text found as many as 22 articles which were then screened and 6 articles were found that met the inclusion criteria.

The result of this systematic review found that both laser and ozone are beneficial and valuable as adjuncts to conventional periodontal therapy. However when particularly considering anti-inflammatory property, laser thereby proved to be superior to ozone and in terms of wound healing ozone demonstrated superior wound healing properties.

Findings from one study in this review by Yilmaz S et al[23] when he compared anti-microbial property of laser and ozone as an adjuct after SRP, after 90 days. All three groups (SRP alone, SRP + ozone, SRP + Er:YAG Laser) showed statistically significant improvement in clinical parameters such as Probing Depth (PD), Clinical Attachment Level (CAL), Plaque Index (PI) and Gingival Index(GI) from day 0 to day 90. Er:YAG laser +SRP Group showed the significant clinical improvement in : Greater PD reduction and greater CAL gain compared to both SRP alone and SRP + ozone groups ($p<0.05$). Total bacterial counts and proportion of obligate anaerobic microorganisms decreased in all groups. No statistically significant differences in microbial reduction between the three groups.

Although Kshitish et al[24]. showed that Ozone had an anti bacterial effect under in vivo conditions, Eick et al[25]. detected a decrease in the antibacterial properties of ozone in gingival crevicular fluid in a similar environment containing saline which could possibly explain why ozone could not show superior anti-microbial property as compared to laser and SRP.

The results in this study has shown that when laser is used as an adjunctive to initial periodontal therapy, the Er:YAG laser leads to significant gains in attachment levels and reductions in subgingival bacteria. Results were in accordance with the studies conducted by Schwarz F[26] in which he compared periodontal treatment with laser compared to scaling and root planing. They suggest that nonsurgical treatment with an Er:YAG laser is a suitable alternative to conventional scaling and root planing, offering superior reductions in bleeding and gains in clinical attachment.

These results can be explained by the fact that Anti microbial property of laser is achieved through various mechanisms, including the generation of reactive oxygen species and photothermal reactions that damage or eliminate bacteria. Different laser types, such as Nd:YAG and diode lasers, have demonstrated effective bactericidal effects in periodontal therapy.Similar anti microbial result related to laser were seen in study conducted by schwarz F et al[26] in which he compared scaling and root planing with and without laser.

Similarly anti microbial property of ozone can be explained on the basis of cell membrane disruption by ozonolysis (breaking down double bonds) also ozone induces modification of intracellular contents through secondary oxidant effects, leading to protein oxidation and loss of organelle function.

Similar results related to antimicrobial effect of ozone was seen in a study conducted by Huth, K.C et al[27] in which he had seen effectiveness of ozone against periodontal pathogenic microorganisms.

In other study in this systematic review by Sandra V K V et al[28] they compared the anti inflammatory property of ozone and laser and they showed that for all the clinical parameters and MCP-1 levels derived from GCF, a significant reduction was observed with both subgingival irrigation with ozonated water and laser irradiation during all time points. In addition,

there was a statistically significant difference among experimental(laser) and control(ozone) sides for all the parameters evaluated at all study points with laser irradiation showing better results as compared to subgingival ozone irrigation. Hence they concluded in there study that Clinical parameters and the mean concentration of MCP-1 in GCF were reduced more significantly using diode laser irradiation when compared to treaatment with ozonated water irrigation. Results of this study were in accordance to study conducted by Ren et al[29] who demonstrated a significant decrease in clinical parameters after laser irradiation.

Laser treatment is known to coagulate blood vessels, seal lymphatics, and sterilize wound during ablation while maintaining a clear and clean surgical field.

Laser can stimulate mitochondrial activity which results in biomodulation of inflammatory processes by mitigating prostaglandin E_2 release; hence they are recommended in the treatment of gingival inflammation. A study conducted by Pejcic et al[30] showed low level laser as an adjunct oral treatment resulted in the reduction of tissue inflammation and which was reflected in histopathological changes of the gingival tissue .

Similarly anti inflammatory property of ozone can be explained by mechanism that Ozone disrupts the cell membrane by ozonolysis (breaking down double bonds) and induces modification of intracellular contents through secondary oxidant effects, leading to protein oxidation and loss of organelle function.

Apart from anti microbial and anti inflammatory properties ozone and laser has wound healing properties also. During wound healing multiple local and systemic factors can interfere with one or more phases of wound healing leading to impaired tissue healing.

Some local factors that can deleteriously effect wound healing are wound hypoxia, infection, foreign body and lack of vascularity. Oxygenation plays a key role in wound healing as it facilitates cellular proliferation and prevents infections.

Optimal oxygen levels will benefit a healing wound. Therapeutic options to deliver oxygen to a healing wound include hyperbaric oxygen therapy (HBOT) and ozone application. Ozone has various beneficial effects such as anti-microbial activity, increases pO2 in tissues, improves metabolism of inflamed tissues, facilitates proper oxygen metabolism, increased circulation and oxidation of biomolecules.

Apart from ozone therapy, photobiomodulation (PBM), which is also known as low level laser therapy (LLLT) has been well documented as an effective application for accelerating wound healing by enhancing collagen production, increasing levels of growth factors and extracellular matrix-remodeling proteins, and by stimulating synthesis of adenosine triphosphate, fibroblastic proliferation, and angiogenesis in a dose-dependent manner. Hence Gadde P and George J P[31] in their study compared wound healing characteristics of laser and ozone and showed that at all time intervals, the ozone group and LLLT group showed significantly higher reduction of wound surface area (WSA) compared to control group in which no intervention was done. Between 2 test groups, the LLLT group showed a significantly higher WSA reduction on day 3 and day 21.WHI score was significantly higher in control group than test groups on day 3. Between test groups, ozone group showed a significantly higher score on day 3. However on day 7 and 21 all groups showed similar WHI. Hence he concluded in his study that Ozone therapy is safe and effective in promoting wound healing during the 1st 3 weeks post-surgery also Ozone therapy and LLLT application enhanced wound healing after gingivectomy and gingivoplasty procedures, accompanied by better quality of life and reduced pain .

It has also been suggested that laser promotes dissociation of oxygen from oxyhemoglobin in the tissue capillary beds, which makes more oxygen available for oxidative metabolism and ATP production. Laser which is based on biostimulation / biomodulation may induce cellular processes that influence wound healing.

Various studies have concluded that laser improves wound healing after periodontal surgical procedures

Tualzik T et al[32] also compared healing characteristics of laser and ozone and similarly showed that On the **3rd day**, Group 1 (ozonated olive oil) exhibited a significantly better HI compared to Group 2 (PBM therapy).By the **7th and 15th days**, both groups showed similar HI scores. Both groups experienced a reduction in postoperative pain over time, with no significant differences between them at time point. Which they concluded as **ozonated olive oil** is more effective in promoting initial wound healing in gingival depigmented areas compared to PBM therapy. However, both treatments are equally effective in reducing postoperative pain and achieving comparable healing outcomes by the 15th day post-procedure.

Similar findings were seen in the study conducted by uslu O M and Akgul S[33] in which they had concluded that PBM group provided a better wound healing after gingivectomy. Also, it was observed that PBM application after scalpel gingivectomy improves patient comfort. In total, from the results of this study, it is concluded that PBM and Ozone application have a beneficial effect on quality of life of the patient.

Isler S C et al[34] also compared healing of laser and ozone and he stated that Adjunctive Ozone therapy could have a significantly beneficial effect on the acceleration of palatal wound healing following FGG procedures. Both PBM and Ozone therapy reduced postoperative discomfort during wound healing.

Conclusion:

The primary objective of this systematic review was to explore the various therapeutic properties of ozone and laser and their potential benefits when used as adjuncts to conventional periodontal therapy. This systematic review found that both lasers and ozone therapy provided additional benefits when used along with conventional periodontal therapy owing to its antimicrobial , anti- inflammatory, wound healing properties, etc. However, laser was found to be slightly better than ozone in terms of anti-inflammatory property whereas ozone was slightly better for wound healing than laser. The findings of this systematic review have provided substantial evidence to promote the use of Laser and ozone as adjuncts to periodontal therapy while also highlighting the need to conduct more studies, with a larger population size, with more diverse periodontal procedures and larger follow up periods to further strengthen the conclusions drawn from this systematic review.

References :

1. Armitage, G.C. (2003). Research, Science and Therapy Committee of the American Academy of Periodontology. Diagnosis of periodontal diseases. J. Periodontol. 74, 1237–47.
2. Dayan, S., Stashenko, P., Niederman, R., and Kupper, T.S. (2004). Oral epithelial over expression of IL-1 alpha causes periodontal disease. J. Dent. Res. 83, 786–790.
3. Aspriello, S.D., Piemontese, M., Levrini, L., and Salvatore, S. (2011). Ultramorphology of the root surface subsequent to hand-ultrasonic simultaneous instrumentation during nonsurgical periodontal treatments. An in vitro study. J. Appl. Oral Sci. 19, 74–81.
4. Novak, M.J., and Novak, K.F. (2009). Chronic Periodontitis, in: Clinical Periodontology, 10th ed. F.A. Carranza (ed.). Philadelphia: W.B. Saunders Co., pp. 494–499.
5. Adriaens, P.A., Edwards, C.A., De Boever, J.A., and Loesche, W.J. (1958). Ultrastructural observation on bacterial invasion in cementum and radicular dentin of periodontally diseased human teeth. J. Periodontol. 59, 493–503.
6. Caffesse, R.G., Sweenay, P.L., and Smith, B.A. (1986). Scaling and root planing with and without periodontal flap surgery. J. Clin. Periodontol. 13, 205–210.
7. Aoki, A., Miyuki, S.K., Watanabe, H., and Ishikawa, I. (2004). Lasers in nonsurgical periodontal therapy. Periodontol. 2000 36, 59–97.
8. Stanton G, Levy M, Stahl SS. Collagen restoration in healing human gingiva. Journal of Dental Research. 1969; 48(1):27-31.
9. Yilmaz, S., Kut, B., Gursoy, H., Eren Kuru, B., Noyan, U., and Kadir, T. (2012). Er:YAG laser versus systemic metronidazole as an adjunct to nonsurgical periodontal therapy: a clinical and microbiological study. Photomed. Laser Surg. 30, 325–330.
10. El Meligy OA, Elemam NM, Talaat IM. Ozone Therapy in Medicine and Dentistry: A Review of the Literature. Dent J (Basel). 2023 Aug 7;11(8):187. doi: 10.3390/dj11080187. PMID: 37623283; PMCID: PMC10453584.
11. Burns, D.T. (1997). Early problems in the analysis and the determination of ozone. Fresenius J. Anal. Chem. 357, 178–
12. Nogales, C.G., Ferrari, P.H., Kantorovich, E.O., and Lage– Marques, J.L. (2008). Ozone therapy in medicine and dentistry. J. Contemp. Dent. Pract. 9, 75–84.
13. Saini, R. (2011). Ozone therapy in dentistry: a strategic review J. Nat. Sci. Biol. Med. 2, 151–153.
14. Huth, K.C., Quirling, M., Lenzke, S., Paschos, E., Kamereck, K., Brand, K., Hickel, R., and Ilie, N. (2011). Effectiveness of ozone against periodontal pathogenic microorganisms. Eur. J. Oral Sci. 119, 204–210.
15. Moritz A. Oral Laser Application. Chicago: Quintessence; 2006. [Google Scholar]
16. Review Article Application of Laser in Dentistry – A Literature Review Amrita Kumari, Malvika Bagati, Karan Asrani, Ashish Yadav Year: 2021, Volume: 13, Issue: 2, Page no. 39-47, DOI:10.26715/rjds.13_2_3
17. A comparative randomized clinical trial to assess the effectiveness of the diode lasers in both contact and non-contact mode and 0.1% triamcinolone acetonide mouth paste in treatment of oral ulcers—an in vivo study - Manmeet Kour & Anshuman Dwivedi
18. Sarver DM, Yanosky M. Principles of Cosmetic Dentistry in Orthodontics: Part 2. Soft Tissue Laser Technology and Cosmetic Gingival Contouring. Am J Orthod Dentofacial Orthop. 2005;127:85–90. doi: 10.1016/j.ajodo.2004.07.035. [DOI] [PubMed] [Google Scholar]
19. de Paula EC, de Freitas PM, Esteves OM, Aranha AC, Ramalho KM, Simoes A, et al. Laser Phototherapy in the Treatment of Periodontal Disease. A review. Lasers Med Sci. 2010;125:781–92. doi: 10.1007/s10103-010-0812-y. [DOI] [PubMed] [Google Scholar]
20. Cardoso BS, Fioranelli VG, Eduardo CD, de Freitas PM, Aranha AC. Laser Phototherapy (660 nm) Can be Beneicial for Reducing Gingival Inflammation in Prosthodontics. Case Rep Dent. 2015;2015:132656. doi: 10.1155/2015/132656. [DOI] [PMC free article] [PubMed] [Google Scholar]
21. Pejcic A, Zivkovic V. Histological Examination of Gingiva Treated with Low Level Laser in Periodontal Therapy. J Oral Laser Appl. 2007;71:37–43. [Google Scholar]
22. Pejcic A, Kojovic D, Kesic L, Obradovic R. The Effects of Low-Level Laser Irradiation on gingival inlammation. Photomed Laser Surg. 2010;28:69–74. doi: 10.1089/pho.2008.2301. [DOI] [PubMed] [GoogleScholar]
23. Sculean A, Schwarz F, Berakdar M, Romanos G, Arweiler N, Becker J. Evaluation of the clinical and antimicrobial effects of an Er:YAG laser or gaseous

ozone as adjuncts to initial periodontal therapy: a randomized clinical study. *J Clin Periodontol*. 2004 Jan;31(2):79–84. doi:10.1111/j.1600-051X.2004.00449.x
24. Kshitish, D., and Laxman, V.K. (2010). The use of ozonated water and 0.2% chlorhexidine in the treatment of period ontitis patients: a clinical and microbiologic study. Indian J. Dent. Res. 21, 341–348.
25. Eick, S., Tigan, M., and Sculean, A. (2012). Effect of ozone on periodontopathogenic species—an in vitro study. Clin. Oral. Investig. 16, 537–544
26. Schwarz, F., Sculean, A., Georg, T., and Reich, E. (2001). Periodontal treatment with an Er:YAG laser compared to scaling and root planing. A controlled clinical study. J. Per iodontol. 72, 361–367.
27. Huth, K.C., Quirling, M., Lenzke, S., Paschos, E., Kamereck, K., Brand, K., Hickel, R., and Ilie, N. (2011). Effectiveness of ozone against periodontal pathogenic microorganisms. Eur. J. Oral Sci. 119, 204–210.
28. **Vani SVK, Ziauddhin S, Simhadri G, Govindu OGLR, Bindu Priya S, Naveen M.** Comparison of laser therapy and ozonated water on gingival inflammation in orthodontic patients with fixed appliances. *J Clin Transl Res*. 2021 Sep 27;7(5):625–630. doi:10.18053/jctres.07.202105.003. PMID:? 34778592
29. Ren C, McGrath C, Gu M, Jin L, Chang C, Sum FH, et al. Low-Level Laser-Aided Orthodontic Treatment of Periodontally Compromised Patients:A Randomised Controlled Trial. Lasers Med Sci. 2020;35:729–39. doi: 10.1007/s10103-019-02923-0
30. Pejcic A, Kojovic D, Kesic L, Obradovic R. The Effects of Low-Level Laser Irradiation on gingival inflammation. Photomed Laser Surg. 2010;28:69–74. doi: 10.1089/pho.2008.2301.
31. Gadde P, George JP. Comparative Evaluation of the Effects of Low-Level Laser Therapy and Ozone Application on Wound Healing After Gingivectomy and Gingivoplasty: A Randomized Control Clinical Trial. *Int J Dent Res*. 2023;8(1)
32. Tualzik T, Chopra R, Gupta SJ, Sharma N, Khare M, Gulati L. Effects of ozonated olive oil and photobiomodulation using diode laser on gingival depigmented wound: A randomized clinical study. J Indian Soc Periodontol 2021;25:422-6
33. Uslu MÖ, Akgül S. Evaluation of the effects of photobiomodulation therapy and ozone applications after gingivectomy and gingivoplasty on postoperative pain and patients' oral health-related quality of life. *Lasers Med Sci*. 2020;35(7):1637–1647. doi:10.1007/s10103-020-03037-8
34. Isler SC, Uraz A, Guler B, Ozdemir Y, Cula S, Cetiner D. Effects of Laser Photobiomodulation and Ozone Therapy on Palatal Epithelial Wound Healing and Patient Morbidity. *Photomed Laser Surg*. 2018 Nov;36(11):571–580. doi:10.1089/pho.2018.4492. PMID:? 30260741