A comparative evaluation of efficacy of oxygen releasing formula gel, chlorhexidine gel and scaling and root planing alone in the management of chronic periodontitis– A clinico-microbiological study

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ABSTRACT

Aim: The aim of the present study is to compare and evaluate the efficacy of oxygen releasing formula gel and chlorhexidine gel adjunct to scaling and root planing and scaling and root planing alone in patients with chronic mild-moderate periodontitis clinically and microbiologically in red complex bacteria (*Porphyromonas gingivalis, Treponema denticola*, and *Tannerella forsythia*).

Materials and method: 10 Mild to moderate chronic periodontitis patients were selected. 3 sites of different quadrants were selected from each patient which summed up to the required sample size i.e., 30 sites (n=30). The quadrants were randomly allocated by using convenient sampling technique. (n-30) into three groups.

GROUP A- Scaling and root planing was carried out as a stand-alone therapy.

GROUP B- Scaling and root planing with application of chlorhexidine gel.

GROUP C- Scaling and root planing with application of oxygen releasing formula gel.

Clinical parameters (plaque index, gingival index, pocket probing depth, clinical attachment level) and level of red complex bacteria were assessed at base line and after three months of follow up.

Results: Significant improvement in the clinical parameters (PI, GI, PPD, CAL) and microbiological count (*P.g., T.f., T.d.)* in oxygen gel group and chlorhexidine group in adjunct to SRP when compared to SRP alone from baseline to 3 months. Overall, no statistically significant difference was observed in comparison among all the three groups from baseline to 3 months except *P.g.*count which was statistically significant.

Conclusion: Two of the gels i.e chlorhexidine gel and Blue m gel can be used as an reliable option or adjunctive to SRP, in the present study Blue m gel has shown to be fairly and coequally effective when compared to the chlorhexidine gel in treating mild to moderate periodontal pockets.

INTRODUCTION

Periodontal disease encompasses several pathological conditions affecting the tooth supporting structures.[1] It involves supportive structures of the teeth which prevails in all groups, ethnicities, races and both genders. Its etiology is multifactorial[2] (1) a susceptible

host, (2) the presence of pathogenic species and (3) the absence, or small portion of beneficial bacteria.[3] It has been well established that it is a result of local bacterial infection with a pathogenic microflora in the periodontal pocket. It includes conditions such as chronic periodontitis, aggressive periodontitis, systemic disease- associated periodontitis and necrotizing periodontitis.[1]

Chronic periodontitis has been defined as an "infectious disease resulting in inflammation within the supporting tissues of the teeth, progressive attachment and bone loss and is characterized by pocket formation and/or recession of the gingiva. It is recognized as the most frequently occurring form of periodontitis. It is prevalent in adults, but can occur at any age."[4] The disease is usually associated with the presence of plaque and calculus. It is associated with a variable microbial pattern.[4] The bacteria associated with chronic periodontitis are *Porphyromonas gingivalis (P.g.), Tannerella forsythia (T.f.), Prevotella intermedia(P.i.), Campylobacter rectus, Fusobacterium nucleatum(F.n.), Aggregatib acteractinomycetemcomitans(A.a.), Peptostreptococcus micros, Treponema* and *Eubacterium* species.[3]

Conventional nonsurgical periodontal therapy consists of mechanical supra- gingival and subgingival tooth debridement and instruction in self-administered oral health care measures. Non -surgical periodontal therapy like scaling and root planing (SRP) allows for the removal of both supra- and subgingival deposits. Sometimes scaling and root planing may not completely eliminate all these species due to their invasive potential into gingival epithelial cells and subepithelial connective tissues. Hence, to overcome this, systemic and local drug delivery of antimicrobials was initiated to enhance nonsurgical therapy by serving as an adjunct to scaling and root planing[5].

To override the shortcomings of the systemic administration, Dr. J.Max Goodson in the year 1979, developed the concept of controlled release of local drug delivery (LDD). Local administration of anti-infective agents, directly in the pocket, has the potential to provide greater concentrations directly to the infected area and reduce possible systemic side effects.[3]

Hardy et al in 1982 delivered chlorhexidine (CHX) solution within the periodontal pocket of 3 mm from the apical plaque border to the bottom of the deep pockets.[6]Then Soh et al in 1982 performed a clinical study to evaluate the effect of subgingival irrigation with 0.2% CHX in to the periodontal pockets and showed reduction in periodontal inflammation, even in the absence of effective interdental mechanical plaque removal by the patients.[6] Coventry et al in 1982, used the same approach as Goodson and replaced it with cellulose-based dialysis tube filled with chlorhexidine in acute periodontitis patients and showed promising results.[8]

A team of dental surgeons led by Dr. Peter Blijdorp in the Netherlands, developed a product based on release of active oxygen.[8] This oxygen releasing gel is used in improving the wound healing by enhancing levels of oxygen level at the site of wound. This high level of active oxygen concentration also helps in reducing the pocket depth, bleeding gums, wound healing after extraction of failed implant. Cellular hypoxia affects cell growth, cell proliferation, survival, regulation of pH, angiogenesis and metabolism, causing increase in number of periodontopathogens increasing the oxidative stress in the fibroblasts of the periodontal ligament causing destruction of the protective mechanism.[9]

Hence the present study was aimed to investigate efficacy of oxygen releasing formula gel, chlorhexidine gel and scaling and root planing alone in the management of chronic periodontitis patients.

MATERIALS AND METHODS

Ethical approval: The institutional ethics committee of Bharati Vidyapeeth (Deemed to be University) medical college and hospital, Sangli (BV(DU)MC & H/Sangli/ IEC/ Dissertation 2020-21/ D-37) has approved the present study.
Source of data: 10 Mild to moderate chronic periodontitis patients were selected from the out patient department, Department of Periodontology, Bharati Vidyapeeth (Deemed to be University), Dental College & Hospital, Sangli. 3 sites of different quadrants were selected from each patient which summed up to the required sample size i.e., 30 sites (n=30). The quadrants were randomly allocated by using convenient sampling technique. (n-30) into three groups.
GROUP A- Scaling and root planing was carried out as a stand-alone therapy.
GROUP B- Scaling and root planing with application of chlorhexidine gel.
GROUP C- Scaling and root planing with application of oxygen releasing formula gel.
Clinical parameters (plaque index, gingival index, pocket probing depth, clinical attachment level) and level of red complex bacteria were assessed at base line and after three months of follow up.

Inclusion criteria
1. Systemically healthy patient.
2. Age 30-50 years.
3. Patients with mild to moderate chronic periodontitis.
4. Shallow probing pocket depth of 4-5 mm.

Exclusion criteria
1. Subjects who had taken antibiotics 6 months prior or on antibiotics during this trial.
2. Patients with history of systemic disease.
3. Pregnant or lactating mothers.
4. Patients with history of smoking
5. Patients with history of tobacco chewing.

The patient was recalled for follow up after three months and the plaque samples were collected again for assessing the levels of red complex bacteria and all the clinical parameters were assessed to compare and evaluate the efficacy of oxygen releasing formula gel over chlorhexidine gel and scaling and root planing alone.

Microbiological Parameters
Before starting the treatment procedure, subgingival plaque samples were collected from shallow pockets of 4-5mm in the control, positive control and test groups with the help of paper points. The plaque samples were then immediately be transferred into a transport medium (1ml of TE buffer medium) and the sample were sent for semi- quantitative analysis by conventional multiplex polymerase chain reaction (PCR) method. The pure strain of red complex bacteria was considered as the positive control to run the PCR cycle.

RESULT
statistics Statistical analysis performed according to the appropriate statistical test. Descriptive applied to assess mean, standard deviation & frequencies. One way ANOVA test was used for comparison among Group A, Group B and Group C.
Paired t test was used for comparison between baseline and 3 months of all the groups. P value < 0.05 will be fixed for statistical significance.

Table 1 and graph 1 shows intergroup comparison of mean *Porphyromonas gingivalis* count between Group A (SRP), Group B (SRP+CHX) and Group C (SRP+O2 Gel).

At baseline
Group A had higher mean score as compare to Group B, Group C at baseline. Overall, no statistically significant difference ($p>0.05$) was observed at baseline using Kruskal Wallis test. On pairwise comparison using Mann Whitney U test, no statistically significant difference was observed among any pair of groups.

At 3 months
Group A had higher mean score as compare to Group B, Group C at baseline. Overall, statistically significant difference ($p<0.05$) was observed using Kruskal Wallis test. On pairwise comparison, no statistically significant difference was observed among Group A - Group B, Group B-Group C. But, Group A had statistical significant difference greater mean count than Group C.

Change from baseline to 3 months
Overall highest efficacy in reduction was observed in Group C followed by Group B and least in Group A. Overall, statistically significant difference ($p<0.05$) was observed using Kruskal Wallis test. On pairwise comparison, highly statistically significant difference was observed among Group A - Group B, Group A-Group C. But Group C had greater reduction in mean count than Group B but the difference was not found to be of statistical significance.

Table 2 and graph 2 shows intergroup comparison of mean *Treponema denticola* count between Group A (SRP), Group B (SRP+CHX) and Group C (SRP+O2 Gel).

At baseline
Group A had higher mean score as compare to Group B, Group C at baseline. Overall, no statistically significant difference ($p>0.05$) was observed at baseline using Kruskal Wallis test. On pairwise comparison using Mann Whitney U test, no statistically significant difference was observed among any pair of groups.

At 3 months
Group A had higher mean score as compare to Group B, Group C at baseline. Overall, statistically significant difference ($p<0.05$) was observed using Kruskal Wallis test. On pairwise comparison, no statistically significant difference was observed among Group A - Group B, Group B-Group C, Group A-Group C

Change from baseline to 3 months
Overall highest efficacy in reduction was observed in Group A followed by Group C and least in Group B. Overall, no statistically significant difference ($p<0.05$) was observed using Kruskal Wallis test. On pairwise comparison, no statistically significant difference was observed among Group A - Group B, Group B-Group C, Group A-Group C.

Table 3 and graph 3 shows intergroup comparison of mean *Tannerella forsythia* count between Group A (SRP), Group B (SRP+CHX) and Group C (SRP+O2 Gel).

At baseline
Group A had higher mean score as compare to Group B, Group C at baseline. Overall, no statistically significant difference ($p>0.05$) was observed at baseline using Kruskal Wallis test. On pairwise comparison using Mann Whitney U test, no statistically significant difference was observed among any pair of groups.

At 3 months
Group A had higher mean score as compare to Group B, Group C at baseline. Overall, statistically significant difference ($p<0.05$) was observed using Kruskal Wallis test. On pairwise comparison, no statistically significant difference was observed among Group A - Group B, Group B-Group C, Group A-Group C

Change from baseline to 3 months
Overall highest efficacy in reduction was observed in Group C followed by Group A and least in Group B. Overall, no statistically significant difference ($p<0.05$) was observed using Kruskal Wallis test. On pairwise comparison, no statistically significant difference was observed among Group A - Group B, Group B-Group C, Group A-Group C.

Table 4and graph 4 shows intergroup comparison of mean plaque index score between Group A (SRP), Group B (SRP+CHX) and Group C (SRP+O2 Gel).

At baseline
Group A had lowest mean score as compare to Group B, Group C at baseline. Overall, no statistically significant difference ($p>0.05$) was observed at baseline using One-way ANOVA F test. On pairwise comparison using Tukey's post hoc test, no statistically significant difference was observed among any pair of groups.

At 3 months
Group A had equal mean score as compare to Group B, Group C at baseline. Overall, no statistically significant difference ($p>0.05$) was observed using One-way ANOVA F test on pairwise comparison using Tukey's post hoc test, no statistically significant difference was observed among Group A - Group B, Group B- Group C, Group A-Group C

Change from baseline to 3 months
Overall highest efficacy in reduction was observed in Group C and Group B followed by Group A. Overall, no statistically significant difference ($p<0.05$) was observed using One-way ANOVA F test. On pairwise comparison using Tukey's post hoc test, no statistically significant difference was observed among Group A -Group B, Group B-Group C, Group A-Group C.

Table 5 and graph 5 shows intergroup comparison of mean gingival index score between Group A (SRP), Group B (SRP+CHX) and Group C (SRP+O2 Gel).

At baseline
Group A had lowest mean score as compare to Group B, Group C at baseline. Overall, no statistically significant difference ($p>0.05$) was observed at baseline using One-way ANOVA F test. On pairwise comparison using Tukey's post hoc test, no statistically significant difference was observed among any pair of groups.

At 3 months
Group A had equal mean score as compare to Group B, Group C at baseline. Overall, no statistically significant difference ($p>0.05$) was observed using One-way ANOVA F test. On pairwise comparison using Tukey's post hoc test, no statistically significant difference was observed among Group A - Group B, Group B- Group C, Group A-Group C

Change from baseline to 3 months
Overall highest efficacy in reduction was observed in Group C and Group B followed by Group A. Overall, no statistically significant difference ($p<0.05$) was observed using One-way ANOVA F test. On pairwise comparison using Tukey's post hoc test, no statistically significant difference was observed among Group A -Group B, Group B-Group C, Group A-Group C.
Table 6 and graph 6 shows intergroup comparison of mean probing pocket depth score between Group A (SRP), Group B (SRP+CHX) and Group C (SRP+O2 Gel).

At baseline
Group A had lowest mean score as compare to Group B, Group C at baseline. Overall, no statistically significant difference ($p>0.05$) was observed at baseline using One-way ANOVA F test. On pairwise comparison using Tukey's post hoc test, no statistically significant difference was observed among any pair of groups.

At 3 months
Group C had lowest mean score as compare to Group B, Group C at baseline. Overall, no statistically significant difference ($p>0.05$) was observed using One-way ANOVA F test. On pairwise comparison using Tukey's post hoc test, no statistically significant difference was observed among Group A - Group B, Group B- Group C, Group A-Group C

Change from baseline to 3 months
Overall highest efficacy in reduction was observed in Group C and Group B followed by Group A. Overall, no statistically significant difference ($p<0.05$) was observed using One-way ANOVA F test. On pairwise comparison using Tukey's post hoc test, no statistically significant difference was observed among Group A -Group B, Group B-Group C, Group A-Group C.

Table 7 and graph 7 shows intergroup comparison of mean clinical attachment values between Group A (SRP), Group B (SRP+CHX) and Group C (SRP+O2 Gel).

At baseline
Group A had lowest mean score as compare to Group B, Group C at baseline. Overall, no statistically significant difference ($p>0.05$) was observed at baseline using One-way ANOVA F test. On pairwise comparison using Tukey's post hoc test, no statistically significant difference was observed among any pair of groups.

At 3 months
Group C had lower mean score as compare to Group B, Group C at baseline. Overall, no statistically significant difference ($p>0.05$) was observed using One-way ANOVA F test. On pairwise comparison using Tukey's post hoc test, no statistically significant difference was observed among Group A - Group B, Group B- Group C, Group A-Group C

Change from baseline to 3 months

Overall highest efficacy in reduction was observed in Group C, Group B followed by Group A. Overall, no statistically significant difference ($p<0.05$) was observed using One-way ANOVA F test. On pairwise comparison using Tukey's post hoc test, no statistically significant difference was observed among Group A -Group B, Group B-Group C, Group A-Group C.

Table 1: Intergroup comparison of mean *Porphyromonas gingivalis (P.gingivalis)* between Group A, Group B and Group C respectively

	BASELINE MEAN (SD)	**3 MONTHS MEAN (SD)**	**Change from baseline to 3 months MEAN (SD)**
Group A (SRP)	**449420 (384388.0)**	**303240 (310621)**	**146180 (73767)**
Group B (SRP+CHX)	**398365 (310621)**	**142560 (153006)**	**255805 (157615)**
Group C (SRP+O2 GEL)	**383300 (293980)**	**123680 (13765)**	**259620 (280215)**
Kruskal Wallis 'H' test	**H = 32.0**	**H = 5.87**	**H =3.98**
P value (overall)	**p =0.897**	**p =0.009***	**p=0.002***
Group A (SRP) vs Group B (SRP+CHX)^	**p =0.937**	**p =0.175**	**p< 0.001****
Group A (SRP) vs Group C (SRP+O2 GEL)^	**p =0.897**	**p =0.007***	**p<0.001****
Group B (SPR +CHX) vs Group C (SPR +O2 gel)^	**p =0.994**	**p =0.310**	**p =0.825**

p>0.05 – no significant difference *p< 0.05 – significant **p< 0.001 – highly significant
^ p value (pairwise) done using Mann Whitney U test

Table 2: Intergroup comparison of mean *Treponema denticola (T.denticola)* between Group A, Group B and Group C from baseline to 3 months respectively

	BASELINE MEAN (SD)	**3 MONTHS MEAN (SD)**	**Change From Baseline To 3 Months MEAN (SD)**
Group A (SRP)	**909690.0 (1569370)**	**544000 (1015700)**	**365690 (553670)**
Group B (SRP+CHX)	**369640 (175129)**	**55217 (32066)**	**314423 (143063)**
Group C (SRP+O2 GEL)	**376320 (196685)**	**15782 (19168)**	**360538 (180517)**
Kruskal Wallis 'H' test	**H = 26.81**	**H = 14.981**	**H = 20.91**
P value (overall)	**P =0.335**	**P =1.000**	**P =0.481**
Group A (SRP) vs Group B (SRP+CHX)^	**P =0.400**	**P =0.169**	**P =0.213**
Group A (SRP) vs Group C (SRP+O2 GEL)^	**P =0.408**	**P =0.128**	**P =0.826**
Group B (SPR +CHX) vs Group C (SPR +O2 gel)^	**P =1.000**	**P =0.988**	**p = 0.173**

p>0.05 – no significant difference *p< 0.05 – significant **p< 0.001 – highly significant
^ p value (pairwise) done using Mann Whitney U test

Table 3: Intergroup comparison of mean *Tannerella forsythia (T.forsythia*) between Group A, Group B and Group C respectively

	BASELINE MEAN (SD)	**3 MONTHS MEAN (SD)**	**Change from baseline to 3 months MEAN (SD)**
Group A (SRP)	**109210 (180454)**	**44309 (83483)**	**64901 (96971)**
Group B (SRP+CHX)	**75500 (102822)**	**19343 (27742)**	**56157 (75080)**
Group C (SRP+O2 GEL)	**79703 (97538)**	**3733.1 (1772)**	**75970 (95766)**
Kruskal Wallis 'H' test	**H = 31.29**	**H = 18.02**	**H = 23.83**
P value (overall)	**p =0.826**	**p =0.216**	**p =0.571**
Group A (SRP) vs Group B (SRP+CHX)^	**p =0.838**	**p =0.523**	**p =0.612**
Group A (SRP) vs Group C (SRP+O2 GEL)^	**p =0.873**	**p =0.193**	**p =0.471**
Group B (SPR +CHX) vs Group C (SPR +O2 gel)^	**p =0.997**	**p =0.773**	**p = 812**

p>0.05 – no significant difference *p< 0.05 – significant **p< 0.001 – highly significant
^ p value (pairwise) done using Mann Whitney U test

Table 6 and graph 6 shows intergroup comparison of mean *Tannerella forsythia* count between Group A (SRP), Group B (SRP+CHX) and Group C (SRP+O2 Gel)

Table 4: Intergroup comparison of mean Plaque index score in Group A, Group B and Group C respectively

	BASELINE MEAN (SD)	**3 MONTHS MEAN (SD)**	**Change from baseline to 3 months MEAN (SD)**
Group A (SRP)	**1.3 (0.48)**	**1.1 (0.31)**	**0.2(0.17)**
Group B (SRP+CHX)	**2.0 (0.81)**	**1.1 (0.31)**	**0.9 (0.5)**
Group C (SRP+O2 GEL)	**2.0 (0.81)**	**1.1 (0.31)**	**0.9 (0.5)**
One wayAnova 'F' test	**F = 3.128**	**F = 0.0**	**F = 0.263**
P value (overall)	**P =0.06**	**P =1.000**	**p =0.894**
Group A (SRP) vs Group B (SRP+CHX)^	**P =0.096**	**P =1.000**	**p =0.189**
Group A (SRP) vs Group C (SRP+O2 GEL)^	**P =0.096**	**P =1.000**	**p =0.189**

Group B (SPR +CHX) vs Group C (SPR +O2 gel)^	**P =1.000**	**P =1.000**	**p =1.000**

p>0.05 – no significant difference *p< 0.05 – significant **p< 0.001 – highly significant

^ p value (pairwise) done using Tukey's post hoc test

Table 5: Intergroup comparison of mean Gingival index score between Group A, Group B and Group C respectively

	BASELINE MEAN (SD)	**3 MONTHS MEAN (SD)**	**Change from baseline to 3 months MEAN (SD)**
Group A (SRP)	**1.8 (0.63)**	**1.1 (0.31)**	**0.7 (0.32)**
Group B (SRP+CHX)	**2.0 (0.47)**	**1.1 (0.31)**	**0.9 (0.16)**
Group C (SRP+O2 GEL)	**2.0 (0.47)**	**1.1 (0.31)**	**0.9 (0.16)**
One wayAnova 'F' test	**F = 0.474**	**F = 0.0**	**F = 0.189**
P value (overall)	**p =0.628**	**p =1.000**	**p =0.814**
Group A (SRP) vs Group B (SRP+CHX)^	**p =0.680**	**p =1.000**	**p =0.376**
Group A (SRP) vs Group C (SRP+O2 GEL)^	**p =0.680**	**p =1.000**	**p =0.376**
Group B (SPR +CHX) vs Group C (SPR +O2 gel)^	**p = 1.000**	**p =1.000**	**p =1.000**

p>0.05 – no significant difference *p< 0.05 – significant **p< 0.001 – highly significant

^ p value (pairwise) done using Tukey's post hoc test

Table 6: Intergroup comparison of mean Probing Pocket Depth score between Group A, Group B and Group C respectively

	BASELINE MEAN (SD)	**3 MONTHS MEAN (SD)**	**Change from baseline to 3 months MEAN (SD)**
Group A (SRP)	**4.5 (0.52)**	**3.6 (0.51)**	**0.9 (0.01)**
Group B (SRP+CHX)	**5.1 (0.73)**	**3.9 (0.87)**	**1.2 (0.13)**
Group C (SRP+O2 GEL)	**4.7 (0.48)**	**3.5 (0.52)**	**1.2 (0.04)**
One wayAnova 'F' test	**F = 2.653**	**F = 0.992**	**F = 1.973**
P value (overall)	**p =0.089**	**p =0.384**	**p =0.216**
Group A (SRP) vs Group B (SRP+CHX)^	**p = 0.079**	**p =0.574**	**p 0.147**
Group A (SRP) vs Group C (SRP+O2 GEL)^	**p=0.734**	**p =0.379**	**p =0.191**

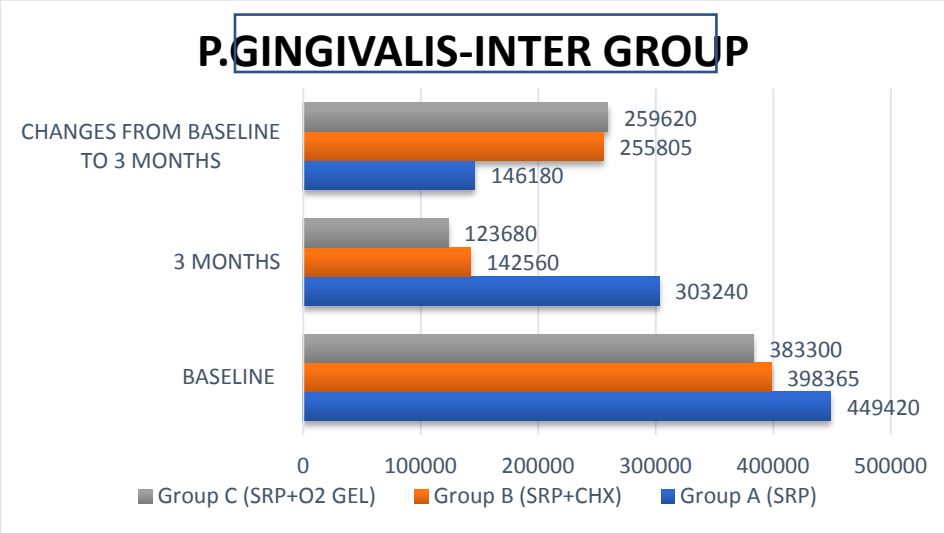
Group B (SPR +CHX) vs Group C (SPR +O2 gel)^	**p=0.303**	**p =0.379**	**p = 0.369**

p>0.05 – no significant difference *p< 0.05 – significant **p< 0.001 – highly significant
^ p value (pairwise) done using Tukey's post hoc test

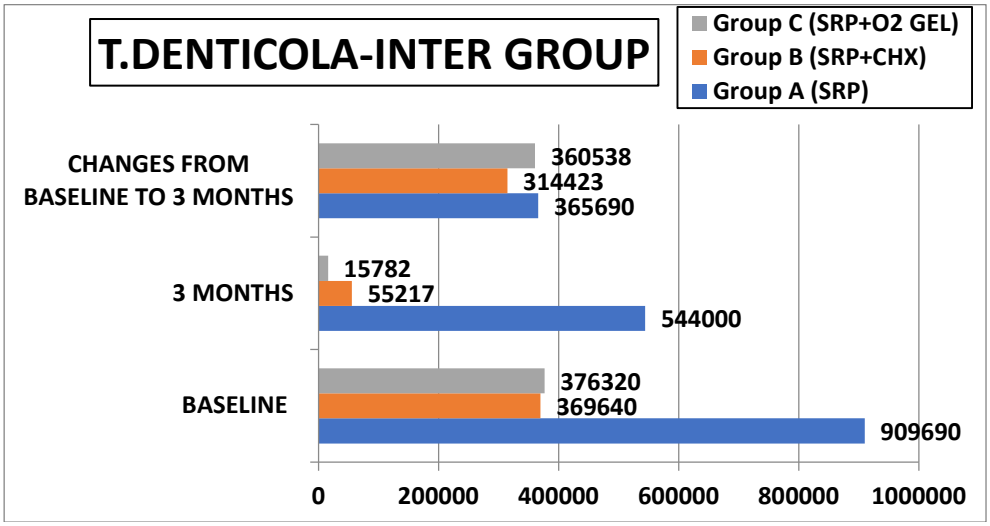
Table 7: Intergroup comparison of mean Clinical Attachment Loss score between Group A, Group B and Group C from baseline to 3 months respectively

	BASELINE MEAN (SD)	**3 MONTHS MEAN (SD)**	**Change from baseline to 3 months MEAN (SD)**
Group A (SRP)	**5.1 (1.1)**	**4.3 (1.25)**	**0.8 (0.25)**
Group B (SRP+CHX)	**5.6 (1.07)**	**4.5 (1.35)**	**1.1 (0.31)**
Group C (SRP+O2 GEL)	**5.4 (0.84)**	**4.2 (0.78)**	**1.2 (0.06)**
One wayAnova 'F' test	**F = 0.617**	**F =0.174**	**F = 0.287**
P value (overall)	**p = 0.547**	**p =0.841**	**p =0.591**
Group A (SRP) vs Group B (SRP+CHX)^	**p =0.520**	**p = 0.921**	**p = 0.769**
Group A (SRP) vs Group C (SRP+O2 GEL)^	**p =0.787**	**p =0.980**	**p =0.846**
Group B (SPR +CHX) vs Group C (SPR +O2 gel)^	**p =0.899**	**p =0.832**	**p = 0.856**

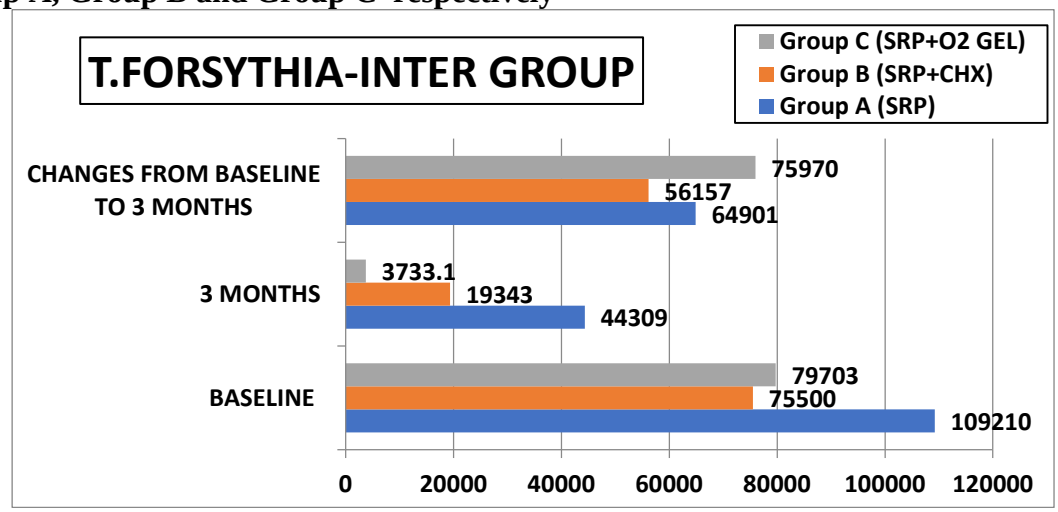
p>0.05 – no significant difference *p< 0.05 – significant **p< 0.001 – highly significant
^ p value (pairwise) done using Tukeys post hoc test



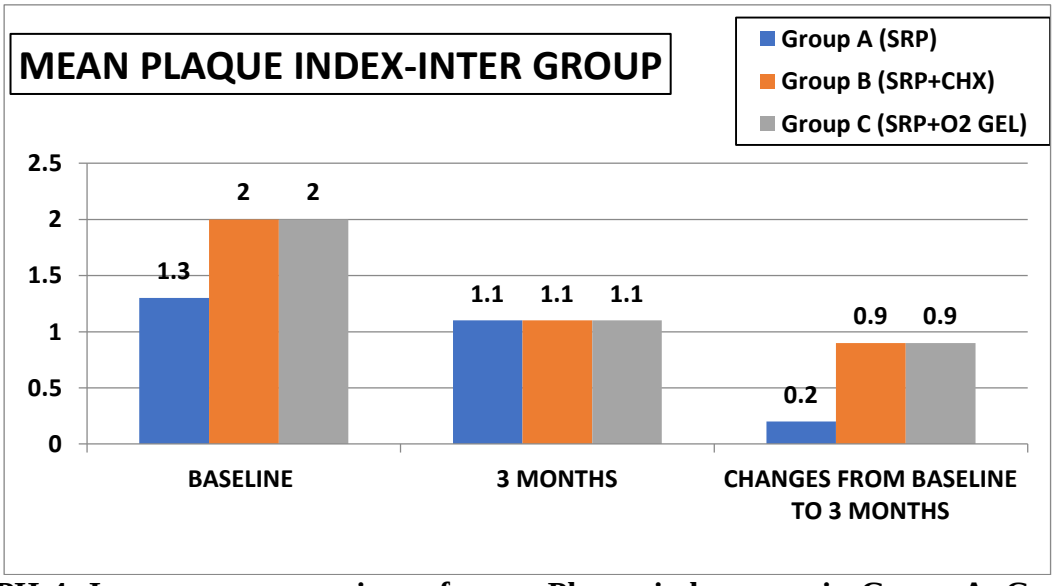
GRAPH 1: Intergroup comparison of mean *Porphyromonasgingivalis (P.gingivalis)* between Group A, Group B and Group C respectively



GRAPH 2: Intergroup comparison of mean *Treponema denticola (T.denticola)* between Group A, Group B and Group C respectively

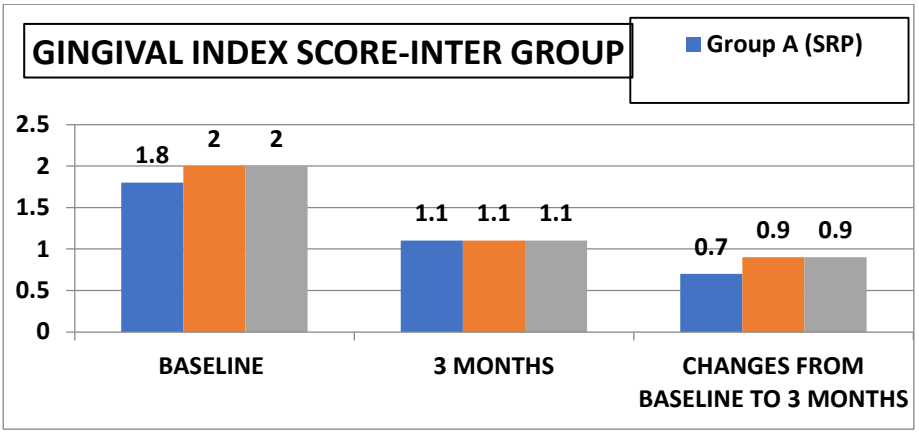


GRAPH 3: Intergroup comparison of mean *Tanerella forsythia (T.forsythia)* between Group A, Group B and Group C respectively

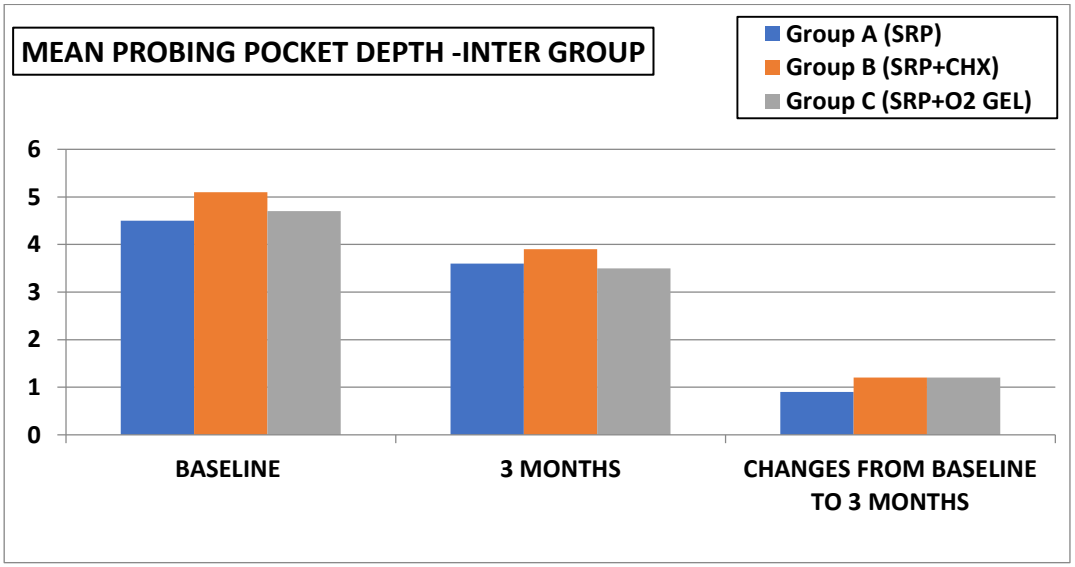


GRAPH 4: Intergroup comparison of mean Plaque index score in Group A, Group B

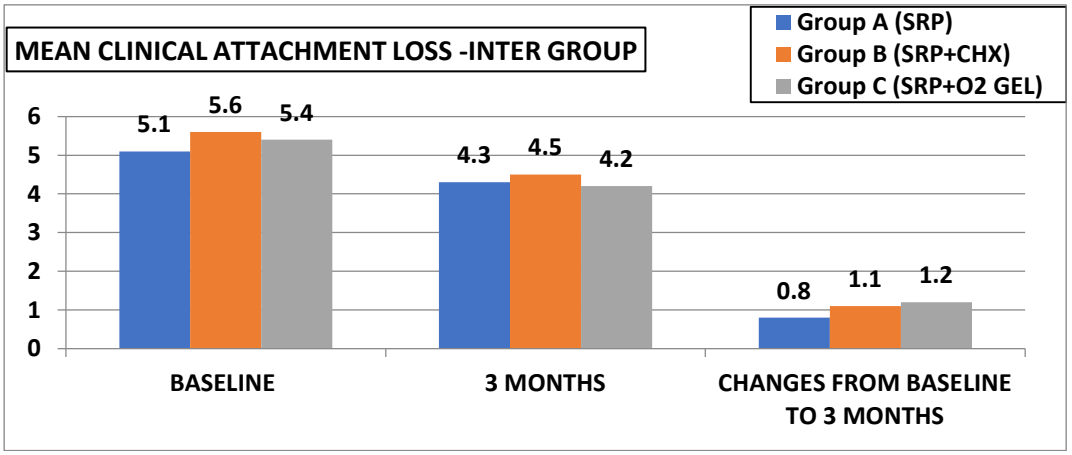
and Group C respectively



GRAPH 5: Intergroup comparison of mean Gingival index score between Group A, Group B and Group C respectively



GRAPH 6: Intergroup comparison of mean Probing Pocket Depth score between Group A, Group B and Group C respectively



GRAPH 7: Intergroup comparison of mean Clinical Attachment Loss score between Group A, Group B and Group C from baseline to 3 months respectively.

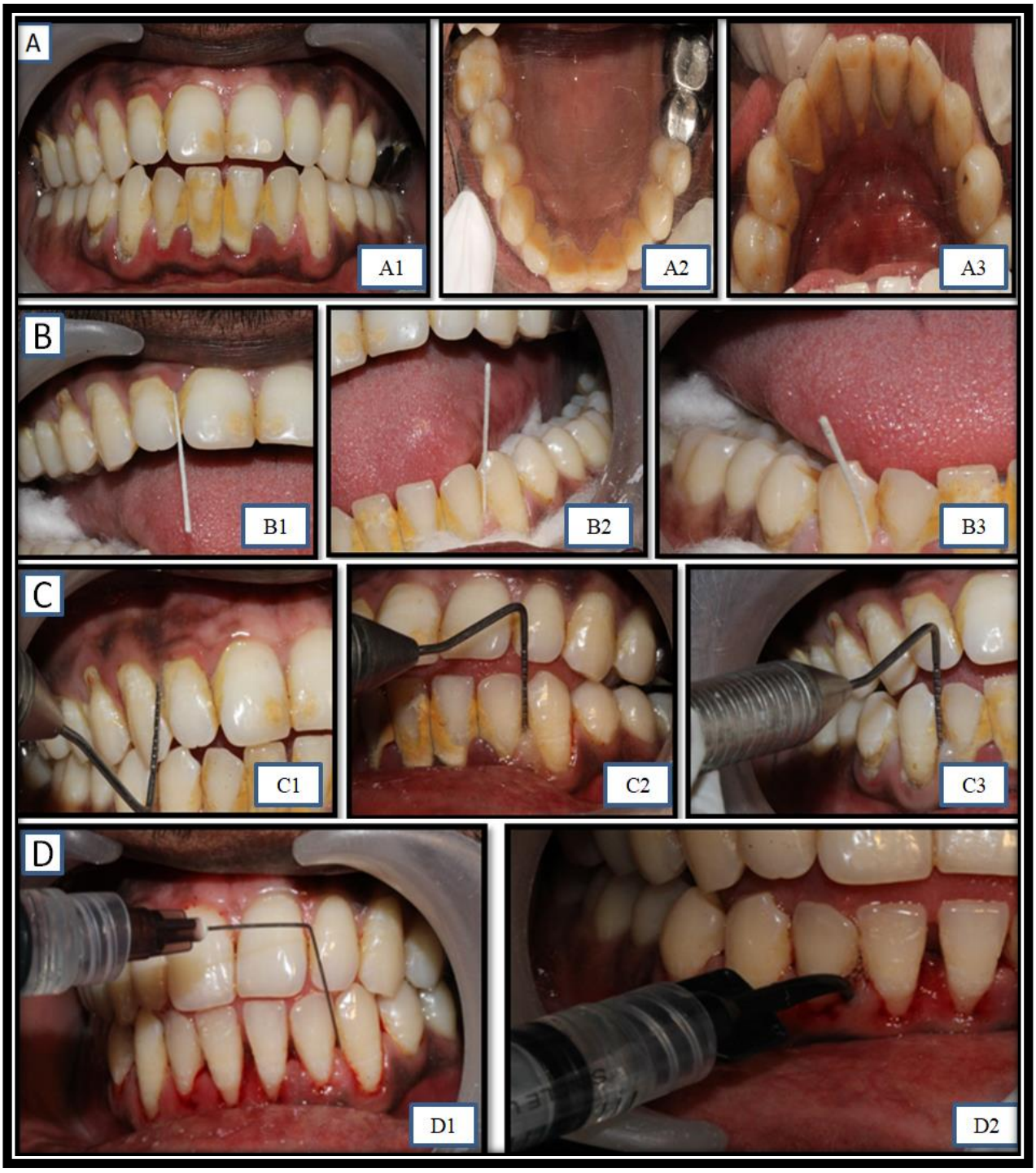


Fig 1: **A**: Pre-operative images; A1: Labial view; A2: Palatal view; A3: Lingual view.
B: Plaque sample collection; B1: Group A; B2: Group B; B3: Group C.
C: Probing pocket depth; C1: Group A; C2: Group B; C3: Group C.
D: Local drug delivery done; D1: Group B; D2: Group C.

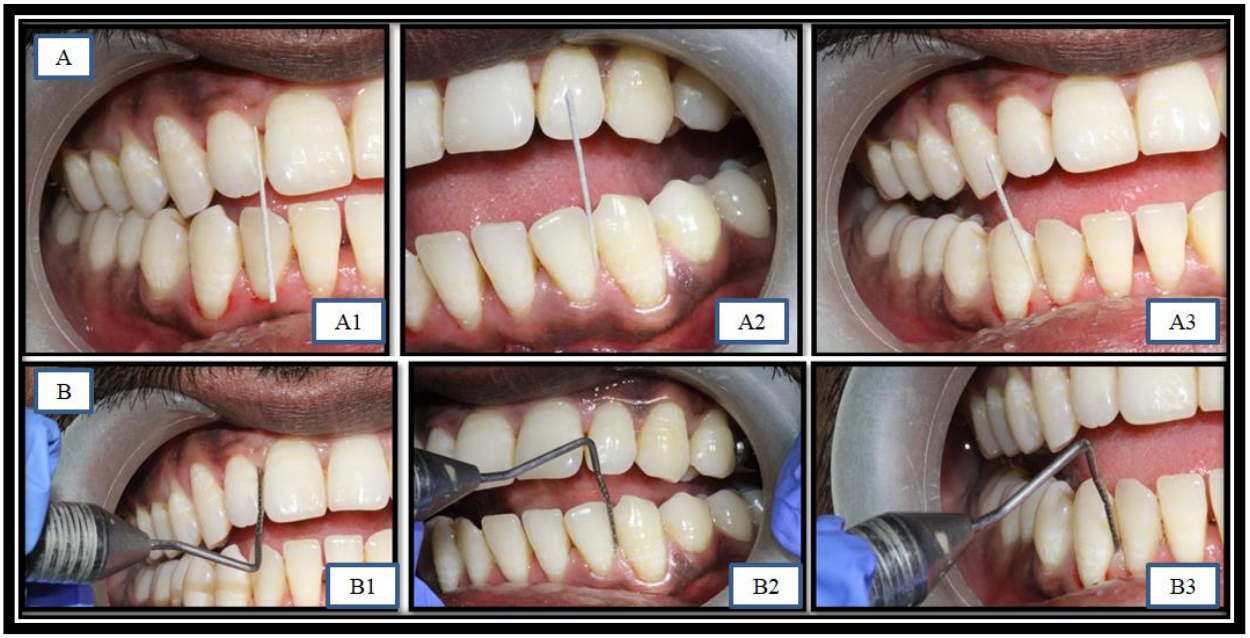


Fig 2: 3-months follow up; **A**: Plaque sample collection; A1: Group A; A2: Group B; A3: Group C. **B**: Probing pocket depth; B1: Group A; B2: Group B; B3: Group C

DISCUSSION

Successful periodontal therapy is dependent on anti-infective procedures aimed at eliminating pathogenic organisms found in dental plaque associated with the tooth surface and within other niches in the oral cavity.[10] Complete mechanical debridement being the "gold standard" of periodontal treatment[11] still does not eliminate the micro- organisms in the soft tissue wall of the pocket, neither is complete resection of the diseased tissues possible. Additional soft tissue curettage procedures using ultrasonics and other chemicals as well as several adjunctive locally delivered agents such as antimicrobials, antiseptic agents, anti-inflammatory agents, and host-modulating agents have been evaluated for enhancing the treatment outcome of chronic periodontitis with varying degrees of success.[12]

Mild to moderate chronic periodontitis is initially treated non surgically by performing scaling and root planing aiding in reduction of probing depth. Over the years chlorhexidine has been considered as a "gold standard" adjunct to non-surgical periodontal therapy in patients with mild to moderate chronic periodontitis. As it has been observed that oxygen is an important substrate in wound healing with potential benefits like prevention of infection, increased re-epithelialization and collagen synthesis by induction of fibroblast growth.[13] Oxygen releasing formula gel was used in this study to evaluate its efficacy over chlorhexidine gel and scaling and root planing alone clinically and microbiologically in red complex bacteria *(Porphyromonas gingivalis, Treponema denticola,* and *Tannerella forsythia*).

Chlorhexidine, as yet is said to be the most popular anti plaque agent and is considered as a 'gold standard' because of its potent antiplaque action, against which potency and benefit of other anti-Bluem® oral gel formula is developed by a man on mission namely Peter Blijdrop for specific problems in the mouth with the following ingredients :Aqua, Alcohol, Glycerin, Silica, Sodium Saccharin, Sodium Perborate, Citric Acid, PEG-32, Sodium Gluconate, Lactoferrin, Xanthan Gum, Cellulose Gum with their specific functions.[14] It improves the healing of the wounds by intensifying the levels of oxygen in periodontal pockets, bleeding gum, wounds which results from traumatic extraction, in implant dentistry, chemotherapy. The use of this unique formula improves oral hygiene of an individual and also, reduces the

risk of infections and inflammation.[14] A Randomized Controlled Clinical Trial showed that toothpastes containing active oxygen and lactoferrin have comparable anti-plaque and anti-gingivitis efficacies with triclosan-containing toothpastes.[15]

Intergroup comparison of mean **plaque index** score between Group A (SRP), Group B (SRP+CHX) and Group C (SRP+O2 Gel). **Change from baseline to 3 months:** Overall highest efficacy in reduction was observed in Group C and Group B followed by Group A. Overall, no statistically significant difference ($p<0.05$) was observed using One-way ANOVA F test. On pairwise comparison using Tukey's post hoc test, no statistically significant difference was observed among Group A -Group B, Group B-Group C, Group A-Group C. These findings are in accordance with the study done by **Singh A. and Sridhar R. et al[16]**which illustrated improvement in plaque index scores in LDD groups but no statistically significant result among all the three groups. In contrast to the present study statistically significant result was observed from baseline to 3 months in test group when compared to control group in the study done by **Babita S. and Gathe B. et al.[17]**

Intergroup comparison of mean **probing pocket depth and clinical attachment level** score between Group A (SRP) , Group B (SRP+CHX) and Group C (SRP+O2 Gel). **Change from baseline to 3 months:** Overall highest efficacy in reduction was observed in Group C and Group B followed by Group A. Overall, no statistically significant difference ($p<0.05$) was observed using One-way ANOVA F test. On pairwise comparison using Tukey's post hoc test, no statistically significant difference was observed among Group A -Group B, Group B-Group C, Group A-Group C. These findings are in accordance with the study done by **Singh A. and Sridhar R. et al[16]**where reduction in probing depth in all the groups were seen but statistically no significant result was observed whereas in contrast to the study statistically significant results were seen in the test group in comparison to control group from baseline to 3 months according to **Puri K. and Dodwad V. et al.[18]**

Intergroup comparison of mean ***Porphyromonas gingivalis,Treponema denticola,Tannerella forsythia*** count between Group A (SRP), Group B (SRP+CHX) and Group C (SRP+O2 Gel). **Change from baseline to 3 months:** Overall highest efficacy in reduction was observed in Group C followed by Group B and least in Group A. Overall, statistically significant difference ($p<0.05$) was observed using Kruskal Wallis test. On pairwise comparison, highly statistically significant difference was observed among Group A -Group B, Group A- Group C. But Group C had greater reduction in mean count than Group B but the difference was not found to be of statistical significance. This is in accordance to the study done by **Paolantonio M. and Angelo M. et al[19]**which showed statistically highly significant reduction in the microorganisms in the test group from baseline to 3 months compared to control group. In contrast to the study, **Daneshmand et al.[20] and Medaiah et al.[21]** also suggested that test group did not provide significant results from baseline to follow up.

Collected data indicated that significant improvement in the clinical parameters (PI, GI, PPD, CAL) and microbiological count (*P.g., T.f., T.d.)* in oxygen gel group and chlorhexidine group in adjunct to SRP when compared to SRP alone from baseline to 3 months. Highly statistically significant results were seen in test group with respect to all the above mentioned clinical and microbiological parameters except CAL which was statistically significant from baseline to 3 months. Statistically significant results were seen in positive control group with respect to all the parameters except GI and CAL which was highly statistically significant and not statistically significant respectively from baseline to 3 months. No statistically significant results were seen with respect to control group except GI, PPD and *T.f.*count which were statistically significant from baseline to 3 months. Overall, no statistically significant difference was observed in comparison among all the three groups from baseline to 3 months except *P.g.* count which was statistically significant.

CONCLUSION

To summarise with, two of the gels i.e chlorhexidine gel and Blue m gel can be used as an reliable option or adjunctive to SRP, in the present study Blue m gel has shown to be fairly and coequally effective when compared to the chlorhexidine gel in treating mild to moderate periodontal pockets.

Significant reduction in clinical and microbiological parameters in sites treated with Blue M gel is because of release of more active oxygen of Blue m gel. This causes fast and progressive healing. The reduction in colony forming units was because of the fact that blue m gel is said to normalise and controls detrimental bacteria and thus, is analogous to chlorhexidine gel. Also, there were no complications or risks associated with performing the study with the Blue m gel.

However, within the Limitation of the study, the substantivity of Blue m gel is not clear also the sample size and duration was less and is not cost effective.

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