ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at:www.ijdsir.com

Volume – 8, Issue – 4, August – 2025, Page No. : 297 - 309

Clinical and microbiological evaluation of four different local drug delivery agents in the management of stage I Grade A/B Periodontitis: A Comparative Study

[1]Dr Navneet Kaur, PhD Scholar, Department of Periodontology & Oral Implantology, Desh Bhagat University, Mandi, Gobindgarh. Punjab.

[2]Dr Vikram Bali, Professor & Head, Department of Periodontology & Oral Implantology, Desh Bhagat University, Mandi, Gobindgarh.

[3]Dr Vaneet Gupta, Associate Professor, Department of Periodontology & Oral Implantology, Yamuna Institute of Dental Sciences & Research, Yamuna Nagar, Haryana.

Corresponding Author: Dr Navneet Kaur, PhD Scholar, Department of Periodontology & Oral Implantology, Desh Bhagat University, Mandi, Gobindgarh. Punjab.

Citation of this Article: Dr Navneet Kaur, Dr Vikram Bali, Dr Vaneet Gupta, "Clinical and microbiological evaluation of four different local drug delivery agents in the management of stage I Grade A/B Periodontitis: A Comparative Study", IJDSIR- August – 2025, Volume – 8, Issue – 4, P. No. 297 – 309.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Periodontitis is a complex multifactorial disease and results in a progressive loss of attachment and formation of periodontal pocket. There are multiple options of anti-microbials that can be locally delivered into the mucosa such as Tetracycline, Doxycycline, Silver nanoparticle Chlorhexidine, Metronidazole, Ornidazole and Quaternary ammonium compounds. Since research with drug delivery system is limited, this clinical study evaluates the comparative efficacy of four different local drug delivery agents as an adjunct to scaling and root planing in the management of Stage I Grade A/B periodontitis.

Material and Methods: The study involved 140 patients randomly divided into 4 groups/sites. Group 1/Site 1 treated with Ornidazole as an adjunct to SRP, Group 2/Site 2 treated with Metronidazole as an adjunct to SRP, Group 3/Site 3 treated with Siver nanoparticle gel as an adjunct to SRP and Group 4/Site 4 treated with oxygen releasing formula blue M gel as an adjunct to SRP. Clinical parameters were assessed for investigation included PI, GI, PPD and CAL at baseline, 1 month and 3 months. Microbiological parameters were recorded following baseline and after 3 months for every subject in all the four groups post treatment.

Results: All the groups showed significant improvement in PI, GI, PPD and CAL gain from baseline to 3 months of time interval when treated with Ornidazole, Metronidazole, Siver nanoparticle gel and oxygen releasing formula blue M gel. Group 4/Site 4 and Group

3/Sites 3 showed more substantial reductions in CFU counts $4.30\times10^2\pm6.11$ and $3.67\times10^2\pm4.72$ respectively after 3 months of intervention.

Conclusion: It can be assumed that the adjunctive use of oxygen releasing formula (Blue M gel™), Siver nanoparticle gel (Megaheal gel™), Ornidazole (Ornigreat gel™) and Metronidazole (Metrohex plus gel™) after scaling and root planning improved the treatment outcome in subjects with Stage I Grade A/B periodontitis.

Keywords: Periodontitis, adjunctive treatment, Ornidazole, Metronidazole, Siver nanoparticle gel, oxygen releasing formula blue M gel, anaerobic flora, bacterial count

Introduction

Periodontitis is a chronic inflammatory condition affecting the tooth-supporting structures, leading to progressive damage of the periodontal ligament and alveolar bone. The disease is initiated by specific bacteria residing in the subgingival biofilm and is exacerbated by the host's immune-inflammatory response to these pathogens. The sub gingival biofilm harbour's a variety of bacterial species; the composition of the biofilm may vary between subjects and sites. Among the various Gram-negative anaerobic species associated with periodontitis, Porphyromonas gingivalis is recognized as a primary causative organism.[1,2] It includes the initial microbial challenge, a subsequent host inflammatory response, and various risk factors that contribute to host susceptibility and progression of the disease. Management of periodontitis focuses on eliminating microbial etiologic factors and restoring periodontal health. Treatment approaches include patient education on oral hygiene, non-surgical interventions, surgical procedures, and ongoing supportive periodontal therapy. Mechanical debridement and the quality of the patient's home care are of vital importance in preventing inflammation that manifests as both gingivitis and periodontitis. Scaling and root planing (SRP) remains the gold standard for non-surgical care, traditionally performed with hand instruments or ultrasonic scalers. This therapy leads to significant improvements in subgingival microbial composition and clinical parameters.[3] However, conventional SRP may be less effective in certain situations, such as when treating inaccessible deep pockets, furcation areas, or root concavities, or when systemic health issues impair the host's immune response. In such cases, adjunctive measures—such as systemic antibiotics, sub gingival irrigation and locally delivered antimicrobial agents are often employed alongside SRP.

Local drug delivery agents used locally into the periodontal pocket with advantage of positive results in periodontitis cases. However, the flaw for systemic antibiotics allergic reactions, resistance to microflora, time period of action is slow and deficient and in some cases GIT disturbances. To overthrow the problems with systemic antibiotics local drug delivery agents was introduced by Goodson's et al in 1979 in various forms such as fibers, films, gels, vesicles, strips and nanoparticle systems. The resorbable carriers are used locally in the form of tetracycline, minocycline, metronidazole, doxycycline, ornidazole and silver nanoparticle gel etc. as an additional therapy with mechanical scaling and root planning.[4,5] Local drug delivery agents can be released in controlled manner or sustained release and follows zero order and first order kinetics respectively.[6]

Ornidazole is a safe, reliable controlled-release of local drug delivery agent. It contains 0.25% chlorhexidine gluconate w/w + 1% ornidazole w/w. It has a direct

interaction with the genetic material DNA causes suppression of protein synthesis and cell death. The biodegradable controlled delivery methods of ornidazole follows zero order kinetic and has low minimal inhibitory concentration. Metronidazole is a semi solid suspension broadly effective against anaerobic microflora like Fusobacterium, P. gingivalis, P. intermedia, spirochetes and clostridium species.[7,8] Having a semi solid suspension, the drug remains in the periodontal pocket without the flushing action of GCF.

Recent advancement in nanotechnology introduced a new therapeutic material is silver nanoparticle gel. The gel has a bacteriostatic action based on three principal mechanisms: firstly, interaction with DNA genetic material, secondly cell membrane destruction and thirdly blocked the enzymes which are important for regulation of transport of electrons.[9] Silver is the metal of choice as they hold the promise to kill microbes effectively. Silver nanoparticles have been recently known to be a promising antimicrobial agent that acts on a broad range of target sites both extracellularly as well as intracellularly. Silver nanoparticles are effective against gram positive as well as gram negative bacteria including multi-resistant strains. Oxygen releasing formula gel which is blue M gel is composed of sodium perborate, Xylitol, Lactoferrin and glucose oxidase enzyme derived from honey. The high proportion of active oxygen concentration reduces pocket depth, bleeding gums, and wound healing. The distinctive formula improves oral hygiene of an individual and also reduces the risk of infections and inflammation.[10] Blue m gel has the property of anti-plaque and anti-gingivitis when used topically in the oral cavity however the literature data is very limited for oxygen therapy as topical approach.

In the light of the above facts, the aim of the present study is the comparative evaluation of four different local delivery agents as an adjunct to scaling and root planning in the management of Stage I Grade A/B periodontitis.

Materials and Methodology

Study Population

For the proposed study, a total of 140 patients diagnosed with Stage I Grade A/B periodontitis having minimum of 5 teeth with PPD between 5-6 mm were selected from the outpatient department of Periodontics and Oral Implantology Desh Bhagat dental college & hospital. An ethical approval for the study was obtained from the Institutional Ethical Board Committee and a detailed verbal and written consent was taken from each of the patient.

Randomized control clinical trial was performed. Patients were allocated randomly into four study groups/sites.

Group 1 / Site 1- comprised of 35 patients treated with Ornidazole (Ornigreat gel™) as additional therapy to SRP.

Group 2 / Site 2 – comprised of 35 patients treated with Metronidazole (Metrohex plus gel™) as additional therapy to SRP.

Group 3 / Site 3- comprised of 35 patients treated with Siver nanoparticle gel (Megaheal gel™) as additional therapy to SRP.

Group 4 / Site 4- comprised of 35 patients treated with oxygen releasing formula (Blue M gel™) as additional therapy to SRP.

Inclusion Criteria

- Patient should have minimum of 20 teeth
- Patient of both genders between age group 20-50 years
- Patients diagnosed with Stage I Grade A/B periodontitis having minimum of 5 teeth with PPD between 5-6 mm
- Patient had not experienced any periodontal therapy from past 6 months

- Patient freed from any unusual oral lesion.
- Patients had not experienced any antibiotic therapy from past 6 months
- Systemically healthy patient without known allergic conditions

Exclusion Criteria

- Patients with known allergy to metronidazole, chlorhexidine, silver nanoparticles or ornidazole
- Patient with systemic disease
- Smoker and Chronic alcoholic patients
- Any tooth with periapical disease
- Teeth with furcation involvement
- Pregnancy, lactation and use of contraceptives medication

Methodology

A total of 140 patients diagnosed with Stage I Grade A/B periodontitis having minimum of 5 teeth with PPD between 5-6 mm were selected& divided into four groups/sites with 35 patients in each group/site. A thorough phase I therapy was conducted that encompassing patient guidance and activation as well as plaque control measures. All patients were instructed to follow oral hygiene measures that include tooth brushing with a soft brush two times a day.

Group 1 / Site 1- 35 patients received subgingival administration of Ornidazole (Ornigreat Gel™) as part of the treatment protocol into the deepest selected periodontal pocket using a disposable syringe. The drug was delivered by blunting the cannula tip to keep down the chance for tissue trauma. After isolating and drying the target site, the gel was carefully dispensed into the base of the periodontal pocket. A periodontal dressing was subsequently placed over the site to secure the area.

Group 2 / Site 2 – 35 patients received subgingival delivery of Metronidazole (Metrohex Plus Gel™) into the deepest selected periodontal pocket using disposable syringe. The procedure was performed by dulling the cannula tip to prevent damage of tissue by sharp needle. After isolating and drying the treatment site, the gel was carefully introduced into the base of the periodontal pocket. A periodontal dressing was subsequently applied to protect the area.

Group 3 / Site 3- 35 patients received subgingival application of silver nanoparticle gel (Megaheal Gel™) into the deepest selected periodontal pocket using disposable syringe. The disposable syringe was prepared by blunting the cannula tip to prevent any potential tissue injury that could occur with a sharp needle. After proper isolation and drying of the treatment site, the gel was carefully dispensed into the base of the periodontal pocket. A periodontal dressing was applied afterward to secure and protect the area.

Group 4 / Site 4- 35 patients received subgingival application of an oxygen-releasing formulation (Blue M Gel™) into the deepest selected periodontal pocket using disposable syringe. The disposable syringe was prepared by dulling the tip of the cannula to prevent potential trauma to the soft tissues. The site was isolated and dried before carefully introducing the gel into the base of the periodontal pocket. Periodontal dressing utilized to protect and stabilize the area.

Postoperative directions for home included soft bristle tooth brush two times daily without utilizing chemotherapeutics and irrigation devices was discouraged.

Subgingival Plaque Sample Collection

Plaque samples below the gingival margin gathered at baseline and after three months using sterile paper points. The sample was put down directly into sterile glass vial composed of 2.5 ml as fluid thioglycolate medium and transported to the Microbiology Department for anaerobic bacterial analysis. The resulting suspension

was subjected to serial dilution using the same medium to achieve a final dilution factor of 10^2. From each dilution, 0.1 ml was injected on plate of blood agar and evenly spread using a sterile glass spreader following the spread plate technique. The culture media employed included blood agar enriched with 5–10% fresh sheep or human blood and nutrient agar supplemented with 5–10% defibrinated fresh blood. The injected plate laid down under anaerobic conditions using an anaerobic jar equipped with a GasPak system, maintained at 37°C for 48 to 72 hours. Upon completion of incubation, plate was inspected to check growth of bacteria in the form of colonies. The total colony count on each plate was recorded, and bacterial concentration manifested as colony-forming units per millilitre (cfu/ml) using the standard formula:

$$\text{CFU/ml} = \frac{\text{Total number of colonies x dilution factor}}{\text{volume of inoculum transferred}}$$

Assessment of Clinical and Microbiological Parameter

Clinical parameters were assessed for investigation included Plaque index, Gingival index, Probing Pocket depth and Clinical attachment level (with the help of UNC-15 Probe). These variables were assessed at baseline, 1 month and 3 months. Microbiological parameters were recorded following baseline and after 3 months for every subject in all the four groups post treatment.

Statistical Analysis

Numerical values were tabulated and analysed through Statistical Package SPSS 23.0 version. Descriptive statistics for variable with numerical values collected was carried out. The descriptive statistics included mean, standard deviation frequency and percentage Different parameter were compared through One-way analysis of variance (ANOVA), Bonferroni post hoc ANOVA and Paired t test for intergroup and intragroup comparison.

Results

Table 1: Intergroup comparison of all clinical parameters among different groups within different time period

Time Period	Group/Site	Plaque Index (PI)		Gingival Index (GI)		Probing Pocket Depth (PPD)		Clinical Attachment Level (CAL)	
		Mean±SD	p value	Mean±SD	p value	Mean±SD	p value	Mean±SD	p value
At Baseline	Group 1/site 1	1.88±0.31	0.012*	2.12±0.27	0.020*	5.55±0.39	0.079**	7.54±0.39	0.316**
	Group 2/site 2	2.01±0.23		2.33±0.25		5.68±0.31		7.62±0.33	
	Group 3/site 3	1.83±0.36		2.15±0.39		5.73±0.25		7.47±0.38	
	Group 4/site 4	2.04±0.33		2.25±0.31		5.69±0.28		7.60±0.37	
1 Month	Group 1/site 1	1.26±0.35	0.072**	1.62±0.31	0.001*	4.61±0.53	0.345**	6.66±0.38	0.902**
	Group 2/site 2	1.44±0.39		1.43±0.36		4.66±0.41		6.58±0.48	
	Group 3/site 3	1.47±0.38		1.39±0.39		4.82±0.59		6.62±0.53	
	Group 4/site 4	1.29±0.50		1.28±0.40		4.66±0.56		6.62±0.50	
3 Months	Group 1/site 1	1.08±0.29	0.029*	0.81±0.26	0.309**	3.54±0.56	0.269**	5.80±0.50	0.117**
	Group 2/site 2	1.13±0.30		0.76±0.35		3.57±0.56		5.60±0.55	

	Group 3/site 3	1.12±0.30		0.85±0.28		3.71±0.52		5.56±0.46	
	Group 4/site 4	0.96±0.16		0.73±0.27		3.46±0.56		5.53±0.53	

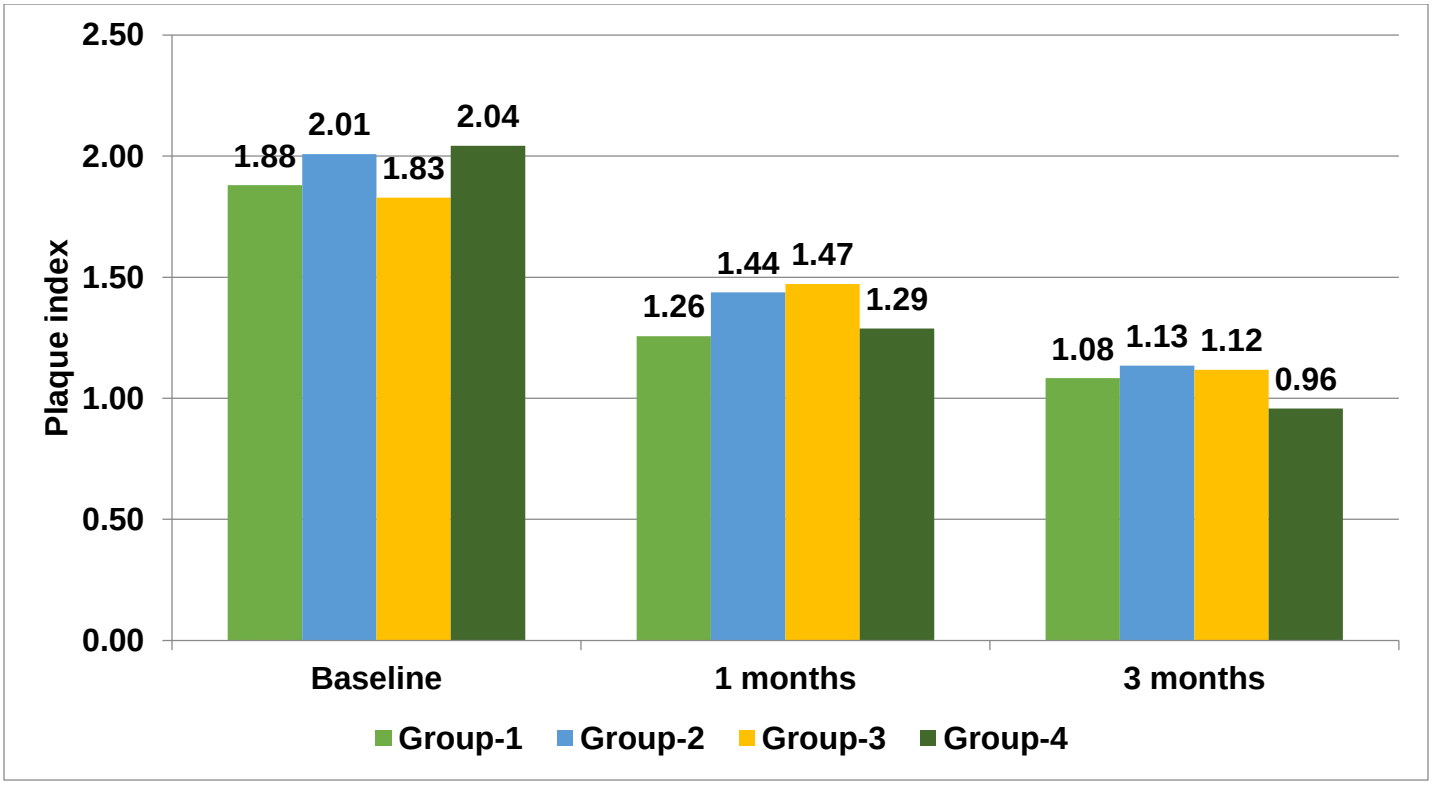
* Statistically significant; ** statistically non-significant

Table 1 showed intergroup comparison of all the clinical parameter was compared among different groups within different time period. The mean plaque index score at the baseline, 1 month and 3-month time interval were 1.88±0.31, 1.26±0.35 and 1.08±0.29 for the Group 1/Site 1. For the Group 2/Site 2, it was 2.01±0.23, 1.44 ±0.39 and 1.13±0.30 at the baseline, 1 month and 3 months' time interval respectively. For the Group 3/Site 3, it was 1.83±0.36, 1.47 ±0.38 and 1.12±0.30 at the baseline, 1 month and 3 months' time interval respectively. For the Group 4/Site 4, it was 2.04±0.33, 1.29±0.50 and 0.96±0.16 at the baseline, 1 month and 3 months' time interval respectively. At baseline and after 3 months of time interval, the mean plaque index score was found to be statistically significant. However, it was found to be statistically non-significant after 1 month of time interval.

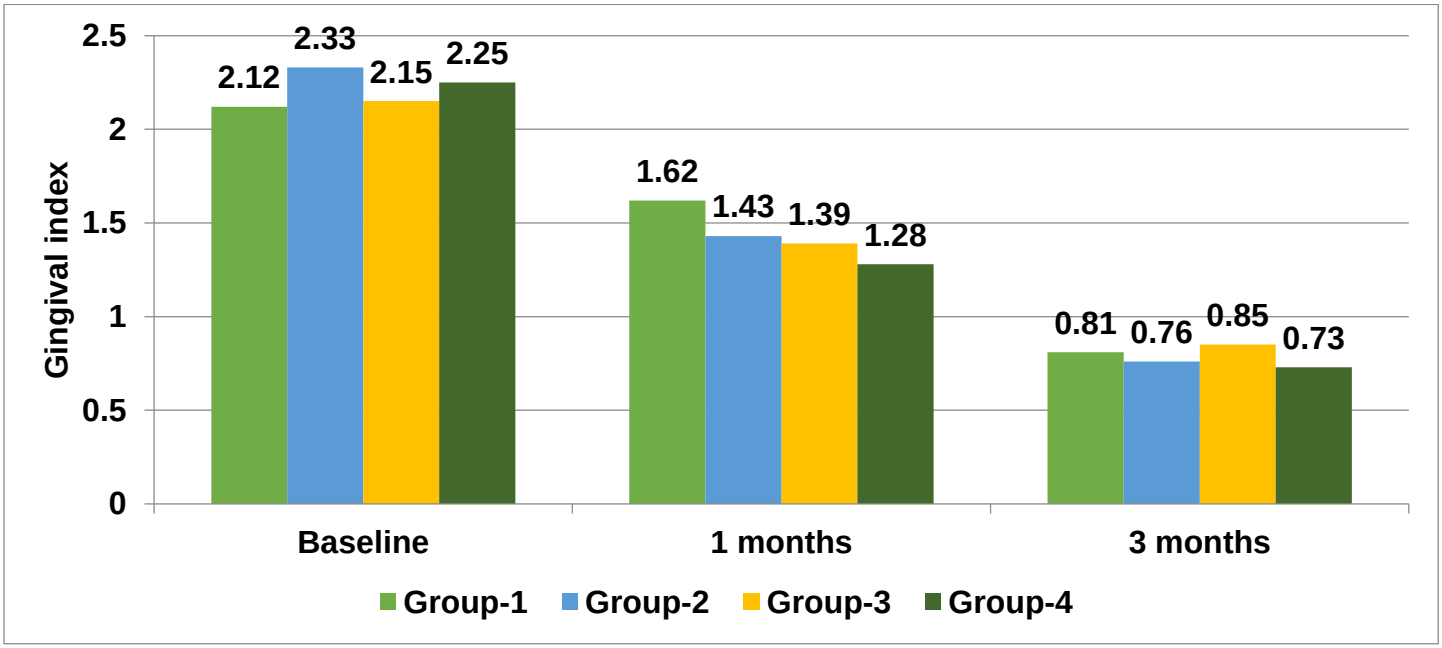
The mean gingival index score at the baseline, 1 month and 3-month time interval were 2.12±0.27, 1.62±0.31 and 0.81±0.26 for the Group 1/Site 1. For the Group 2/Site 2, it was 2.33±0.25, 1.43±0.36 and 0.76±0.35 at the baseline, 1 month and 3 months' time interval respectively. For the Group 3/Site 3, it was 2.15±0.39, 1.39±0.39 and 0.85±0.28 at the baseline, 1 month and 3 months' time interval respectively. For the Group 4/Site 4, it was 2.25±0.31, 1.28±0.40 and 0.73±0.27 at the baseline, 1 month and 3 months' time interval respectively. At baseline and after 1 month of time interval the mean gingival index score was found to be statistically significant. However, it was found to be statistically non-significant after 3 months of time interval.

The mean probing pocket depth value at the baseline, 1 month and 3-month time interval were 5.55±0.39, 4.61±0.53 and 3.54±0.56 for the Group 1/Site 1. For the Group 2/Site 2, it was 5.68±0.31, 4.66±0.41 and 3.57±0.56 at the baseline, 1 month and 3 months' time interval respectively. For the Group 3/Site 3, it was 5.73±0.25, 4.82±0.59 and 3.71±0.52 at the baseline, 1 month and 3 months' time interval respectively. For the Group 4/Site 4, it was 5.69±0.28, 4.66±0.56 and 3.46±0.56 at the baseline, 1 month and 3 months' time interval respectively. At baseline, after 1 month and after 3 months of time interval, probing pocket depth was found to be statistically non-significant.

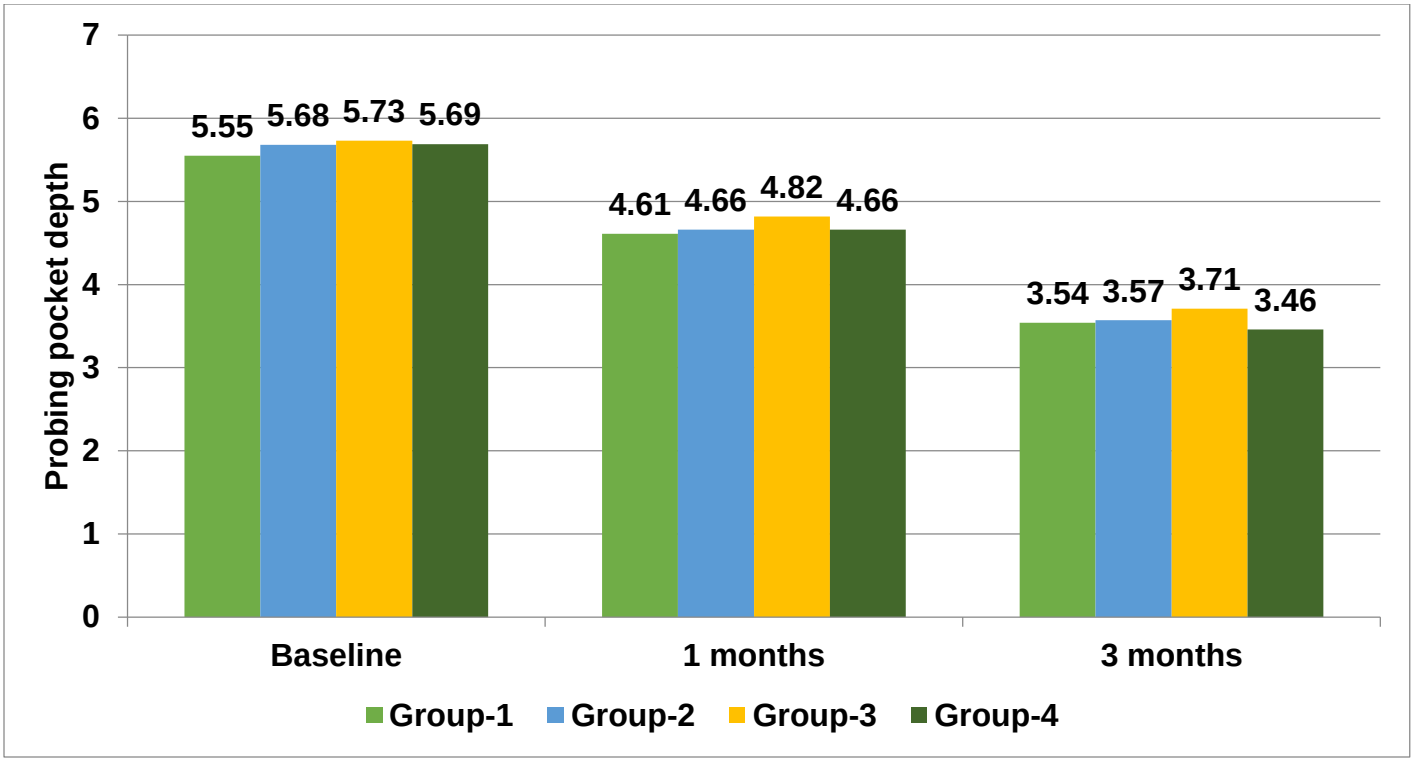
The mean clinical attachment level at the baseline, 1 month and 3-month time interval were 7.54±0.39, 6.66±0.38 and 5.80±0.50 for the group 1/site 1. For the group 2/site 2, it was 7.62±0.33, 6.58±0.48 and 5.60±0.55 at the baseline, 1 month and 3 months' time interval respectively. For the Group 3/Site 3, it was 7.47±0.38, 6.62±0.53 and 5.56±0.46 at the baseline, 1 month and 3 months' time interval respectively. For the Group 4/Site 4, it was 7.60±0.37, 6.62±0.50 and 5.53±0.53 at the baseline, 1 month and 3 months' time interval respectively. At baseline, after 1 month and after 3 months of time interval, clinical attachment level was found to be statistically non-significant.



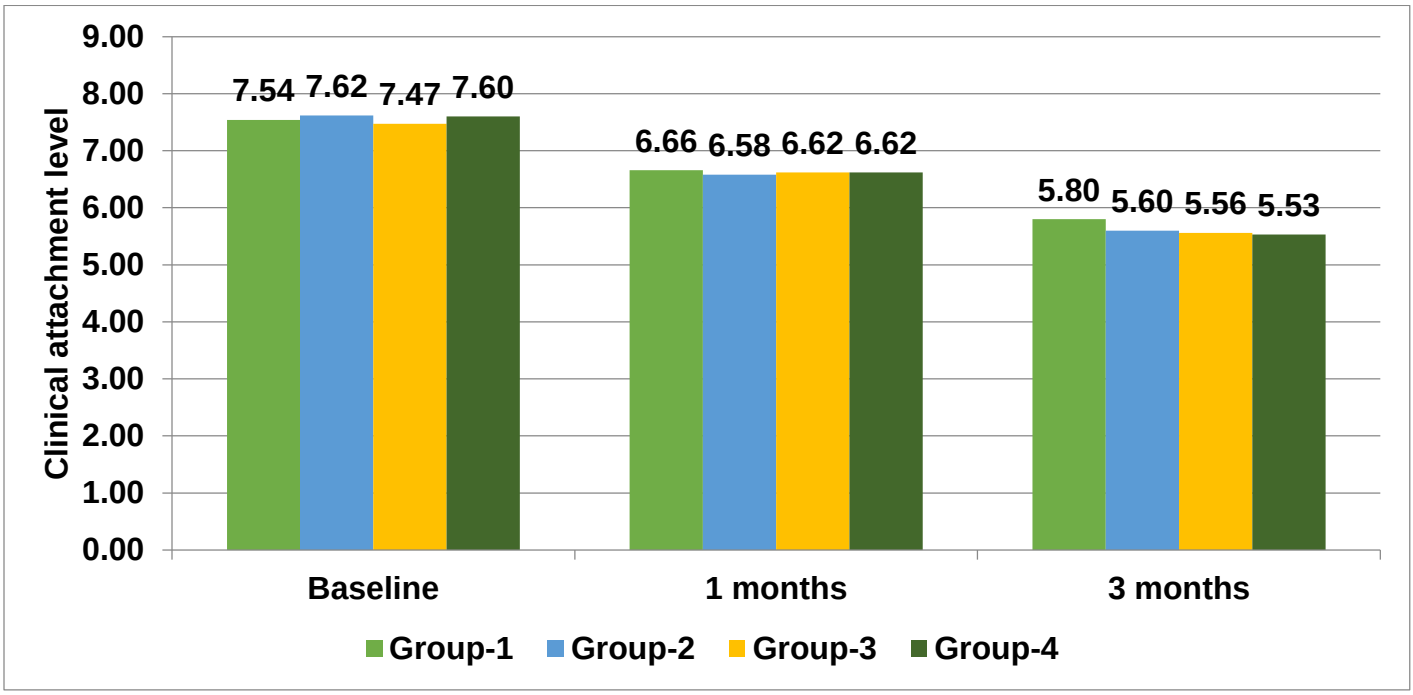
Graph 1: Intergroup comparison of plaque index score among different groups within different time period



Graph 2: Intergroup comparison of gingival index score among different groups within different time period



Graph 3: Intergroup comparison of probing pocket depth among different groups within different time period



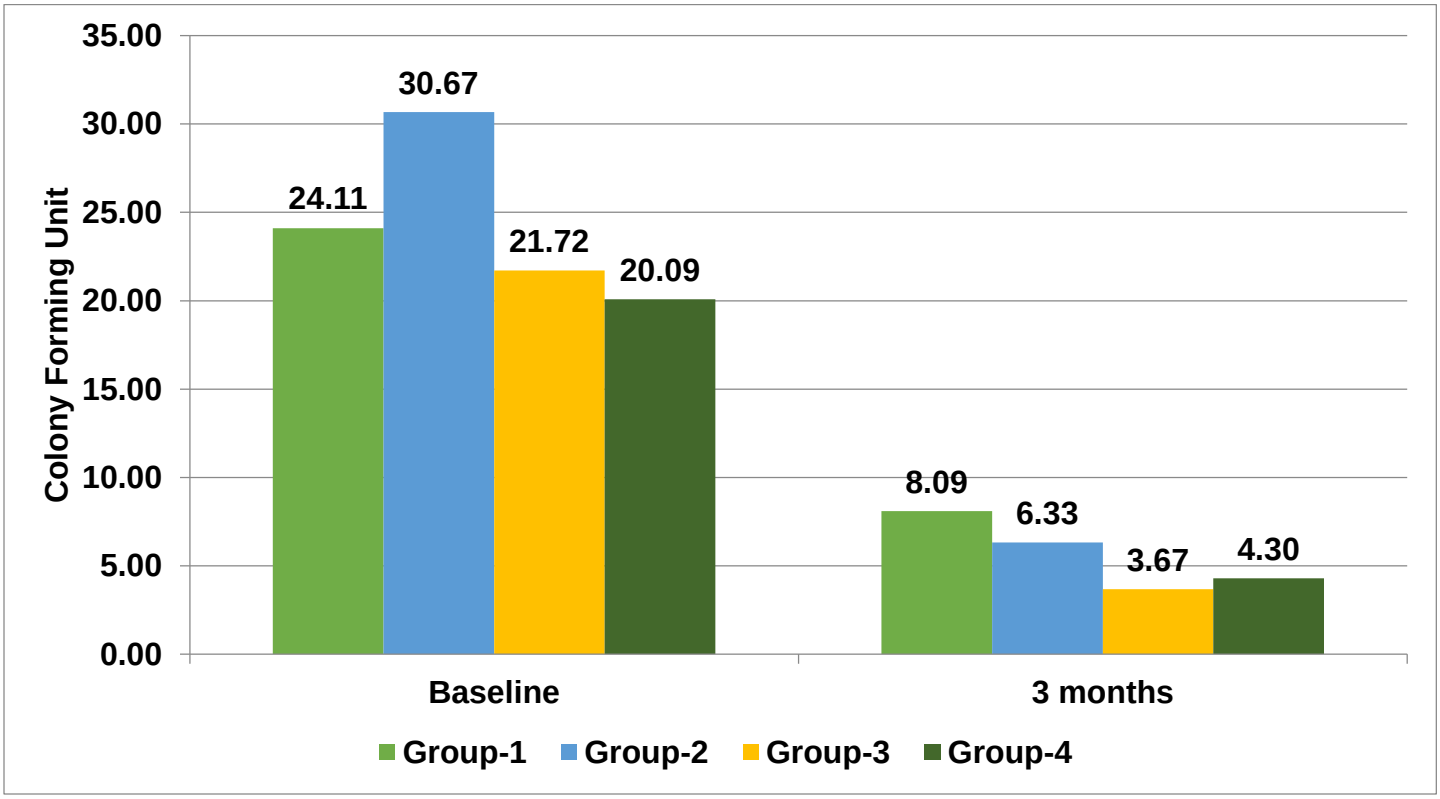
Graph 4: Intergroup comparison of clinical attachment level among different groups within different time period

Table 2: Intergroup comparison of colony forming unit among different groups within different time period

	Group/Site	Mean±SD	P Value
At Baseline	Group 1/site 1	$24.11\times10^2\pm20.83$	0.140**
	Group 2/site 2	$30.67\times10^2\pm25.49$	

	Group 3/site 3	$21.72\times10^2\pm18.13$	
	Group 4/site 4	$20.09\times10^2\pm14.75$	
3 Months	Group 1/site 1	$8.09\times10^2\pm10.92$	0.052**
	Group 2/site 2	$6.33\times10^2\pm6.00$	
	Group 3/site 3	$3.67\times10^2\pm4.72$	
	Group 4/site 4	$4.30\times10^2\pm6.11$	

** statistically non-significant



Graph 5: Intergroup comparison of colony Forming Unit ($\times 10^2$) among different groups within different time period

The mean of Colony Forming Unit at the baseline and 3-month time interval were $24.11\times10^2\pm20.83$ and $8.09\times10^2\pm0.50$ for the group 1/Site 1. For group 2/Site 2, the CFU count was $30.67\times10^2\pm25.49$ and $6.33\times10^2\pm6.00$ at the baseline and 3 months' time interval respectively. For the Group 3/Site 3, the CFU count was $21.72\times10^2\pm18.13$ and $3.67\times10^2\pm4.72$ at the baseline and 3 months' time interval respectively. For the Group 4/Site 4, the CFU count was $20.09\times10^2\pm14.75$ and $4.30\times10^2\pm6.11$ at the baseline and 3 months' time interval respectively. At baseline and after 3 months of time interval, Colony Forming Unit was found to be statistically non-significant.

Discussion

Non-surgical mechanical periodontal therapy serves as the primary and foundational approach in the management of periodontal infections. This conventional treatment typically involves mechanical removal of supra- and subgingival deposits, complemented by patient education on effective self-performed oral hygiene practices. Nevertheless, subgingival scaling and root planing is a technically challenging procedure and may not consistently achieve complete elimination of

periodontal pathogens or sufficient reduction of gingival inflammation, particularly in periodontal pockets exceeding 5 mm in depth. Consequently, the adjunctive use of locally applied subgingival chemotherapeutic agents is considered a rational strategy to enhance both the clinical and microbiological outcomes of mechanical debridement.

The combination of mechanical and chemical approach to control the subgingival plaque would seems in authenticated treatment modality for maintaining a periodontal health. In corporation of an appropriate chemotherapeutic agent as an adjunct with mechanical instrumentation may provide an additional antimicrobial effect which increase the opportunity to control the disease. Local delivery of antimicrobial pharmaceutical agents has been employed in an attempt to treat and control the periodontal diseases. Local drug delivery effectively reaches the base of the periodontal pocket and remains for an adequate time period to have its antimicrobial effect. The antimicrobial agents also reduce the bacterial load from the pocket area and results in significant improvement clinically as well as microbiologically. The approach of local drug delivery also has a bacteriostatic and bactericidal effects providing a subsequent clinical improvement. Therefore, the aim of present investigation was the comparative evaluation of four different local delivery agents as an adjunct to scaling and root planing in the management of Stage I Grade A/B periodontitis. Clinical parameters were assessed such as plaque index, gingival index, probing pocket depth and clinical attachment level at baseline, 1 month and 3 months. Total microbial load was analysed at baseline and after 3 months of time interval.

The present study showed a significant reduction in plaque index in between four groups from baseline to 3 months of time interval and found to be statistically significant. However, it was found to be statistically non-significant after 1 month of time interval on intergroup assessment. On intragroup assessment the mean plaque index score was found to be statistically significant. Group 3/Site 3 and Group 4/Site 4 was comparatively superior as compared to group 2/site 2 and group 1/site 1 in terms of reduction in mean plaque index score at baseline and after 3 months' time interval. The reduction in plaque might be due to the reinforcement of oral hygiene instruction with effectively re-motivation at the patient level. Group 3/Site 3 was treated with Siver nanoparticle gel (Megaheal gel™) and Group 4/Site 4 was treated with oxygen releasing formula (Blue M gel™) as an adjunct to SRP showed a reduction in mean plaque index score as compared to group 2/site 2 and group 1/site 1. The results of the study were in accordance with various studies who investigated for local drug delivery drugs in periodontitis. **Masurkar SA et al.2012** hypothesized that silver nanoparticle enhances quorum quenching quality for S. aureus and arrest biofilm formation.[11] **Gavali et al 2022 and Agarwal S et al 2024** investigated the effect of blue M gel as local delivery agent as an adjunct to SRP and found a significant improvement in plaque index score from baseline to 3 months of time interval.[12,13] Blue m gel ahs the potential to heal the wound at a faster rate and prevents the plaque biofilm formation in the oral cavity.

Group 1/Site 1 and Group 4/Site 4 was comparatively greater effect in terms of reduction in mean gingival index score at baseline and after 3 months' time interval. Group 1/Site 1 was treated with Ornidazole (Ornigreat gel™) as an adjunct to SRP and showed a reduction in mean gingival index score as compared to group 3/site 3, group 4/site 4 followed by group 2/ site 2. Similar studies showed with evidence by **Bindhu Madhuri et al 2016 and Upendra Prasad et al 2021** found a significant

improvement in gingival index score from baseline to 3 months' time interval.[14,15] When multiple comparison of plaque index and gingival index score was done from baseline to 1 month, 1 month to 3 months and from baseline to 3 months, the result was found to be statistically significant. The adjunctive use of local drug delivery agent showed decrease in gingival inflammation with a shift of pathogenic microbial flora to non-pathogenic flora. In the present study, group 4/site 4 also showed improvement in gingival inflammation because of active oxygen molecules released at the targeted site.

Regarding the periodontal parameters i.e., probing pocket depth and clinical attachment level was found to be statistically non-significant at baseline, after 1 month and 3 months of time interval on intergroup comparison. Group 1/Site 1 and Group 4/Site 4 was superior in comparison with group 3/site3 and group 2/site2 from baseline to 3 months. The reduction in probing pocket depth might be because of reduction in inflammation and alteration in the sub gingival microbiota along with by chance removal of inflammatory components present in and around the epithelium during SRP. **Nagasree M et al 2016** demonstrated the clinical efficiency of ornidazole as an adjunct to SRP showed significant reduction in probing pocket depth from baseline to 3 months of time interval.[14] When multiple comparison of probing pocket depth was done from baseline to 1 month, 1 month to 3 months and from baseline to 3 months the result was found to be statistically significant. Similar supportive studies conducted in the literature by **Anisha Koul et al 2019 and Niveda and Kaarthikeyan et al 2020** investigated PPD as a significant parameter.[10,16] At baseline Group 3/Site 3 is better for gaining CAL followed by Group 1/Site 1, Group 4/Site 4 and Group 2/Site 2. After 1 month of time interval, group 2/site 2 is better in terms of gain in clinical attachment level followed by group 4/site 4, group 3/site 3 and group 1/site 1. After three months of time interval, group 4/site 4 is better for gaining CAL followed by group 3/site 3, group 2/site 2 and group 1/site 1. The result of the present study is in agreement with the study conducted by **Bali et al 2022** demonstrated the reduction in inflammation resulting in a decrease in PPD and gain in CAL.[17] **Griffiths et al 2000** demonstrated metronidazole gel produced significant favourable results in terms of PPD and CAL when used as an adjunct to SRP.[18] Group 4/Site 4 was treated with oxygen releasing formula (Blue M gel™) as an adjunct to SRP showed statistically non-significant difference. However, favourable gain in CAL after 3 months' time interval. **Agarwal S et al 2024 and Sharmishtha Vijay et al 2023** supported the result of the present study.[13,19]

The present study showed significant difference in colony forming unit from baseline to 3 months in all the four groups/ sites on intragroup comparison. However, on intergroup comparison it was found to be statistically non-significant. Group 4/Site 4 and Group 3/Sites 3 showed comparatively more reduction in microbial load $4.30\times10^{2}\pm6.11$ and $3.67\times10^{2}\pm4.72$ respectively after 3 months of time interval. **Kadam P et al 2020 and Kale S et al 2018** examined microbiological parameters especially for periodontal pathogens and showed reduction in microbial load after the intervention when LDD agents used as an adjunct to SRP.[20,21] **Paolantonio M. and Angelo M. et al 2008** demonstrated reduction in microorganisms count in test group from baseline to 3 months follow up time period.[22] LDD agents decrease the growth of pathogenic bacteria along with clinical improvement in parameters resulting in arresting of disease process. Therefore, LDD agents can be used alone or as an adjunct to SRP.

Conclusion

The present study results indicates that the adjunctive use of four different local drug delivery agents when used as an adjunct to scaling and root planning effectively improved the treatment outcome in patients with Stage I Grade A/B periodontitis. The use of LDD agents is efficient in disrupting plaque biofilm through the area surrounding the tooth and results in significant improvement for clinical and microbiological parameter. The overall results showed an improvement in the management of Stage I Grade A/B periodontitis. However, it needs further elucidation with large sample size and long-term investigations by using to confirm the present findings and evaluate the longitudinal benefits of the study.

References

1. Slots, J. & Ting, M. Actinobacillus actinomycetemcomitans and Porphyromonas gingivalis in human periodontal disease: occurrence and treatment. Periodontology 2000 1999; 20: 82–121.
2. Herrera, D., Contreras, A., Gamonal, J., Oteo, A., Jaramillo, A., Silva, N., Sanz, M., Botero, J. E. & Leon, R. Subgingival microbial profiles in chronic periodontitis patients from Chile, Colombia and Spain. Journal of Clinical Periodontology 2008; 35:106–113.
3. Haffajee AD, Cugini MA, Dibart S, Smith C, Kent RL Jr, Socransky SS. The effect of SRP on the clinical and microbiological parameters of periodontal diseases. J clin. periodontol 1997 ;24(5): 324-34.
4. Greenstein G, Polson A. The role of local drug delivery in the management of periodontal diseases: A comprehensive review. J Periodontol. 1998;69(5):507-20.
5. Stanford T W Jr. Local drug delivery in the treatment of periodontitis. Tex Dent J. 2001;118(10):978-83.
6. I G Needleman. Controlled drug release in Periodontics. A review of new therapies. British Dental Journal 1991; 170:405-7.
7. Edwards DI. Nitroimidazole drugs-action and resistance mechanisms. I. Mechanisms of action. J Antimicrob Chemother. 1993;31(1):9-20.
8. Bhavin Patel, Samir Shah, Santosh Kumar. Evaluation of Ornidazole Gel as an Adjunct to the Phase I Therapy. Adv Hum Biol. 2014; 4(3):21-25.
9. McCann M, Curran R, Ben-Shoshan M, McKee V, Tahir AA, Devereux M, et al. Silver(I) complexes of 9-anthracenecarboxylic acid and imidazoles: synthesis, structure and antimicrobial activity. Dalton Trans. 2012; 41:21.
10. Anisha Koul et al Comparative evaluation of oxygen releasing formula (Blue-M Gel) and chlorhexidine gel as an adjunct with scaling and root planing in the management of patients with chronic periodontitis A clinico-microbiological study, J Dent Specialities, 2019; 7(2): 111-117.
11. Masurkar SA, Chaudhari PR, Shidore VB, Kamble SP. Effect of biologically synthesised silver nanoparticles on Staphylococcus aureus biofilm quenching and prevention of biofilm formation. IET Nanobiotechnol. 2012;6(3):110-4.
12. Gavali A, Yogesh S. Doshi and Mona U. Shah. Assessment of Clinical and Microbiological Changes In Patients With Chronic Periodontitis Treated With Scaling And Root Planing (SRP) Alone And Scaling And Root Planing (Srp) With Blue-M Gel: A Split-Mouth Randomized Clinical Trial. European Journal of Pharmaceutical and Medical Research 2022; 9(5): 511-517.

13. Agarwal S, Bali S, Aggarwal P, Garg A, Nautiyal A, Sharma M. Evaluation of the efficacy of oxygen-releasing gel as an adjunct to scaling and root planing in chronic periodontitis: A split-mouth randomized controlled trial. J Int Clin Dent Res Organ 2024; 16:157-62.
14. M. Nagasree, P. Bindu Madhuri, S.V.V.S Musalaiah, P. Aravind Kumar, P. Indeevar. Efficacy Of Ornidazole Gel as An Adjunct to Scaling and Root Planing in Chronic Periodontitis Patients: A Clinical and Microbiological Study. Journal of Biomedical and Pharmaceutical Research 2016;5(6):12-18.
15. Upendra Prasad, Abhinav Deshpande, Praneeta Kamble, Abhishek Singh, Adiya Apon, Geetika Prabhakar. Topical Chemotherapeutic Adjuncts in Non-Surgical Periodontal Therapy – A Randomised Controlled Double Blinded Trial. International Journal of Medical and Biomedical Studies 2021;5(3):177-185.
16. R. Niveda and Gurumoorthy Kaarthikeyan. Effect of Oxygen Releasing Oral Gel Compared to Chlorhexidine Gel in the Treatment of Periodontitis. Journal of Pharmaceutical Research International 2020; 32(19): 75-82.
17. Bali S, Bhargava A, Arora S, Aggarwal P, Nautiyal A, Singhal D, et al. Oxygen-releasing versus 0.2% chlorhexidine gel as an adjuvant to scaling and root planing: A randomized controlled trial. World J Dent 2022;13:s220-4.
18. Griffiths GS, Smart GJ, Bulman JS, Weiss G, Shrowder J, Newman HN. Comparison of clinical outcomes following treatment of chronic adult periodontitis with subgingival scaling or subgingival scaling plus metronidazole gel. J Clin Periodontol. 2000 Dec;27(12):910-7.
19. Sharmishtha Vijay, Pavitra J, Debopriya Chaterjee, Rajeev Soangra, Anjali Kapoor, Jyoti Dad. Comparative Evaluation of Oxygen Releasing Formula (Blue-M Gel®) and Metronidazole Gel as an Adjunct with Scaling and Root Planning in the Management of Patients with Chronic Periodontitis: A Pilot Study. National Research Denticon 2023;12(2):38-44.
20. Pooja Kadama, Swapna Mahalea, Prasad Sonara, Dipali Chaudharia, Shraddha Shimpia, Ankita Kathurwar. Efficacy of silver nanoparticles in chronic periodontitis patients: a clinico-microbiological study. Iberoamerican Journal of Medicine 2020; 3:142-147.
21. Kale S, Mahale S, Sonar P. Antimicrobial Efficacy of Silver Nanoparticles Against Periodontal Pathogens. Int J Current Adv Res. 2018; 7:13457-60.
22. Paolantonio M, D'Angelo M, Grassi RF, et al. Clinical and microbiologic effects of subgingival controlled-release delivery of chlorhexidine chip in the treatment of periodontitis: a multicenter study. J Periodontol. 2008;79(2):271-82.