Comparative Evaluation of Healing using Ozonized Water and Normal Saline after Open Flap Debridement: A Case Control Study

Neelu Verma[1], Roopanshi Mehrotra[2*], Siya Kumari[3],Sanjay Gupta[4], Akanksha Singh[5],Srashti Gupta[6]

[1]Reader, Career Institute of Dental Sciences and Hospital Lucknow

[2, 3, 5, 6]Post Graduate Student, Career Institute of Dental Sciences and Hospital Lucknow

[4] Professor and Head, Career Institute of Dental Sciences and Hospital Lucknow

Email: [1]drneeluraja@gmail.com, [2] roopanshimehrotra12@gmail.com, [3] hlociya@gmail.com, [4] sanru17@rediffmil.com, [5] stubborngirl505@gmail.com, [6] conectwithsrishti28@gmail.com

Abstract

Periodontitis is an inflammatory disease that is initiated by distinct oral pathogens that populate dental plaque biofilms on the tooth surface resulting in damage of tooth supporting structure. The aim of the periodontal therapy is to arrest infection, restore the lost structure and maintain a healthy periodontium. Ozone has a powerful oxidation effect with significant antimicrobial potential.It can inhibit bacterial proliferation, upregulate cellular antioxidant enzymes, enhance the release of growth factors and local oxygen supply and promote hemostasis. This prospective split mouth randomized case control study was conducted in 10 systemically healthy patients with pocket depth of >5mm on at least two teeth in each quadrant of maxilla/mandible. Selected quadrants were randomized using coin toss method into 2 groups:

Group 1 (Case): OFD with ozonized water irrigation

Group 2 (control): OFD with normal saline irrigation

In this study the results showed statistically insignificant difference in clinical parameters between test and the control groups when assessed after1 month, however considerablly better clinical result was seen in ozonized water group. This shows the beneficial role of use of ozonized water with OFD. Ozonized water had satisfactory effects on pain management and showed better healing.

Keywords:Open flap debritment, Ozonized water, Healing Index.

1. Introduction

Periodontitis is an inflammatory disease that is initiated by distinct oral pathogens that populate dental plaque biofilms on the tooth surface resulting in damage of tooth supporting structure.[1] Chronic periodontitis typically originates by constant multi-microbial challenge that advances by producing a host immune response which generates a tenacious inflammatory state.[2] The aim of the periodontal therapy is to arrest infection, restore the lost structure and maintain a healthy periodontium. The effective means of altering the etiology of periodontal disease is mechanical removal of bacterial plaque, calculus and toxic material.[3]Non-surgical treatment alone has been shown to be ineffective for the treatment of periodontitis, therefore surgical therapy is usually required. Surgical therapy are mainly

aimed to be able to access the required areas for mechanical debridement and surface decontamination, so as to reconstruct anatomic conditions suitable for improving plaque control, and eliminate pockets. To achieve this goal, the important part of surgical therapy is to access the periodontal defect for debridement.[4]

Ozone has a powerful oxidation effect with significant antimicrobial potential.[5] It can inhibit bacterial proliferation, upregulate cellular antioxidant enzymes, improve the release of growth factors and local oxygen supply and promote hemostasis. However, in the current literature very little information about the treatment of periodontal diseases using the antimicrobial activity of ozone has been studied.

The purpose of this randomized, controlled, split-mouth study was to evaluate the clinical parameters and healing efficacy of Open Flap Debridement (OFD) using ozonized water or normal saline.

2. Materials and Methods

Study design

This prospective split mouth randomized case control study was conducted in Department of Periodontology and Oral Implantology, Career Post- Graduate Institute of Dental Sciences and Hospital, Lucknow. Written Informed consent was obtained from every participant.10 systemically healthy patients were selected with pocket depth of >5mm on at least two teeth in each quadrant of maxilla/mandible. Selected quadrants were randomized using coin toss method into 2 groups:

Group 1 (Case): OFD with ozonized water irrigation

Group 2 (control): OFD with normal saline irrigation

Inclusion Criteria

- Systemically healthy patients suffering from chronic periodontitis.
- Pocket depth of >5mm on at least two teeth in each quadrant of maxilla/mandible
- Patients who has persistent horizontal bone loss.
- Vital teeth with no endodontic involvement.
- Patients with good oral hygiene maintenance.

Exclusion Criteria

- Patient who were known Smokers.
- Patients who were on antibiotics or any other drug therapy with in the past 6 months.
- Patients allergic to components used
- Pregnant women and lactating mothers.
- Alcoholic patients with other adverse habits

At baseline and 3 months, the following clinical parameters were evaluated: Plaque index, gingival index probing depth and clinical attachment level.

Patient satisfaction was evaluated by visual analog scale for 7 days and 1 month postoperatively. Postoperative healing was measured by wound healing index for 7 days and 1 month post operatively.

Preparation of Ozonized Water

Ozonized water was prepared by pulsating gaseous ozone from ozone generator in 1 liter distilled water for 1.6 minutes. Using a 22-gauge needle subgingival irrigation was done for 5–10 min.(Figure 1)

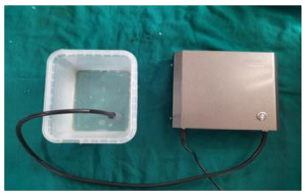

Figure 1: Preparation of Ozonized water

Surgical Procedure

All surgeries were done on an outpatient basis under sterile conditions. Rinse the patient's mouth with 10 ml of 0.2% chlorhexidine solution for 60 s. 2% lignocaine hydrochloride with adrenaline (1:80,000) was used to anaesthetize the selected site.

After obtaining the adequate anesthesia, intracrevicular incisions were made, and full-thickness mucoperiosteal flaps were raised. To eliminate plaque, calculus, granulation tissue and pocket epithelium, surgical debridement was done. The selected sites were irrigated with ozonized water (Group 1) and with sterile saline (Group 2). The surgical flaps were then sutured with 3-0 silk suture, to achieve primary closure. The patients were given the postoperative instructions. Amoxicillin 500 mg thrice daily for 5 days and a nonsteroidal anti-inflammatory agent thrice daily for 5 days was prescribed to the patient. (Figure 2 and Figure 3)

Figure 2: Group A- a)Pre-op b)Incison c)flap raised d)Ozonized water irrigation e)Suture placed f) Post-op after 3 month

Figure 3: Group B- a)Pre-op b)Incison c)flap raised d)Normal Saline irrigation e)Suture placed f) Post-op after 3 month

Result

A) Comparing plaque index (PI) between two groups at different time interval by using independent t test

Table 1: Comparing PI between two groups at different time interval

Time period	Group	Mean± SD	P value
Baseline	Group 1 Group 2	1.7340± .463 1.7340± .463	1
3 month	Group 1 Group 2	.9860± .146 1.2160± .275	.03*

Test used- unpaired t test, p> 0.05 insignificant, p<0.05 significant

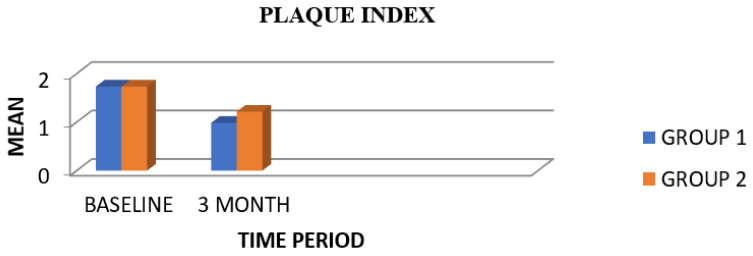

Figure 4: Comparing PI between two groups at different time interval

Mean± SD plaque index same at baseline in group 1 and group 2 was (1.7340± .463) and (1.7340± .463) respectively. Results were found to be insignificant (p=1) and Mean± SD plaque index at 3 month reduced more in group 1(.9860± .146) than group 2 was (1.2160± .275) respectively. Results were found to be significant (p<.03) by using unpaired t test. It was clear in graph also that there was no change in group 1 and group 2 at baseline and plaque index was reduced in both groups at 3 month but plaque index more reduced in group 1 in comparison to group 2. (Table 1 Figure 4)

B) Comparing gingival index (GI) between two groups at different time interval by using independent t test

Table 2: Comparing GI between two groups at different time interval

Time period	Group	Mean± SD	P value
Baseline	Group 1 Group 2	1.6590± .513 1.6590± .513	1
3 month	Group 1 Group 2	1.0340± .422 1.2160± .249	.25

Test used- paired t test, p> 0.05 insignificant, p<0.05 significant

Figure 5: Comparing GI between two groups at different time interval

Mean± SD gingival index at baseline in group 1 and group 2 was same (1.6590± .513) and (1.6590± .513) respectively. Results were found to be insignificant (p=1) and Mean± SD gingival index at 3 month reduced more in group 1(1.0340± .422) than group 2 (1.2160± .249) respectively. Results were found to be insignificant (p=.25) by using unpaired t test. It was clear in graph also that there was no change in group 1 and group 2 at baseline and gingival index was reduced in both groups at 3 month but gingival index more reduced in group 1 in comparison to group 2. (Table 2 Figure 5)

C) Comparing probing pocket depth (PPD) between two groups at different time interval by using independent t test

Table 3: Comparing GI between two groups at different time interval

Time period	Group	Mean± SD	P value
Baseline	Group 1 Group 2	5.900± .567 5.900± .567	1
3 month	Group 1 Group 2	2.4000± .516 3.5000± .547	<0.001**

Test used- paired t test, p> 0.05 insignificant, **p<0.05 significant

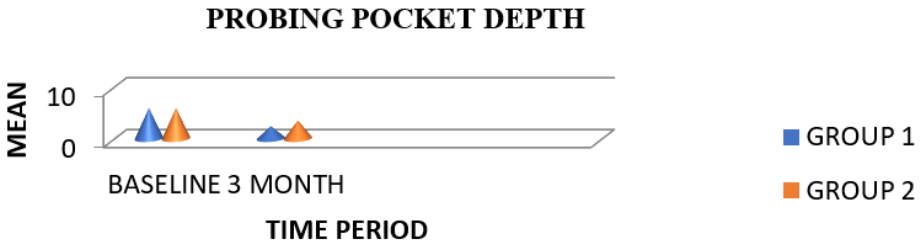

Figure 6: Comparing GI between two groups at different time interval

Mean± SD probing pocket depth same at baseline in group 1 and group 2 was (5.900± .567) and (5.900± .567) respectively. Results were found to be insignificant (p=1) and Mean± SD probing pocket depth at 3 month reduced more in group 1(2.4000± .516) than group 2 was (3.5000± .547) respectively. Results were found to be significant (p<0.001) by using unpaired t test. It was clear in graph also that there was no change in group 1 and group 2 at baseline and probing pocket depth was reduced in both groups at 3 month but probing pocket depth more reduced in group 1 in comparison to group 2. (Table 3 Figure 5)

D) Comparing clinical attachment loss (CAL) between two groups at different time interval by using independent t test

Table 4: Comparing CAL between two groups at different time interval

Time period	Group	Mean± SD	P value
Baseline	Group 1 Group 2	5.900± .567 5.900± .567	1
3 month	Group 1 Group 2	2.4000± .516 3.5000± .547	<0.001**

Test used- paired t test, p> 0.05 insignificant, **p<0.05 significant

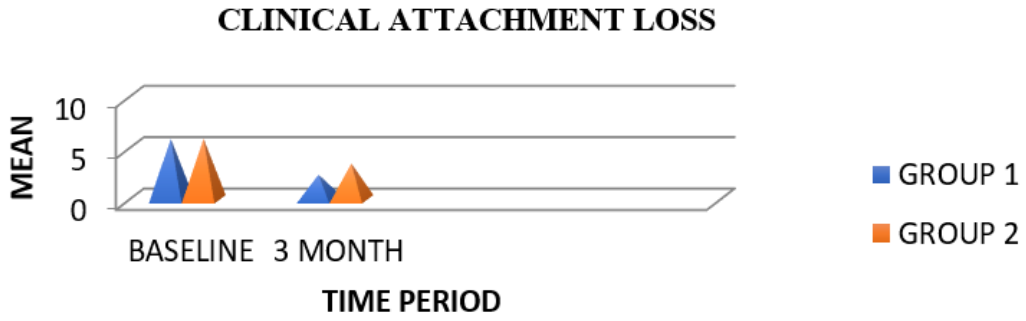

Figure 7: Comparing CAL between two groups at different time interval

Mean± SD clinical attachment loss same at baseline in group 1 and group 2 was (5.900± .567) and (5.900± .567) respectively. Results were found to be insignificant (p=1) and Mean± SD clinical attachment loss at 3 month reduced more in group 1(2.4000± .516) than group 2 was (3.5000± .547) respectively. Results were found to be significant (p<0.001) by using unpaired t test. It was clear in graph also that there was no change in group 1 and group 2 at baseline and clinical attachment loss was reduced in both groups at 3 month but clinical attachment loss more reduced in group 1 in comparison to group 2. (Table 4 Figure7)

E) Comparing healing index (HI) between two groups at different time interval by using independent t test

Table 5: Comparing HI between two groups at different time interval

Time period	Group	Mean± SD	P value
7 days	Group 1 Group 2	2.20± .422 2.70± .483	.02**
1 month	Group 1 Group 2	1.30± .483 1.80± .422	.02**

Test used- paired t test, p> 0.05 insignificant, **p<0.05 significant

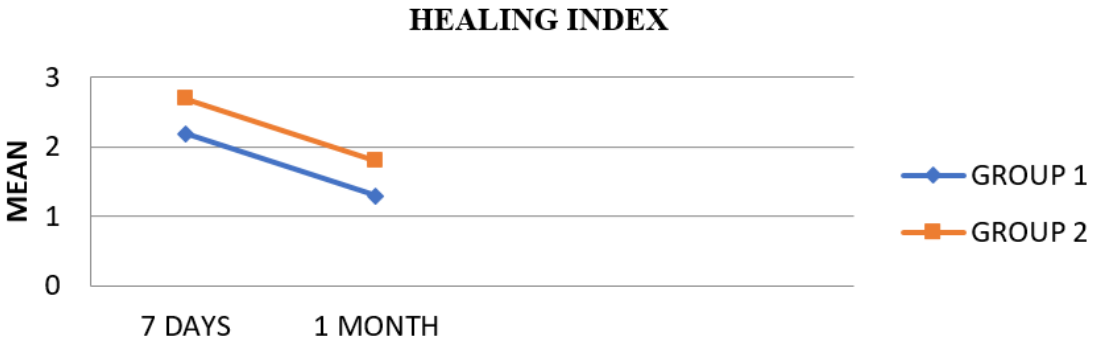

Figure 8: Comparing HI between two groups at different time interval

Mean± SD healing index at 7 days reduced more in group 1 (2.20± .422) compared to group 2 was (2.70± .483) respectively. Results were found to be significant (p=.02) and Mean± SD healing index at 1 month reduced more in group 1(1.30± .483) than group 2 was (1.80± .422) respectively. Results were found to be significant (p=0.02) by using unpaired t test. It was clear in graph also that healing index was reduced more in group 1 than group 2 at 7 days and healing index was reduced in both groups at 1 month also but healing index more reduced in group 1 in comparison to group 2. (Table 5, Figure 8)

F) Comparing visual analogue scale (VAS) between two groups at different time interval by using independent t test

Table 6: Comparing VAS between two groups at different time interval

Time period	Group	Mean± SD	P value
7 days	Group 1 Group 2	1.30± .483 2.60± .516	<0.001**
1 month	Group 1 Group 2	.20± .422 1.70± .483	<0.001**

Test used- paired t test, p> 0.05 insignificant, **p<0.05 significant

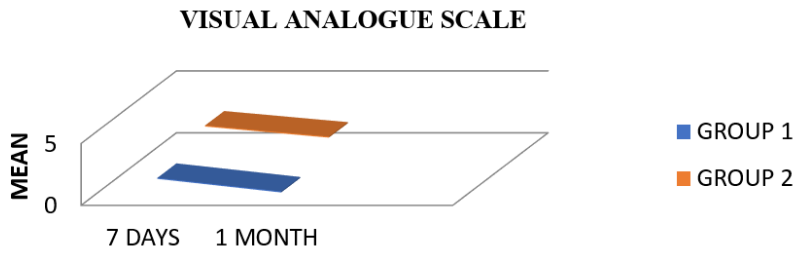

Figure 9: Comparing VAS between two groups at different time interval

Mean± SD visual analogue scale at 7 days reduced more in group 1 (1.30± .483) compared to group 2 was (2.60± .516) respectively. Results were found to be significant (p<0.001) and Mean± SD visual analogue scale at 1 month reduced more in group 1(.20± .422) than group 2 was (1.70± .483) respectively. Results were found to be significant (p<0.001) by using unpaired t test. It was clear in graph also that visual analogue scale was reduced more in group 1 than group 2 at 7 days and visual analogue scale was reduced in both groups at 1 month also but visual analogue scale more reduced in group 1 in comparison to group 2. (Table 9, Figure 6).

3. Discussion

Periodontal disease is a cluster of inflammatory conditions, which is linked to tooth accumulated microbial plaque and the host response.[7] The principal objective of primary periodontal therapy is the disruption, disturbance and regulation of the pathogenic plaque biofilms on the surface of tooth.[8] Moreover, complete eradication of subgingival residues and efficient control of the subgingival flora is difficult to achieve with nonsurgical therapy.[9]

Recently, ozone therapy has been reported as an adjunctive treatment modality for of periodontal disease.[5]**Fisch (1936)** was the first to use ozone as either ozonated water or gas in medical practice.[10] Ozonized water (4 mg/l) was found effective for removing gram-negative and gram-positive oral microbes in pure culture along with bacteria in plaque biofilm. Hence, it might be helpful to regulate oral infectious microbes in dental plaque.[11] Various studies on chronic and aggressive periodontitis have reported significant improvements in Probing Depth, Plaque Index, Gingival Index, and bacterial count in quadrants treated with ozone therapy.[5,11,12] However, the current study assessed the clinical efficacy of adjunct ozonized water with OFD in treatment of periodontitis. To the best of our knowledge, this is the first time that ozonized water has been used clinically with OFD.

In this study all the clinical parameters showed insignificant but slightly better result in Group 1 as compared to Group 2. This was in accordance with the studies by **Dengizek et al.(2019)** who found no significant improvement in clinical parameters when patients were

treated with Scaling and Root Planing (SRP) combined with ozone therapy and SRP alone[14]. However, studies by **Dodwad (2011)** have reported significant improvement in clinical parameters when treated with ozonized water.[15]**Dhingra (2011)** has also reported that ozone is effective in reducing gingival inflammation and diminishing lactate dehydrogenase enzyme level.[16]

In the present study Healing Index and VAS showed significant improvement in Group 1 as compared to Group 2. This was in accordance with studies done by **Filippi A (2001)**[17] and **Isler (2018)**[18] who have shown that ozone administration significantly reduces genotoxic damage, increase blood perfusion, causes faster wound healing and improve post-operative quality of life.

4. Conclusion

The results in the present study revealed statistically insignificant difference in clinical parameters between test and the control groups when evaluated after1 month, however considerably better clinical result was observed in ozonized water group. This shows the beneficial role of use of ozonized water with OFD. Ozonized water had satisfactory effects on pain management and showed better healing.

To the best of our understanding none of the studies conducted so far have considered ozonized water with OFD technique in a split-mouth manner. However, a better study design with longer follow up duration would be needed to assess the beneficial use of ozonized water in management of chronic periodontitis in routine clinical conditions.

Apart from the limitations seen in the current study, it can be said that ozone therapy as an adjunct to the treatment of chronic periodontitis is a valuable tool.

References

[1] The American Academy of Periodontology. Parameter on chronic periodontitis with advanced loss of periodontal support. J Periodontol. 2000;71:856-858.

[2] AlSarhan MA, Altammami MA, Alaqeely RS, AlEbdi A, Al Jasser R, Al Otaibi D et al. Short-term improvement of clinical parameters and microbial diversity in periodontitis patients following Indocyanine green-based antimicrobial photodynamic therapy: A randomized single-blind split-mouth cohort. Photodiagnosis Photodyn Ther. 2021;35:1-8.

[3] Drisko CH. Nonsurgical periodontal therapy. Periodontol 2000. 2001;25:77–88.

[4] Harrel SK. A minimally invasive surgical approach for periodontal regeneration: Surgical technique and observations. J Periodontol. 1999;70:1547–57.

[5] Al Habashneh R, Alsalman W, Khader Y. Ozone as an adjunct to conventional nonsurgical therapy in chronic periodontitis: a randomized controlled clinical trial. J Periodontal Res 2015;50:37-43.

[6] McKenna DF, Borzabadi-Farahani A, Lynch E. The effect of subgingival ozone and/or hydrogen peroxide on the development of peri-implant mucositis: a double-blind randomized controlled trial. Int J Oral Maxillofac Implants 2013;28:1483-9.

[7] Meimandi M, Ardakani MR, Nejad AE, Yousefnejad P, Saebi K, Tayeed MH. The effect of photodynamic therapy in the treatment of chronic periodontitis: a review of literature. J Lasers Med Sci. 2017;8(1):7-11.

[8] Lazar V, Ditu LM, Curutiu C, Gheorghe I, Holban A, Popa M et al. Impact of dental plaque biofilms in periodontal disease: Management and future therapy. InTech Open.2017;15:11-42.

[9] Heitz-Mayfield LJ, Lang NP. Surgical and nonsurgical periodontal therapy. Learned and unlearned concepts. Periodontol 2000. 2013;62:218-31.

[10] Fish E. Apparatus for the production and use of ozone in therapeutics. United States Patent 2,054,367. September 15, 1936.

[11] Srikanth A, Sathish M, Harsha AV. Application of ozone in the treatment of periodontal disease.J Pharm Bioall Sci. 2013;5(1):89-94.

[12] Skurska A, Pietruska MD, Paniczko-Drężek A, Dolińska E, Zelazowska-Rutkowska B, Zak J, et al. Evaluation of the influence of ozonotherapy on the clinical parameters and MMP levels in patients with chronic and aggressive periodontitis. Adv Med Sci 2010;55:297-307.

[13] Hayakumo S, Arakawa S, Mano Y, Izumi Y. Clinical and microbiological effects of ozone nano-bubble water irrigation as an adjunct to mechanical subgingival debridement in periodontitis patients in a randomized controlled trial. Clin Oral Investig 2013;17:379-88.

[14] Seydanur Dengizek E, Serkan D, Abubekir E, Aysun Bay K, Onder O, Arife C. Evaluating clinical and laboratory effects of ozone in non-surgical periodontal treatment: A randomized controlled trial. J Appl Oral Sci 2019;27:e20180108.

[15] Dodwad V, Gupta S, Kumar K, Sethi M, Masamatti S. Changing paradigm in pocket therapy-ozoneversus conventional irrigation. Int J Public Health Dent. 2011; 2 :7–12.

[16] Dhingra K, Vandana KL. Management of gingival inflammation in orthodontic patients with ozonated water irrigation – a pilot study. Int J Dent Hyg 2011; 9: 296-302

[17] Filippi A (2001) The influence of ozonised water on the epithelial wound healing process in the oral cavity. Clinic of Oral Surgery, Radiology and Oral Medicine, University of Basel, Switzerldand.

[18] Isler SC, Uraz A, Guler B, Ozdemir Y, Cula S, et al. (2018) Effects of Laser Photobiomodulation and Ozone Therapy on Palatal Epithelial Wound Healing and Patient Morbidity. Photomed Laser Surg.