

## Comparative Assessment of Herbal, Saturated Saline and Chlorhexidine Mouthrinse on Oral Hygiene Status of Visually Compromised Children: A Randomised Parallel Arm Clinical Study

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### Abstract

**Background:** The condition of children's teeth has far-reaching effects on their overall health. This is especially important for the visually impaired, who may lack the manual dexterity necessary to properly care for their oral hygiene. Better oral hygiene can be attained by combining traditional tooth brushing with the mechanical movements of mouth rinse. Constant efforts have been made to replace it with other holistic ways due to certain unpleasant side effects on long-term usage of chlorhexidine (CHX) and an overall paradigm shift towards the use of more organic items.

**Aim:** To evaluate and compare the efficacy of herbal, chlorhexidine, and saturated saline mouthwash on the oral hygiene status of children with visual impairment.

**Methodology:** A total of 42 children with visual impairments, ranging in age from 6 to 12 years old, were randomly assigned to one of three groups: Group A (Herbal), Group B (Chlorhexidine), or Group C (Saturated Saline). The level of oral hygiene was evaluated for each group using the "Silness-Loe Plaque index (PI)" and the "Gingival Index (GI) by Loe and Silness" at the beginning of the study as well as after 21 and 45 days had passed.

**Results:** At the 45th day, Group B had the lowest plaque index and gingival index (PI=0.890.06, GI=0.830.04), followed by Group A (PI=0.960.06, GI=0.970.04) and Group C (PI=1.160.07, GI=1.250.07). However, no statistically significant difference in plaque index (P=0.019) or gingival index (P=0.173) was identified between Group A and Group B at the 45th day. At the 45th day, there was a statistically significant difference between Group A-Group C and Group B-Group C for both plaque index and gingival index (P<0.001).

**Conclusion:** Green tea mouthwash can be a viable alternative to chlorhexidine in reducing plaque index and gingival index. Using saturated saline mouthwash regularly can enhance a person's overall oral hygiene and hence it can be used as an economical and easily accessible alternative.

## 1. Introduction

The mouth is a portal to the body, and oral-systemic health is a two-way interaction that affects systemic health. Dental, gingival and the surrounding soft tissue health all contribute to an individual's total oral health. Plaque is the primary factor in gingival disease and its progression. There are two different approaches of controlling plaque: 1) Mechanical 2) Chemical. Brushing and flossing are two examples of mechanical plaque management strategies. However, these approaches cannot reach the objective of full dental hygiene on their own. Additionally, both brushing and flossing need a certain level of physical dexterity, which restricts their applicability to individuals with particular health care requirements. Compared to members of other subgroups of the population with unique medical requirements, those who are visually impaired have a greater number of challenges. Children who are visually impaired tend to have a poor sense of orientation as a direct result of their vision impairment, which has a negative impact on their ability to detect directions and their ability to move around. This results in a high prevalence of trauma due to brushing and an elevated risk of general trauma, both of which are produced by the children's diminishing orientation in terms of directions and their abilities. In turn, this is caused by the fact that the prevalence of trauma due to brushing leads to an increased risk of general trauma. These children are unable to see the plaque that has formed on the surface of their teeth, which can result in partial removal of the plaque. Therefore, chemical plaque control approaches, in addition to mechanical methods, are of equal importance. Oral chemotherapeutic rinse has been recommended as a complement for avoiding plaque development and maintaining gingival health, as stated in a study that was conducted by DeVore L et al in 2002. Inadequate dental hygiene leads to the formation of plaque, which is one of the primary causes of gingivitis.

For almost 20 years, chlorhexidine (CHX) has been a popular mouthwash. 0.2% CHX kills bacteria faster than conventional oral antiseptics.<sup>1</sup> It inhibits salivary bacteria for at least 7 hours.<sup>2</sup> However, it has a number of disadvantages, including xerostomia, hypogeusia, and a tongue that is discoloured.<sup>3</sup> Staining of the teeth is the most undesirable adverse effect of using CHX mouthwash for an extended period of time and is the primary factor that limits its use. This occurs as a result of the Maillard reaction, as well as the generation of

coloured metal sulphide formation in the pellicle.<sup>4</sup> When the impacts, both positive and negative, are taken into account, there has been shown to be a paradigm shift that leans more towards the usage of holistic approaches. There is a large variety of medicinal plants and plant products available in India. *Camellia sinensis*, also known as green tea, is one of the plants that can be used in a variety of medical contexts. There are 4000 different bioactive chemicals found in it, one third of which are isopolyphenols. Isopolyphenols contain a variety of catechins, the most important of which are epigallocatechin gallate (EGCG), epicatechin gallate (ECG), epigallocatechin (EC), and epicatechin (EGC).<sup>5</sup> In addition to that, it has carotenoids, tocopherols, ascorbic acid (commonly known as vitamin C), minerals like chromium, manganese, selenium, and zinc, as well as certain phytochemical components. The odor-causing periodontal bacteria *P. gingivalis* and *Prevotella* spp. were susceptible to the bactericidal effects of catechins when tested in vitro. Catechins and its derivatives have the potential to inhibit the collagenase and cysteine proteinase activities of *P. gingivalis*, hence lowering the risk of periodontal disease.<sup>5</sup> Taking into consideration all of the benefits green tea mouthwash offers for dental health, it was evaluated in our study to discover how successful it is at improving oral hygiene.

Saltwater rinses are an extremely antiquated yet effective method for removing oral bacteria.<sup>6</sup> When treating a sore throat, doctors have long suggested saltwater gargle. Saturated saline mouthwash has the benefit of being easy to make using readily available ingredients. The ability of saturated saline mouthwashes to improve children's oral hygiene, in particular by reducing plaque levels, has been the subject of a large body of research. The purpose of this research was to examine the effects of three different types of mouthwash on the dental hygiene of visually impaired children: herbal, saturated saline, and chlorhexidine.

The null hypothesis provided was that there would be no statistically significant difference in plaque index or gingival index after using green tea mouthwash, chlorhexidine mouthwash, or saturated saline mouthwash.

## 2. Materials and Methods

### Study Design

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A prospective randomized clinical study was conducted in a school for visually compromised children. Before the study began, the college's ethics committee gave its permission for the study protocol. Informed and written consent was also taken from authority of school and local guardian. The current study was in accordance with Declaration of Helsinki guidelines.

A total of 70 children were screened for eligibility. Out of which 42 children meeting the inclusion criteria were included in the study. Following are the selection criteria of the present study:

## INCLUSION CRITERIA

- Visually impaired children
- Children aged 6 to 12 years with minimum of 20 teeth present.
- Children who have not undergone oral prophylaxis in past 6 months
- Children identified with mild to moderate type of gingivitis.

## EXCLUSION CRITERIA

- Medically compromised subjects
- Children undergoing any other dental treatment
- Children with a known history of chemical or herbal product allergies.

42 children who fulfilled the selection criteria were randomly assigned to one of three groups:

- **Group A: Green Tea**
- **Group B: 0.2% Chlorhexidine**
- **Group C: Saturated Saline**

All the children were gathered in a hall and were educated about the oral hygiene practice in day- to- day life. Teacher of Students with Visual Impairments

(TVI) conveyed the important information through braille and the instructions were recorded for reinforcement. Clinical examination was done in hall with adequate illumination and diagnostic instruments.

Tell-feel-do technique was used before introducing instruments into child's mouth which reduces their fear of unknown and makes the child feel more familiar with the whole procedure.

Mouthwash containing 5% green tea was utilised on participants in group A. The green tea mouthwash was produced by dissolving one teaspoon (5 grams) green tea powder into one hundred millilitres of water.<sup>7</sup> According to the recommendations provided by the manufacturer, 10 millilitres of a chlorhexidine mouthwash containing 0.2 percent chlorhexidine was used for group B.

According to White and Armaleh's instructions, a saturated solution of saline was prepared by mixing 9 teaspoons of salt with two thirds of a cup of water.<sup>8</sup> This was done for group C.

After brushing their teeth for at least 30 minutes, each subject was advised to rinse their mouth out with the mouthwash provided twice daily for 20 seconds. After using the mouthwash for 20 minutes, they were allowed to rinse their mouth with water. Silness-Löe Plaque index<sup>9</sup> and Löe-Silness Gingival index<sup>9</sup> were measured with William Probe at baseline and then it was compared for the effectiveness of mouthwash at 21<sup>st</sup> and 45<sup>th</sup> day as shown in Figure 1.

## STATISTICAL ANALYSIS

SPSS version 20.0 for MS Windows was used to analyse the data. The confidence interval was 95%, and  $P < 0.05$  was used to evaluate response significance. Descriptive statistics used mean and standard deviation. ANOVA followed by Tukey HSD post hoc test compared three groups. Intragroup comparison utilised paired t test.



**Figure 1:** Recording gingival index with William probe

### 3. Results

PI and GI at baseline did not differ between three groups ( $P=0.740$  and  $P=0.768$ , respectively) over three timelines (Figure2, Figure3). PI and GI ratings differed significantly across three groups at 21st and 45th day ( $P<0.001$ ).

The intragroup comparison for changes in PI and GI from baseline among the groups over time (Table 1) shows that the herbal and chlorhexidine groups had a statistically significant reduction in both PI and GI at 21 and 45 days from baseline ( $P0.001$ ). In contrast, there was no statistically significant reduction in both

PI ( $P=0.198$ ) and GI ( $P=0.079$ ) at the 21st day for saturated saline mouthwash, but a statistically significant reduction in both PI and GI was reported at the 45th day ( $P0.001$ ). Multiple comparisons utilising the Tukey HSD Post Hoc test (Table 2) reveal that there was no statistically significant difference between the efficacy of herbal and chlorhexidine mouthwash on PI at the 21st and 45th day ( $P=0.060$  and  $0.019$ , respectively). Results for GI at 21 days ( $P=0.161$ ) and 45 days ( $P=0.173$ ) were comparable. At both the 21st and 45th day, a statistically significant difference was observed between chlorhexidine-saturated saline mouthwash and herbal-saturated saline mouthwash

**Table 1:** Intragroup comparison of PI and GI change from Baseline among the groups over timelines

Parameter	Timeline	Mean $\pm$ SD change from Baseline								
		Herbal Mouthwash	t	P	Chlorhexidine Mouthwash	t	P	Saturated Saline Mouthwash	t	P value *
PI	21 Day	0.14 $\pm$ 0.08	6.50	<0.001	0.23 $\pm$ 0.11	7.38	<0.001	0.04 $\pm$ 0.09	1.35	<b>0.198</b>
	45 Day	0.84 $\pm$ 0.08	36.42	<0.001	0.93 $\pm$ 0.08	40.34	<0.001	0.65 $\pm$ 0.12	19.83	<0.001
GI	21 Day	0.20 $\pm$ 0.07	10.74	<0.001	0.26 $\pm$ 0.04	21.83	<0.001	0.02 $\pm$ 0.03	1.90	<b>0.079</b>
	45 Day	0.82 $\pm$ 0.05	53.94	<0.001	0.94 $\pm$ 0.05	65.92	<0.001	0.53 $\pm$ 0.07	27.77	<0.001

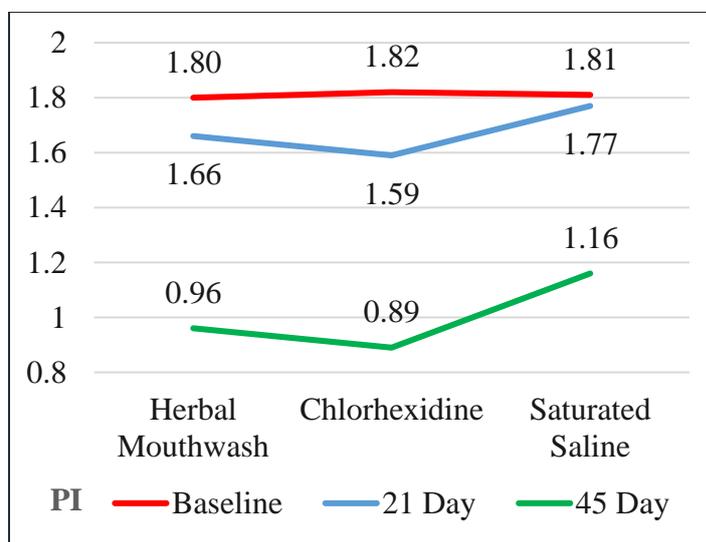
\* Paired t-test

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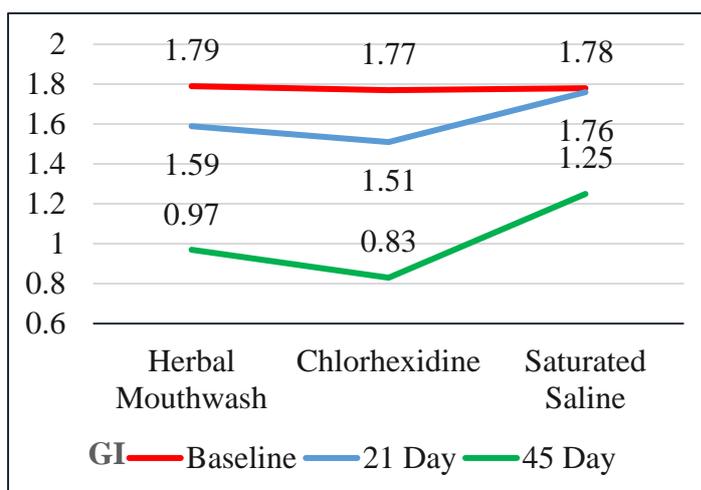
**Table 2: Tukey HSD Post Hoc test for Multiple comparison**

Parameter	Timelines	Group (I)	Group (J)	Mean Difference (I-J)	P value
PI	21 Day	Herbal Mouthwash	Chlorhexidine	0.07	0.060
			Saturated Saline	-0.11	<0.001
		Chlorhexidine	Saturated Saline	-0.18	<0.001
	45 Day	Herbal Mouthwash	Chlorhexidine	0.07	0.019
			Saturated Saline	-0.20	<0.001
		Chlorhexidine	Saturated Saline	-0.27	<0.001
GI	21 Day	Herbal Mouthwash	Chlorhexidine	0.03	0.161
			Saturated Saline	-0.17	<0.001
		Chlorhexidine	Saturated Saline	-0.20	<0.001
	45 Day	Herbal Mouthwash	Chlorhexidine	0.04	0.173
			Saturated Saline	-0.28	<0.001
		Chlorhexidine	Saturated Saline	-0.32	<0.001

\*One-way ANOVA



**Figure 2:** Line graph showing comparison of PI over three timelines



**Figure 3:** Line graph showing comparison of GI over three timelines

#### 4. Discussion

Traditional mechanical plaque control methods are extensively used in all parts of the world, but evidence suggests that they are ineffective. Plaque removal by mechanical means, such as brushing and flossing, is not always effective because it depends on an individual's dexterity and motivation. Additionally, bacteria from sensitive tissues can recolonize tooth surfaces. In conjunction with other treatments, chemical plaque-controlling agents have demonstrated enhanced efficacy in reducing plaque and gingival irritation. Rinses for the mouth are beneficial agents for patients who cannot maintain adequate mechanical plaque control.<sup>10</sup> Sinha et al. 2021 did a study on visually impaired children to compare the effectiveness of three different dental aids (mouthwash, powered toothbrush, and manual toothbrush) on plaque and oral hygiene scores; the results showed that mouthwash was the most effective.<sup>11</sup>

The current study examines the effectiveness of three different mouthwashes on plaque index and gingival index at 21 and 45 days after baseline: green tea, 0.2% chlorhexidine gluconate, and saturated saline mouthwash. Because of its superior antiplaque result and substantivity for 10-12 hours, chlorhexidine remains the gold standard against which the efficacy of newer antiplaque medicines is compared. The antiplaque activity of chlorhexidine was related to its retention in the oral cavity and gradual release. More than forty years have passed since its first successful application. Mouthwash with 0.2% chlorhexidine gluconate was utilised in this research because it is

much more effective in lowering plaque index.<sup>12</sup> Because of the well-known negative consequences that chlorhexidine can have, there is a continuing endeavor to find an alternative mouthwash that is just as effective but has a less percentage of these negative effects.

As a result of India's rich supply of organic herbal remedies, the country's people have traditionally employed these treatments both topically and inwardly to treat a variety of illnesses. It has been observed that there has been a paradigm shift towards the utilisation of herbal items. Tea is the second most popular beverage consumed by people all over the world after water. *Camellia sinensis* is the plant that provides the leaves that are used to make tea. In accordance with the degree of fermentation, it can be further subdivided into the following categories: green tea (which is not fermented), oolong tea (which is partially fermented), and black tea (which is fully fermented). Since green tea is made exclusively from *C. Sinensis* leaves that have been processed in a way that limits the amount of oxidation they experience, it possesses more potent antibacterial, anti-inflammatory, and antioxidant properties.<sup>13</sup>

Saturated saline mouthwash was the third mouthwash used in the present study. This mouthwash is readily available and affordable for this set of children. Salt solution inhibits oral microorganisms differently. As low-salt environments are hypotonic, oral bacteria thrive in osmosis-created watery environments. In high-salt solutions, the surrounding solution has more solutes than the bacterial cytoplasm. This diffusion gradient dehydrates and kills microorganisms.<sup>8</sup>

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In the present study, the efficacy of green tea mouthwash was lower than that of chlorhexidine after 45 days, however the difference was not significant. Green tea plays a vital role in the management of gingival inflammation by lowering the oxidative stress, preventing the production of pathogen's harmful metabolites and the formation of osteoclasts.<sup>14</sup> The green tea mouthwash's decreased collagenolytic activity and inhibitory effect on periodontal bacteria are most likely responsible for the better gingival index at follow-up visits. But the plaque regrowth potential and gingival inflammation were lower in chlorhexidine compared to green tea mouthwash due to substantivity of chlorhexidine mouthwash. The cationic nature of CHX molecules exhibits good adherence to the negatively charged oral surfaces (including mucous membranes, teeth, and salivary glycoproteins) and therefore interferes with bacterial adhesion, allowing substantivity for up to 12 hours.<sup>15</sup> The results of our study was in accordance with study conducted by Biswas et al 2015<sup>16</sup>, Priya et al 2015<sup>17</sup> & Shalini et al 2018<sup>18</sup>.

At the 21st day, the use of saturated saline mouthwash did not reveal a significant reduction in PI or GI index; nevertheless, at the 45th day, there was a statistically significant reduction in PI and GI index. The findings of Ekblom and Hultgren (1982)<sup>19</sup>, who indicated that saline rinses reduce the formation of plaque, lend credence to the plaque-inhibiting effects of saturated saline rinse revealed in the present investigation. Similar results were also found in the study conducted by S Rupesh et al 2015<sup>6</sup> in after using saturated saline mouthwash, wherein statistically significant reductions in dental plaque levels were detected when comparing the data collected at baseline, 10<sup>th</sup> and 21<sup>st</sup> days respectively. According to the findings of a study that was carried out by Gupta et al. 2014<sup>20</sup>, the effectiveness of saline mouthwash in decreasing dental plaque was not on par with that of aloe vera and chlorhexidine mouthwash.

A similar study conducted by Jenabain et al 2012<sup>21</sup> who tested 5% green tea mouthwash with normal saline mouthwash for plaque-induced gingivitis for 5 weeks reported no statistical difference between the two mouthwash; nonetheless, green tea mouthwash demonstrated improved performance when compared to normal saline mouthwash. The current research indicates that using normal saline mouthwash for an extended period of time considerably lowers both the

PI and the GI index. As a result, it is safe to use for a longer period of time as an addition to regular mechanical oral hygiene practises without causing any noticeable adverse effects. Salt water rinses can be recommended for daily usage for the prevention of periodontal disease and dental caries, whereas chlorhexidine may be used for relatively lesser duration due to its well-known side effects. Similar results were also found in a study that was conducted by Aravindh et al 2017<sup>22</sup>. In this study, it was concluded that salt water rinses can be recommended for daily usage.

The primary limitation of the study is that its findings are limited to a sample of children from a single geographic area. Local guardians' oversight was deemed acceptable, but this could introduce bias if a child stopped using mouthwash during the trial. In addition, the benefits and drawbacks of using green tea mouthwash over the long run could be shown by doing a cross-over study over a longer time period.

## 5. Conclusion

Green tea herbal mouthwash is comparable to the gold standard chlorhexidine gluconate mouthwash. Saline mouthwash decreases plaque and gingival index over time. Due to cost and availability, this group of kids can utilise it regularly.

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