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**RESEARCH ARTICLE**
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# COMPARISION AND ASSESMENT OF ANTI PLAQUE AND ANTI GINGIVITIS EFFICACY OF CHLORINE DI OXIDE MOUTH WASH WITH CHLORHEXIDINE MOUTH WASH – A RANDOMIZED, DOUBLE BLIND CLINICAL STUDY

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**ABSTRACT**

**BACKGROUND:** With the increasing incidence of periodontal disease and development of antibiotic resistance, the global need for alternative treatment modalities, safe, effective, and economical products is the need of time. Hence aim of the study was to compare and evaluate the efficacy of Chlorine di oxide with Chlorhexidine mouth wash on reduction of plaque and gingivitis.

**MATERIALS AND METHODS:** 60 healthy subjects were randomly allocated in 2 groups. After scaling and polishing the test group and the control group were asked to rinse their mouth with Chlorine di oxide and Chlorhexidine respectively, twice daily, during a 14 day period. Plaque index, gingival index and bleeding index were assessed at days, 0, 7 and 15. Descriptive statistics, one – way ANOVA, repeated measure ANOVA, paired sample t- test will be performed.

**RESULTS:** There was significant decrease in the level of plaque, gingivitis and bleeding score measured from day 1 to day 15 in both the groups. However P value for group A & group B did not show any statistical difference**.**

**CONCLUSION**: Chlorine di oxide mouth wash is as effective as chlorhexidine mouth wash in controlling plaque and gingivitis and hence chlorine di oxide can be considered as a substitute for long term use of chlorhexidine.

**KEYWORDS:** Gingivitis, Mouth wash, Chlorine di oxide, Chlorhexidine, Plaque control, Anti-Plaque efficacy, Gingival index, Plaque index.

## INTRODUCTION:

Plaque control and prevention of gingivitis is the main goal of prevention of periodontal diseases. Complete plaque removal is difficult to achieve, and prevention of periodontal disease can be enhanced either by reducing the quantity of plaque below the individual's threshold for disease or changing the quality of plaque to a more tissue friendly response [1].

Chemical inhibitors of plaque play an important role in plaque control. A variety of approaches have been considered for chemical plaque control. Most products in current use or under study are antiseptics. Vehicles for delivery of chemical agents with ant - plaque /anti - gingivitis action are tooth pastes, mouthwashes, spray, irrigators, chewing gum, and varnishes. However, mouthwashes are a simple and widely accepted method to deliver the anti-microbial agent (after toothpastes), which can be used by the patient as an oral hygiene aid[2].

Chlorhexidine gluconate is an antiseptic mouthwash much in demand. This cationic bis-biguanide is the best known and most widely used member of the class of broad-spectrum antiseptics[3]. It is effective against an array of microorganisms, including gram-positive and gram-negative organisms, fungi, yeasts, and viruses. It exhibits both anti-plaque and anti-bacterial properties[2].

Although Chlorhexidine is considered as the most effective oral antiseptic agent, its use for extended period of time is related to number of adverse effects. This opens up a need for a newer agent. [4]

Chlorine di oxide mouth wash which has been recently introduced in the market is a very strong oxidizing agent. Since chlorine dioxide readily loses its activity, its stability has been prolonged through a "stabilization" process, which converts chlorine dioxide to molecular chlorine dioxide at a low pH[5].

Chlorine di oxide is bactericidal and it acts by fixing cellular membrane proteins as a result of its oxidizing potential. Penetrates the bacterial cell and reacts with vital amino acids in the cytoplasm to kill the organisms. It is harmless for human cells[4].

It is used to reduce or prevent plaque formation and also treating oral diseases, gingivitis and periodontitis[7].

It oxidizes amino acids, proteins, and poly amides, by attacking sulphide bonds.

- Inhibits pellicle formation. Since the first step is inhibited, the bacterial adhesion and the subsequent steps are retarded.
- Prevention of bacterial agglutination

Bacterial agglutination is conversion of Sucrose into glucans and fructans, by glycosyl transferases which is bacterial origin. Plaque is a complex matrix containing, glycosamino glycans, proteo glycans, glycoproteins, sugars, proteins, and lipids, which aid in the process of bacterial agglutination. Since these compounds are nutrients for bacteria, oxidation of these compounds by $ClO_2$ will inhibit bacterial growth and there by retards plaque growth[7].

- Oxidation of the plaque mass

The initial bacterial residents of the plaque mass are aerobic, the saliva bathing the plaque matrix is the source of oxygen. As the plaque thickens, the deeper layers are deprived of oxygen, as a result plaque develops anaerobic population of bacteria. $ClO_2$ molecules will raise the level of oxygen within the plaque matrix, which will inhibit the anaerobic bacterial growth. As a result potential for development of periodontitis is reduced by $ClO_2$[7].

Chlorine di oxide is odor less and taste less, and it does not cause burning, drying or staining with continued use as compared to traditional alcohol and chlorhexidine based mouth rinse. It is widely and safely used as high antibacterial mouth wash.

- Preferred concentrations are 0.005 to 0.5 %[7].

**AIM OF THE STUDY:**

Hence the aim of the study was to compare and evaluate the efficacy of Chlorine di oxide mouth wash with Chlorhexidine mouth wash on reduction of plaque and gingivitis.

**MATERIALS AND METHODS:**

A total of 60 systemically healthy subjects, in the age group of 18 to 30 years, were selected from the outpatient department of Farooqia dental college and hospital, Mysore. An informed consent was obtained from all the patients. The procedure of the study was explained to the patients before the start of the study. A randomized, double blind clinical study was done.

**INCLUSION CRITERIA:**

- Minimum of 28 natural teeth
- No history of antibiotic or anti-inflammatory drug therapy for the past 3 months.
- Patients with age group of 18 to 30 years.

**EXCLUSION CRITERIA:**

- Patients suffering from known systemic diseases.
- Patients who are pregnant and lactating
- Probing depth greater than 3 mm.
- Patients with removable and fixed prosthesis.
- Patients who are smokers and alcoholics

**STUDY DESIGN:**

Patients were randomly allocated to two groups. Group A (test group) who received chlorine di oxide mouth wash and Group B (control group) who received chlorhexidine mouth wash. The following indices were recorded. Plaque accumulation was assessed by Plaque Index (PI) by Silness and Loe (1964), Gingivitis by Gingival Index by Loe and Silness (1963), and Gingival Bleeding by Modified Sulcular Bleeding Index by Mombelli, Oosten, Schurch, and Land (1975). After scaling and polishing at base line (0 day) the subjects were given any of the mouth washes and were asked to rinse their mouth twice daily, during a 14 day period. The subjects were asked to rinse with 10 ml of the solution for 1 minute, twice daily, after breakfast and after dinner. The patient were asked to avoid drinking or eating for at least 30 minutes after using the mouth wash. The subjects were recalled after 7 days and on 15$^{th}$ day and the same indices were recorded.

**STATISTICAL ANALYSIS:**

Statistical analysis was done using, Contingency co efficient test, Descriptive statistics, Independent sample‘t’ Test.

**RESULTS:**

**Plaque index:** Results were expressed in terms of percentage. There was significant decrease in the level of plaque measured from day 1 to day 15 in both the groups. However, p-value for Group A 0.676 and Group B 0.667 did not show any statistical difference. (Table I and Figure 1)

**FIG I: PLAQUE INDEX**

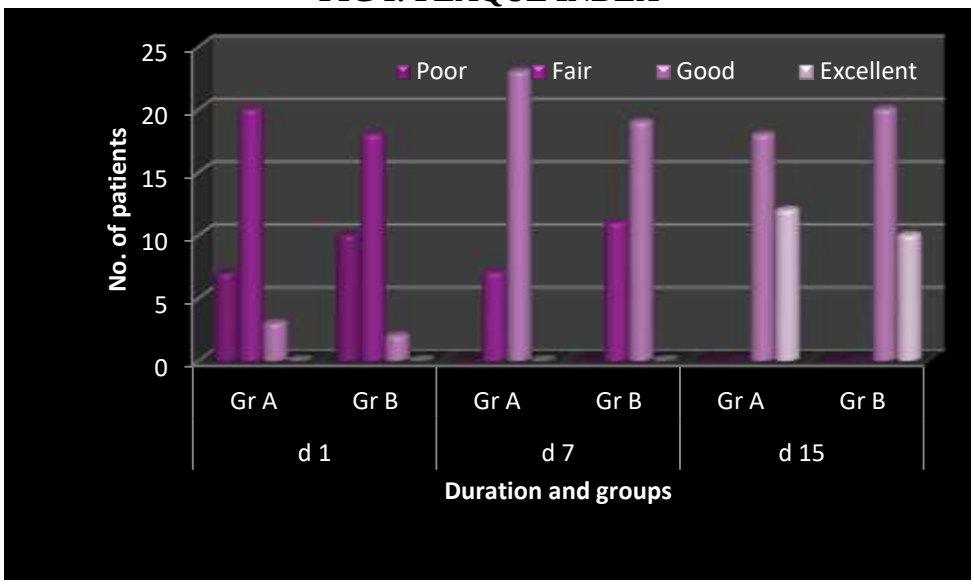


**Table I: Plaque index**

| GROUPS | | | | PLAQUE | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | | | poor | Fair | good | Excellent | |
| Group A | DURATION | Day 1 | Count | 7 | 20 | 3 | 0 | 30 |
| | | | % of DURATION | **23.3%** | **66.7%** | 10.0% | .0% | 100.0% |
| | | Day 7 | Count | 0 | 7 | 23 | 0 | 30 |
| | | | % of DURATION | .0% | 23.3% | **76.7%** | .0% | 100.0% |
| | | Day15 | Count | 0 | 0 | 18 | 12 | 30 |
| | | | % of DURATION | .0% | .0% | **60.0%** | **40.0%** | 100.0% |
| | Total | | Count | 7 | 27 | 44 | 12 | 90 |
| | | | % of DURATION | 7.8% | 30.0% | 48.9% | 13.3% | 100.0% |
| Group B | DURATION | Day 1 | Count | 10 | 18 | 2 | 0 | 30 |
| | | | % of DURATION | **33.3%** | **60.0%** | 6.7% | .0% | 100.0% |
| | | Day 7 | Count | 0 | 11 | 19 | 0 | 30 |
| | | | % of DURATION | .0% | 36.7% | **63.3%** | .0% | 100.0% |
| | | Day15 | Count | 0 | 0 | 20 | 10 | 30 |
| | | | % of DURATION | .0% | .0% | **66.7%** | **33.3%** | 100.0% |
| | Total | | Count | 10 | 29 | 41 | 10 | 90 |
| | | | % of DURATION | 11.1% | 32.2% | 45.6% | 11.1% | 100.0% |

## Gingival index:

There was significant decrease in the level of gingivitis recorded from day 1 to day 15 in both the groups. However, p-value for GROUP A: 0.476 and GROUP B: 0.532 did not show any statistical difference. **(Table II and figure II)**

**FIG II: GINGIVAL INDEX**

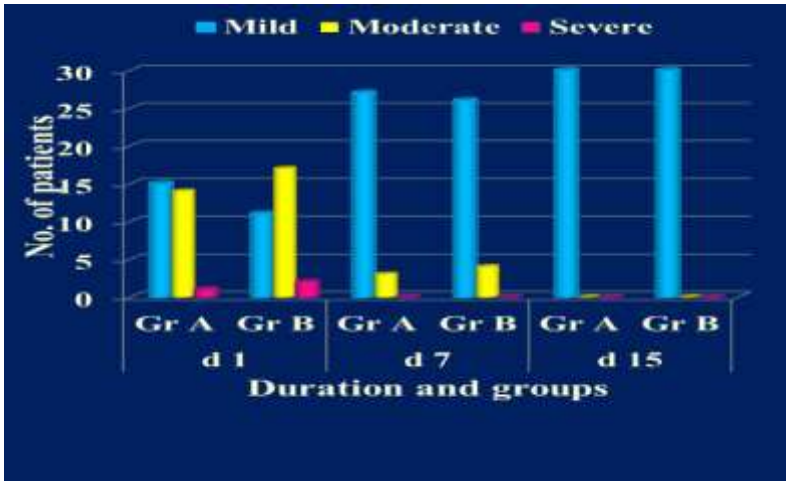


**Table II: Gingival index**

| *GROUPS* | | | | *GINGIVAL INDEX* | | | *Total* |
|---|---|---|---|---|---|---|---|
| | | | | *Mild* | *moderate* | *severe* | |
| *Group A* | *DURATIONN* | *Day 1* | *Count* | *15* | *14* | *1* | *30* |
| | | | *% of DURATION* | ***50.0%*** | ***46.7%*** | *3.3%* | *100.0%* |
| | | *Day 7* | *Count* | *27* | *3* | *0* | *30* |
| | | | *% of DURATION* | ***90.0%*** | *10.0%* | *.0%* | *100.0%* |
| | | *Day 15* | *Count* | *30* | *0* | *0* | *30* |
| | | | *% of DURATION* | ***100.0%*** | *.0%* | *.0%* | *100.0%* |
| | *Total* | | *Count* | *72* | *17* | *1* | *90* |
| | | | *% of DURATION* | *80.0%* | *18.9%* | *1.1%* | *100.0%* |
| *Group B* | *DURATIONN* | *Day 1* | *Count* | *11* | *17* | *2* | *30* |
| | | | *% of DURATION* | *36.7%* | ***56.7%*** | *6.7%* | *100.0%* |
| | | *Day 7* | *Count* | *26* | *4* | *0* | *30* |
| | | | *% of DURATION* | ***86.7%*** | *13.3%* | *.0%* | *100.0%* |
| | | *Day 15* | *Count* | *30* | *0* | *0* | *30* |
| | | | *% of DURATIONN* | ***100.0%*** | *.0%* | *.0%* | *100.0%* |
| | *Total* | | *Count* | *67* | *21* | *2* | *90* |
| | | | *% of DURATION* | *74.4%* | *23.3%* | *2.2%* | *100.0%* |

**Bleeding index:**

Bleeding score was expressed as mean value there was significant decrease in the mean value from day 1 to day 15 in both the groups, however p-value did not show any statistical difference between both the groups. (Table III and figure III)

**FIG III: BLEEDING INDEX**

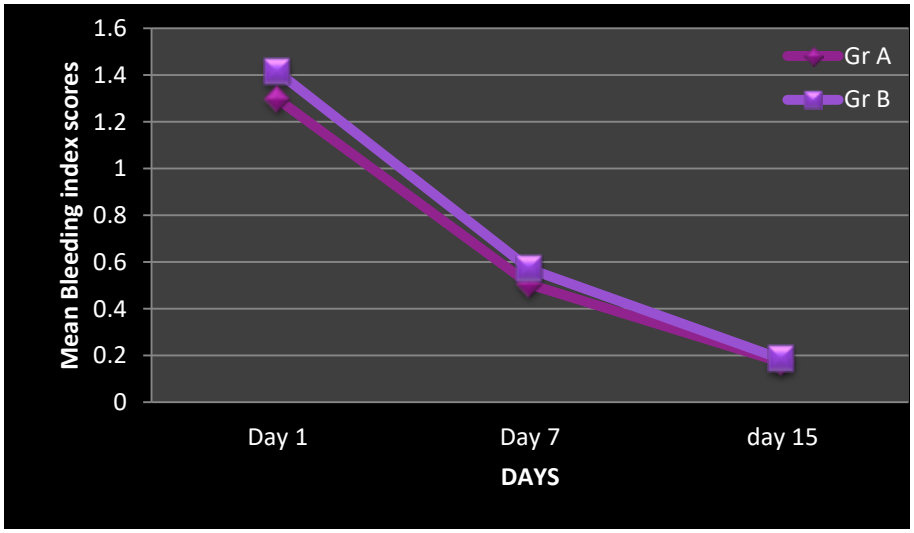

**TABLE III: BLEEDING INDEX**

| | GROUPS | Number | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| **BI Day 1** | **Group A** | 30 | 1.2967 | .28706 | .05241 |
| | **Group B** | 30 | 1.4133 | .31811 | .05808 |
| **BI Day7** | **Group A** | 30 | .5033 | .21251 | .03880 |
| | **Group B** | 30 | .5700 | .21995 | .04016 |
| **BI Day15** | **Group A** | 30 | .1700 | .05960 | .01088 |
| | **Group B** | 30 | .1833 | .06989 | .01276 |

## DISCUSSION

The inflammatory reaction of gingival tissue is often observed at some point during orthodontic treatment with fixed appliances. Moreover, it has been stated that periodontal problems during orthodontic treatment may primarily result from poor oral hygiene. Hence, if optimal oral hygiene is maintained, utilizing mechanical and chemical aids, no harmful effects would arise from orthodontic treatment regarding periodontal health [8].

The gold standard for treating gingivitis has long been CHX mouthwash, recognized for its superior quality among all chemical antiplaque agents [9]. Chlorhexidine mouthwashes possess anti-plaque, antiseptic, and anti-gingivitis properties, effectively inhibiting the formation of volatile sulfur compounds (VSCs). Among the array of chemical plaque control measures, chlorine dioxide mouthwash emerges as a suitable alternative, recognized for its reported efficacy in reducing oral malodor [10]. Chlorine dioxide exhibits high solubility in water and effectively penetrates biofilms. Its properties include antibacterial, antiviral, and antifungal capabilities. Moreover, there is a suggestion that chlorine dioxide possesses size-selective antimicrobial properties, implying its toxicity to non-eukaryotic microorganisms at significantly lower concentrations compared to eukaryotic ones. The present study has shown to have definite effect in reducing gingivitis and plaque accumulation [11]. In the present study although there is no siginificant difference between the two mouth washes, the most important point to consider in terms of reducing gingivitis is very similar to chlorhexidine.

In the study of Kale AM et al. [10] chlorine dioxide (0.1%) mouth rinsing exhibited good compliance with patients. Both 0.2% CHX and 0.1% chlorine dioxide mouthrinses revealed significant clinical findings, including reductions in probing depth, pathogens, and oral malodor. However, saline mouthwash showed relatively better results in terms of early wound healing when compared to both CHX and chlorine dioxide mouthrinses. Whereas in another study Siddeshappa ST [12] revealed a statistical significant reduction in both clinical and microbiological parameters were observed with use of both the mouthwashes. However, herbal mouthwash was more effective in reducing the plaque and gingivitis than chlorine dioxide mouthwash. Alqefari et al. demonstrated the use of chlorhexidine mouthwash in managing plaque-induced gingivitis among patients with fixed orthodontic appliances. Recently, Trombelli et al. [13] assessed the efficacy of a CHX mouthwash containing hyaluronic acid (HA) and an anti-discoloration system in comparison to conventional CHX mouthwash in patients undergoing flap surgery. They discovered equivalent outcomes in both groups, with comparable levels of tooth and tongue staining. The CHX group demonstrated similar results to those reported by Mendigeri et al. [14] who also utilized CHX for orthodontic patients compared to various other anti-plaque agents. However, in Mendigeri et al.'s study, the Plaque Bleeding Index (PBI) showed a significantly greater reduction ($p < 0.001$).

Pham et al. [15] findings indicate that a 0.1% ClO2 mouthwash notably decreases oral malodor and the concentrations of hydrogen sulfide (H2S) and methyl mercaptan (CH3SH) after both 12 hours and 2 weeks. Furthermore, this mouthwash effectively reduces plaque index (PI), tongue coating, and the levels of both Gram-positive and Gram-negative bacteria.

The recent meta-analysis suggests that chlorine dioxide mouthwash could serve as a beneficial supportive therapy for oral halitosis, with no reported side effects [16]. The present study by Vedula C demonstrated that ClO2 mouth rinse was more effective in reducing microbial load after four weeks

of usage compared to CHX [17]. Alqefari J demonstrated Chlorhexidine mouthwash plays a significant role in managing plaque-induced gingivitis among patients with fixed orthodontic appliances.
Hence this study stresses the view point that plaque control is essentially a mechanical oriented (tooth brushing) method and use of mouth wash, however, effective, is an adjunct in oral hygiene regimen.

## LIMITATION OF THE STUDY:

- However, further studies are needed to examine more long-term effects of the mouth wash in larger samples.
- For some subjects, the taste and the smell of the chlorine di oxide mouth wash was dis agreeable. This may be resolved in new formulations which masks these problems.

## CONCLUSION:

The study emphasizes on plaque reduction, reducing the gingival inflammation and reducing the bleeding scores and hence chlorine di oxide can be considered as a substitute for long term use instead of chlorhexidine. Chlorine di oxide mouth wash is as effective as chlorhexidine mouth wash in controlling plaque and gingivitis.

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## CONFLICT OF INTEREST:

The authors declare that there is no conflict of interests regarding the publication of this paper

## REFERENCES:

1. Bathini C, Avula J, Anumala N, Kalakonda B. A randomized, double blind clinical study to assess the anti-plaque and anti-gingivitis efficacy of aloe vera mouth rinse. Journal of Indian Society of Periodontology 2012;16(4): 543 – 548.
2. Simran R. P, Rajkumar N. Parwani, P. J. Chitnis: Comparative evaluation of anti plque efficacy of herbal and 0.2% chlorhexidine gluconate mouth wash in a 4 day plaque re growth study. Journal of Indian Society of Periodontology 2013;17(1):72 – 77.
3. Mandel ID. Chemotherapeutic agents for controlling plaque and gingivitis. J. Clin Periodontol.1998;15:488-98.
4. Abhishek, Benazir. A Comparative evaluation of effect of chlorine di oxide mouth rinse on plaque induced gingivitis and oral mal odour: a clinical study. International Journal of Dental and Health Sciences 2014;1(1): 24-33.
5. Neetha J. Shetty, David .K, Kamala D. N, Ramya Shenoy: Comparative study of a stabilized 0.1 %chlorine dioxide with 0.2% chlorhexidine mouthrinse in inhibiting the formation of volatile sulphur compounds Indian Journal of Applied Research 2013,12:424 – 427.
6. Lorenz K, Brutin G, Heumann C, Netuschill, Bresch M, Hoffman T. Effect of two new chlorhexidine mouth rinses on the development of dental Plaque, gingivitis and discoloration. A randomized investigator blind placebo controlled, 3 week experimental gingivitis study. J.ClinPeriodontol 2006;33:561-567.
7. Ratcliff. Methods for preventing periodontitis. United States Patent. Patent no: 4886, 657,1,1989.
8. Jana Alqefari., et al. “Clinical Efficacy of Hyaluronic Acid Gel Compared to Chlorhexidine Mouthwash in the Management of Plaque-Induced Gingivitis in Orthodontic Patients: A Randomized Clinical Trial”. EC Dental Science 19.5 (2020): 124-132.
9. Mathur S., et al. “Chlorhexidine: The gold standard in chemical plaque control”. National Journal of Physiology, Pharmacy and Pharmacology 1 (2011): 45-50.Siddeshappa ST, Bhatnagar S, Yeltiwar RK, Parvez H, Singh A, Banchhor S. Comparative evaluation of antiplaque and

antigingivitis effects of an herbal and chlorine dioxide mouthwashes: A clinicomicrobiological study. Indian J Dent Res 2018;29:34-40.

10. Kale A, Mahale S, Sethi K, Karde P. Clinical and microbial comparative evaluation of 0.1% chlorine dioxide mouthwash versus 0.2% chlorhexidine mouthwash after periodontal surgery: A randomized clinical trial. Int J Innov Res Sci Eng Techno. 2020;6:935-9.
11. Kerémi B, Márta K, Farkas K, Czumbel LM, Tóth B, Szakács Z, Csupor D, Czimmer J, Rumbus Z, Révész P, Németh A, Gerber G, Hegyi P, Varga G. Effects of Chlorine Dioxide on Oral Hygiene - A Systematic Review and Meta-analysis. Curr Pharm Des. 2020;26(25):3015-3025. doi: 10.2174/1381612826666200515134450. PMID: 32410557; PMCID: PMC8383470.
12. Siddeshappa ST, Bhatnagar S, Yeltiwar RK, Parvez H, Singh A, Banchhor S. Comparative evaluation of antiplaque and antigingivitis effects of an herbal and chlorine dioxide mouthwashes: A clinicomicrobiological study. Indian J Dent Res 2018;29:34-40.
13. Trombelli L., et al. "Clinical efficacy of a chlorhexidine-based mouthrinse containing hyaluronic acid and an antidiscoloration system in patients undergoing flap surgery: A triple-blind, parallel-arm, randomized controlled trial". International Journal of Dental Hygiene 16 (2018): 541-552.
14. Mendigeri V., et al. "Clinical effects of different antiplaque agents on patients undergoing fixed orthodontic treatment- A comparative study". Indian Journal of Orthodontics and Dentofacial Research 3.1 (2017): 43-47.
15. Pham TAV, Nguyen NTX. Efficacy of chlorine dioxide mouthwash in reducing oral malodor: A 2-week randomized, double-blind, crossover study. Clin Exp Dent Res. 2018 Oct 23;4(5):206-215. doi: 10.1002/cre2.131. PMID: 30386642; PMCID: PMC6203824.
16. Szalai E, Tajti P, Szabo´ B, Hegyi P, Czumbel LM, Shojazadeh S, et al. (2023) Daily use of chlorine dioxide effectively treats halitosis: A meta-analysis of randomised controlled trials. PLoS ONE 18(1): e0280377.
17. Vedula C, Potharaju SP, Bathula H, Chinta C, Akula M, Paleti G. Comparison of Effects of Mouthwash Containing Chlorhexidine and Chlorine Dioxide on Salivary Bacteria-A Randomized Control Study. J. Pharm. Res. Int. [Internet]. 2021 Oct. 15 [cited 2024 Mar. 9];33(46A):356-62.