

# A COMPARATIVE EVALUATION OF EFFECT OF CHLORINE DIOXIDE MOUTHRINSE ON PLAQUE INDUCED GINGIVITIS AND ORAL MALODOR: A CLINICAL STUDY

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## ABSTRACT

**Background:** Mouth is home to hundreds of bacterial species that produce several fetid substances as a result of protein degradation. Stabilized chlorine dioxide is a compound with antimicrobial properties that essentially eliminates oral malodor. The current study evaluates clinical effects of chlorine dioxide mouthrinse on plaque induced gingivitis and oral malodor.

**Materials and methods:** 30 patients were included in the study and they were divided into three groups. Group-I: 10 patients using ClO<sub>2</sub> mouthrinse only, Group-II: 10 patients using ClO<sub>2</sub> +SRP (scaling and root planning) and Group-III: 10 Patients with SRP only. Gingival index (Silness & Loe 1964), Plaque Index (Loe & Silness 1963) and Organoleptic measurements were recorded at baseline, 7 and 14 days. Groups were compared by repeated measures analysis of variance (ANOVA) using general linear models (GLM).

**Results:** Statistically significant reduction from baseline in mean PI, GI, and organoleptic measurements observed in Group II AND Group III at 7<sup>th</sup> and 14<sup>th</sup> day whereas no statistically significant difference observed in Group I but only in case of organoleptic measurements.

**Conclusion:** Clinical parameters of gingivitis reduced with the experimental mouthwash used for 14 days. Mouthwash containing ClO<sub>2</sub> improved halitosis.

**Key words:** Oral malodor, Stabilized chlorine dioxide, Organoleptic measurements.



## INTRODUCTION:

Mouth is home to hundreds of bacterial species that produce several fetid substances as a result of protein degradation.<sup>[1]</sup> Oral malodor also called halitosis or bad breath, is a general term used to describe an offensive odor emanating from oral cavity. It is caused

by several factors.<sup>[2]</sup> Although some extraoral conditions (nasal inflammation, diabetes mellitus, uremia, etc.) have been suggested causes of oral malodor, clinical studies have shown that intraoral causes such as gingivitis, periodontitis and tongue coating are the main sources of the disorder.<sup>[3,4]</sup> Periodontal bacteria

produce several malodorous volatile sulfur compounds (VSCs) such as Hydrogen sulfide ( $H_2S$ ), Methyl mercaptan ( $CH_3SH$ ) and Dimethyl sulfide ( $(CH_3)_2S$ ). The substrate for VSCs are largely sulfur containing aminoacids cysteine, cysteine and methionine that are found in saliva GCF and tongue coating debris.<sup>[5]</sup> Bacteria in dental plaque are major etiologic agent initiating gingivitis and periodontitis. During maintenance phase, chemical plaque control products slow down formation of dental plaque reducing risk for periodontal disease. Although CHX is considered the most effective oral antiseptic agent, use of CHX for extended period of time is related to some side effects, such as tooth and tongue staining, bad taste and reduced taste sensation.<sup>[6,7]</sup> Previous studies have suggested that  $ClO_2$  and the  $ClO_2$  anion are chemically reactive oxidants with reducing capacities on VSCs to non malodorous products and through this oxidation consume aminoacids such as cysteine and methionine which acts as precursors to VSCs<sup>[8]</sup>. chlorite anion is a powerfully bactericidal to microorganisms.<sup>[9-11]</sup>

**Mechanism of action for reducing oral malodor:**  $ClO_2$  and the chlorite anion directly oxidises VSCs to non malodorous products. Through this oxidation it consumes aminoacids such as cysteine and methionine which act as precursor to VSCs.

**Mode of action of antimicrobial activity:** Sodium chlorite MMS (miracle mineral supplement) with superior antimicrobial activity (Jim Humble 2008). when acidified sodium chlorite ( $NaClO_2$ ) reacts with 5 DROPS of 10 % citric acid, it releases  $ClO_2$  gas and

destroys anaerobic microbes and parasites.  $ClO_2$  gas penetrates bacterial cells, reacts with vital aminoacids in the cytoplasm to kill organisms (Silwood 2001)<sup>[12,13]</sup>. It exerts its bactericidal effect by fixing cellular membrane proteins (Takayama *et al* 1995).<sup>[14]</sup> Therefore present study was done with the aim to evaluate clinical effects of Chlorine dioxide mouthrinse on plaque induced gingivitis and oral malodor.

## MATERIAL AND METHODS:

30 patients with 20-45 years of age were included with Minimum 20 teeth present and oral malodor present were included in the study. Females, smokers, subjects with oral malodor caused by food, subjects using mouthrinse within last 4 weeks, antibiotic therapy or periodontal treatment for last 3 months were excluded from the study. The subjects received verbal and written information about the study and signed consent forms to participate. Females were excluded as their menstrual cycle may affect oral malodor.<sup>[15]</sup> Patients were randomly divided into 3 groups with 10 patients in each group. Group I consisted of 10 patients using 10 ml  $ClO_2$  mouthrinse only for 30 sec twice daily for 14 days. Group II consisted of 10 patients using 10 ml  $ClO_2$  mouthrinse who also underwent scaling and root planing. Group III consisted of 10 Patients who underwent scaling and root planing only. All dental examination were conducted by one trained examiner for all subjects, both for baseline, 7 and 14 days.

## Periodontal status measurement:

Gingival Index (Silness & Loe 1964), Plaque Index (Loe & Silness 1963). The

clinical assessment of PI<sup>[16]</sup> and GI<sup>[17]</sup> were performed on four sites (buccal, lingual, mesial and distal) of the six key teeth (FDI tooth number ,16,12,24,36,32,44). Each of the site is given a score from 0-3 depending on severity of gingival or periodontal conditions.

**Organoleptic Measurements:** OM score was measured by trained judge after subjects closed their mouth for 3 minutes at baseline ,7 and 14 days. Judges were asked to rate oral malodor on a 0-5 scale where a score of 0 represented absence of odor, 1 = barely noticeable odor ,2 = slight malodor ,3 = moderate malodor, 4 = strong malodor, 5 = severe malodor.<sup>[18]</sup>

**Statistical analysis:** Data were summarized as Mean  $\pm$  SD. Groups were compared by repeated measures analysis of variance (ANOVA) using general linear models (GLM) and the significance of mean difference within (intra) and between (inter) the groups was done by Tukey's post hoc test. A two-sided ( $\alpha=2$ )  $p < 0.05$  was considered statistically significant. Analysis was performed on STATISTICA (version 6.0) software.

**Ethical clearance:** Study was approved according to Helsinki Declaration 1975 as revised in 2000.

## RESULT:

Table 1 showed the Pre and post treatments outcome measures (Mean  $\pm$  SD, n=10) of three groups (Group I: Chlorinedioxide, Group II: SRP, Group III: Chlorinedioxide + SRP) Figure 1 showed the Pre and post treatments mean outcome measures of three groups over the periods. Table 2 showed Intra (within) group comparisons For each

variable and group, significance (p value) of mean difference between the periods by ANOVA followed by Tukey's test (Group I: Chlorine dioxide, Group II: SRP, Group III: Chlorine dioxide + SRP). Figure. 2 showed showed Intra (within) group comparisons For each group, comparative outcome measures between the periods. (\*\*\*  $p < 0.001$ - as compared to baseline). Table 3 showed Inter (between) group comparisons for each variable and period, significance (p value) of mean difference between the groups by ANOVA followed by Tukey's test (Group I: Chlorinedioxide, Group II: SRP, Group III: Chlorinedioxide + SRP).

## Characteristics and oral status of subjects:

All 30 subjects completed the study. Statistically significant reduction from baseline in mean PI, GI and organoleptic measurements observed in Group II and Group III at 7<sup>th</sup> and 14<sup>th</sup> day where as no statistically significant difference observed in Gp I but only in case of organoleptic measurements. Chlorinedioxide mouthwash with scaling and root planning was found to be more effective than scaling and root planning alone which was again found to be more effective than Chlorinedioxide rinse alone .

## DISSCUSSION:

The result of this study demonstrate that rinsing with a ClO<sub>2</sub> mouthwash used over 14 day period ,was effective in reducing morning oral malodor and plaque. Chlorinedioxide is a soluble free radical .It is readily soluble in water forming a clear yellow colour solution in which it can remain intact for considerable period of time. Lynch et al reported the reaction of L-cysteine a thiol compound which contribute substantially

towards oral malodor. [8] with ClO<sub>2</sub> yielded disulfide cysteine as major product. The [process of oxidation of thiols through two step reaction involving ClO<sub>2</sub> are shown as following:



Grootveld et al reported that the oral rinse containing ClO<sub>2</sub> suppressed saliva numbers of *S.mutans* and *lactobacilli* in vivo, observed reflecting bactericidal action of oxohlogenoxidants present. [11] VSCs have been shown to result from bacterial putrefaction of proteins with sulfur containing aminoacids. These proteins are derived from tongue epithelial cells and white blood cells. Periodontal pathogens such as *P.gingivalis*, *T.forsythea*, *T.denticola*, *F.nucleatum* produce large amount of VSCs which are malodorous. The concentration of CH<sub>3</sub>SH is significantly higher in patients with periodontal disease than healthy individuals. [19]

Shinada, et al. 2010 reported that the ClO<sub>2</sub> mouthwash was effective at reducing oral malodor for 4 hours when used by healthy subjects [20] which is in accordance with our study. (Frascella 1998) tested the effectiveness of a ClO<sub>2</sub> containing mouthwash at different points of time for a total of 96 hours

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after rinsing. [21] The results showed a significant improvement in OM scores. Although Chlorhexidine is gold standard, 3 Acidified Sodium Chlorite mouth rinses have equivalent plaque inhibitory action to Chlorhexidine. ASC does not contain alcohol and it can be used immediately after dentifrices. It does not stain teeth. In present study, we have considered only gingivitis patients, other studies have been done in periodontitis patients. Grootveld M 2001 A significant percentage of the probe scores (67.4%) were reduced from  $\geq 4$  mm to  $\leq 3$  mm in an average of 3.4 months after use of chlorine dioxide mouthrinse. [20] Kimoto et al investigated the antibacterial effects of mouthwash containing ClO<sub>2</sub> and its cytotoxicity on human oral cells and found that it is harmless and can be used as a bactericidal agent for dental implants [22]

## CONCLUSION:

Clinical parameters of gingivitis reduced with the experimental mouthwash used for 14 days. Mouthwash containing ClO<sub>2</sub> improved halitosis. Future studies are required to examine more long term effects of the mouthwash in gingivitis and halitosis patients with larger sample size.

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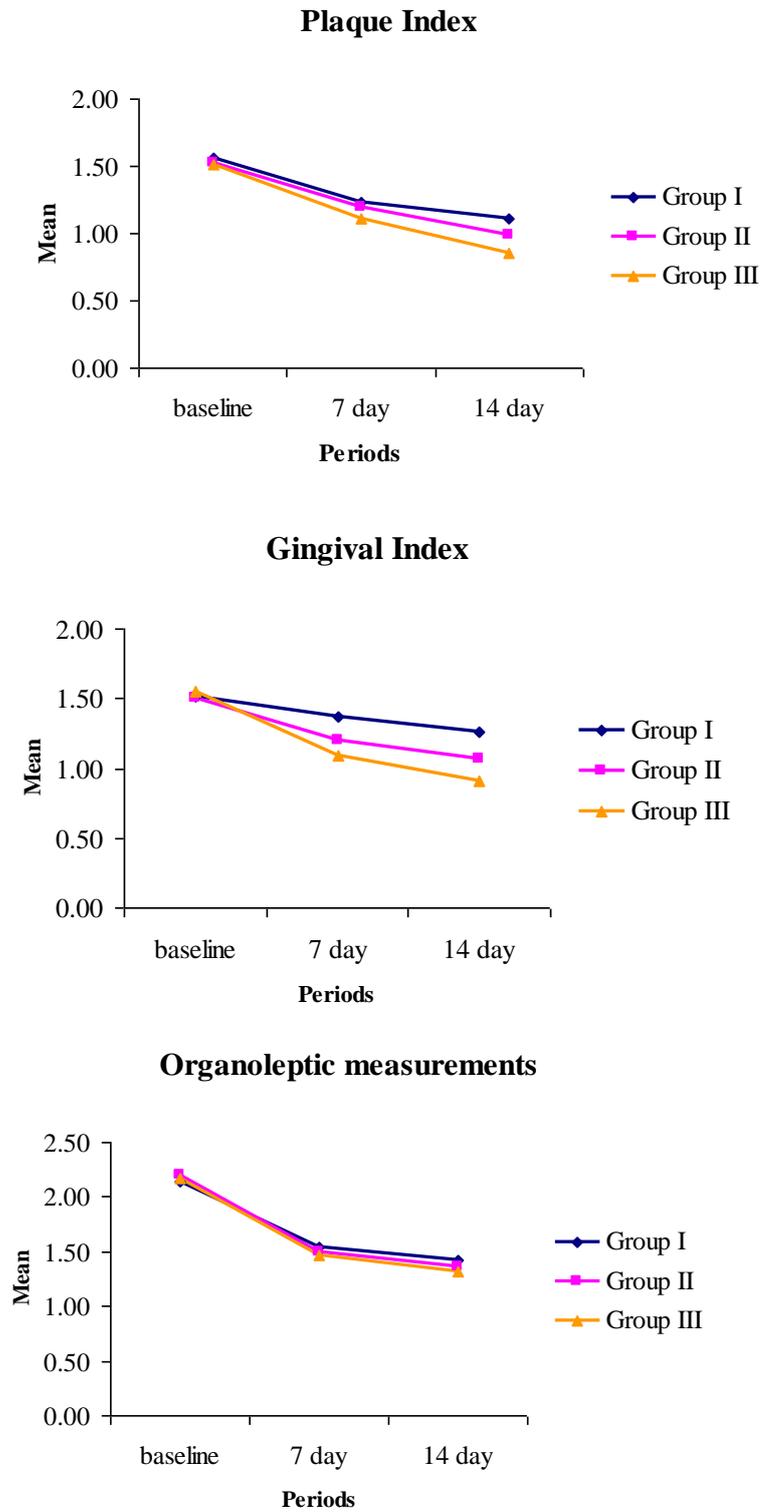
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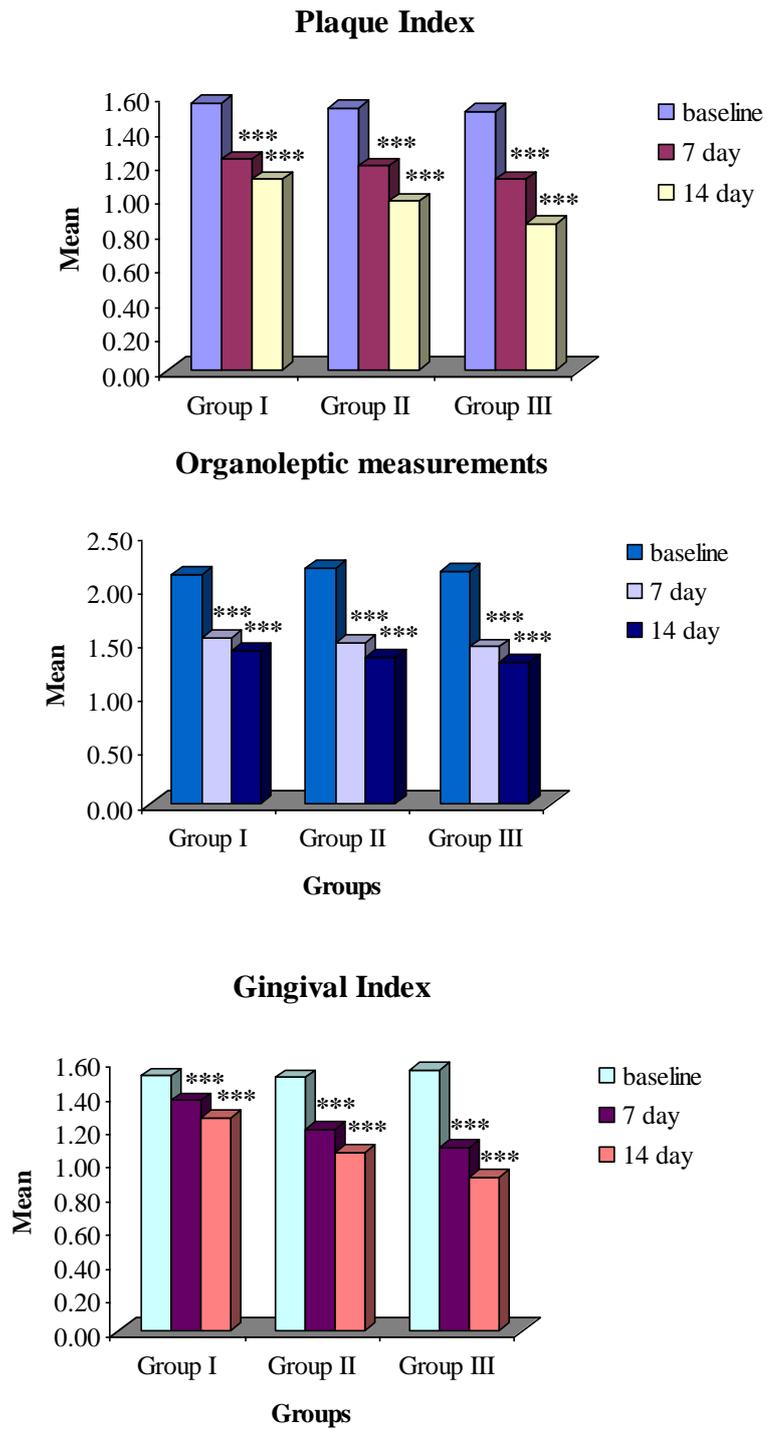
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**FIGURES:**



**Fig. 1.** Pre and post treatments mean outcome measures of three groups over the periods.

\*\*\*p<0.001- as compared to baseline



**Fig. 2.** For each group, comparative outcome measures between the periods.

**TABLES:****Table 1: Pre and post treatments outcome measures (Mean  $\pm$  SD, n=10) of three groups**

<b>Variables</b>	<b>Groups</b>	<b>Baseline</b>	<b>7 day</b>	<b>14 day</b>	<b>% change (baseline to day 14)</b>
Plaque Index	Group I	1.56 $\pm$ 0.07	1.23 $\pm$ 0.06	1.11 $\pm$ 0.08	28.7%
	Group II	1.53 $\pm$ 0.09	1.19 $\pm$ 0.04	0.99 $\pm$ 0.04	35.5%
	Group III	1.51 $\pm$ 0.07	1.12 $\pm$ 0.08	0.86 $\pm$ 0.04	43.3%
Gingival Index	Group I	1.52 $\pm$ 0.07	1.37 $\pm$ 0.06	1.26 $\pm$ 0.06	16.6%
	Group II	1.50 $\pm$ 0.04	1.20 $\pm$ 0.03	1.06 $\pm$ 0.03	28.0%
	Group III	1.55 $\pm$ 0.03	1.09 $\pm$ 0.02	0.91 $\pm$ 0.02	41.2%
Organoleptic measurements	Group I	2.14 $\pm$ 0.17	1.54 $\pm$ 0.09	1.42 $\pm$ 0.05	33.6%
	Group II	2.20 $\pm$ 0.16	1.50 $\pm$ 0.05	1.37 $\pm$ 0.04	37.9%
	Group III	2.17 $\pm$ 0.20	1.46 $\pm$ 0.05	1.31 $\pm$ 0.04	39.5%

**Table 2: For each variable and group, significance (p value) of mean difference between the periods by ANOVA followed by Tukey’s test**

Comparisons	Plaque Index			Gingival Index			Organoleptic measurements		
	Group I	Group II	Group III	Group I	Group II	Group III	Group I	Group II	Group III
Baseline vs. day 7	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
Baseline vs. day 14	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
day 7 vs. day 14	0.005	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	0.177	0.109	0.038

**Table 3: For each variable and period, significance (p value) of mean difference between the groups by ANOVA followed by Tukey’s test**

Comparisons	Plaque Index			Gingival Index			Organoleptic measurements		
	Baseline	day 7	day 14	Baseline	day 7	day 14	Baseline	day 7	day 14
Group I vs. Group II	0.972	0.936	0.002	1.000	p<0.001	p<0.001	0.956	0.994	0.977
Group I vs. Group III	0.698	0.006	p<0.001	0.803	p<0.001	p<0.001	1.000	0.829	0.466
Group II vs. Group III	0.999	0.198	0.001	0.430	p<0.001	p<0.001	1.000	0.999	0.979