

# TASTE PERCEPTION OF TOOTHBRUSH DISINFECTANTS

**DR. ASWINI Y.B**

MDS, Senior Lecturer,

Department Of Preventive and Community Dentistry,

**Teerthankar Mahaveer dental college, Moradabad, Uttar Pradesh, India.**

**DR. VARUN SARDANA**

MDS, Senior Lecturer

Department Of Pedodontics and Preventive Dentistry,

## ABSTRACT

**Background:** Various disinfecting solutions have been indicated for decontamination of toothbrush.

**Objectives:** To know the acceptability of 3% neem, 2% triclosan, 0.2% chlorhexidine gluconate and 1% sodium hypochlorite as toothbrush disinfectants.

**Setting and Design:** This was a double blind, randomized, linear cross over, in vivo comparative trial conducted among 40 children aged 12-15 years.

**Methods and Material:** The study was divided into 5 phases (Phase 1 - distilled water, phase 2 - 3% neem, phase 3 - 2% triclosan, phase 4 - 0.2% Chlorhexidine gluconate and phase 5 - 1% Sodium hypochlorite). The toothbrushes were soaked for 12 hours in antimicrobial solutions of respective phases (with a wash out period of one week in between each phase) after which the children brushed and asked for acceptability regarding taste by an open and closed ended questionnaire.

**Results:** 80.6% of subjects accepted the toothbrushes and 19.4% did not (Chi-square,  $\chi^2 = 7.16$ ,  $p=0.07$ , NS). The acceptance being high for phase 5 (36 subjects).

**Conclusion:** It can be concluded that, all solutions were acceptable for toothbrush decontamination. The preference of taste perception was high for sodium hypochlorite followed by triclosan, neem and then chlorhexidine solution.

**Key words:** Tooth Brush decontamination; Taste perception; Antimicrobial solutions; Neem.

## INTRODUCTION

An old saying by J. Leon Williams goes "A clean tooth never decays"<sup>[1]</sup>. In order to maintain the tooth clean various oral hygiene practices were followed since 3000 B.C since the time of Sumerians. Toothbrush has gone a series of changes from the time it was invented in China (618-970 A.D) and modern toothbrush in England (1780's) till now<sup>[2]</sup>. The racks in markets contains various brands of toothbrushes each claiming superiority over the other. However, little do we think that instead of cleaning the teeth, the brush could be possibly contaminating the teeth. Toothbrushes may become heavily contaminated with cariogenic, periodontopathogenic as well as microorganisms causing systemic infections<sup>[3-9]</sup>.

As the present scenario holds the torch of prevention and infection control, toothbrushes should be correctly stored, disinfected, and changed at regular intervals. There are various methods for disinfecting the toothbrushes from dipping in alcohol, drying in sunlight, table salt,

microwave oven to the new methods of formaldehyde and ethylene oxide gases, sprays like cetyl pyridinium chloride and chlorhexidine gluconate, UV radiation, germ terminator, antibacterial tufts and toothpastes with antimicrobial solutions<sup>[9-17]</sup>. All these methods have their own drawbacks of either being harsh on bristles, ineffective or costly. Soaking the toothbrushes in different disinfecting solutions has shown to be effective and economical<sup>[18-21]</sup>. Numerous studies have reported that the chlorhexidine gluconate<sup>[18-21]</sup>, sodium hypochlorite<sup>[18-21]</sup>, neem<sup>[22]</sup> and triclosan<sup>[22]</sup> as toothbrush antimicrobials are very effective in reducing micro flora and have shown some promising results.

Acceptability of these solutions is important if they have to be incorporated on a day-to-day basis in oral care. Some studies have been carried out to know the influence of chlorhexidine on taste, considering either its concentration in mouthwashes or time of rinsing<sup>[23-25]</sup>. But as toothbrush decontaminant, its effects on taste sensation have not been studied. As well as, there are no studies regarding the taste perceptions of sodium hypochlorite, neem or triclosan as toothbrush disinfectants.

Hence, the aim of this study was to know the acceptability in terms of taste perception of 0.2% chlorhexidine gluconate, 3% neem, 1% sodium hypochlorite and 2% triclosan as toothbrush disinfectants. The objectives were to compare the acceptance of all the above-mentioned solutions as toothbrush disinfectants.

## METHOD

This was a double blind, randomized, linear cross over, in vivo comparative trial. The study subjects and the statistician were blinded. The duration of the study was 2 months. Permission to conduct the study was obtained from Ethical Committee, KLE Institute of Dental Sciences, Belgaum, India, Block Education Officer, Belgaum, India and Principal of the school. A written informed consent was obtained from parents of all the children who were selected for the study.

A purposive sample of residential school subjects in Belgaum city were selected for the study as the environment in which all the subjects resided matched and controlled. A special format was designed exclusively for recording pertinent general information and observed findings. A pilot study was conducted on ten subjects to know the feasibility and acceptability of this study. Sample size of 40 was estimated using the results obtained from this pilot study. The study was started with hypothesis that no difference existed between the taste perception and acceptance of subjects between the phases.

Out of total 191 children of age group 12-15 years

old, 132 subjects fulfilled the study inclusion (subject having at least 3 single rooted and 2 multi rooted functional teeth per quadrant [third molars excluded], free of systemic diseases especially which can alter and DMFT score less than 3) and exclusion criteria (Subjects using antibiotics, antiseptic mouthwashes for at least 3 months prior to the study and at the time of study, undergoing any dental treatment, orthodontic treatment, or with extensive intra oral prosthesis, using neem, triclosan, chlorhexidine, cetyl Pyridinium chloride and fluoride in any form as an oral hygiene aid and under the influence of drugs and tobacco) after interview and clinical examination were done. Out of these 132 subjects, 40 (20 boys, 20 girls) were randomly selected by lottery method.

### Preparation of test solutions

2% triclosan solution (Irgasan pharmaceuticals) was prepared by mixing 6 grams of triclosan powder with 10 ml of distilled water and this mixture was diluted with 300 ml of 0.2N sodium hydroxide. For 3% neem extract, 100 gram neem sticks were cut into small pieces and ground to coarse powder in a blender, then placed in containers and stored at room temperature until the extraction procedure. Later on the well soaked (2-4 hours in water) neem powder was transferred to distillation apparatus along with 10 parts of water and the mixture was continuously heated till 60% of distillate was collected. After cooling, the collected distillate was filtered and 300 ml of extract was dissolved in 1000 ml of distilled water to get 3% neem solution. This extraction procedure is called Araka Kalpana<sup>(26)</sup>. The experiment was carried out within two days of preparation of extract. Commercially available 0.2% chlorhexidine gluconate (Hexidine, 2 mg/mL chlorhexidine gluconate with 5.4% m/v ethanol as a preservative) and 1% Sodium hypochlorite solution (Dentfills, manufactured by Dentfills, Mumbai, India) was used.

The study was divided into five phases i.e., Phase 1 - Distilled water (control), Phase 2 - 3% Neem, Phase 3 - 2% Triclosan, Phase 4 - 0.2% Chlorhexidine gluconate and Phase 5 - 1% Sodium hypochlorite and was planned accordingly. 40 subjects underwent all the phases of the study. The same procedure was carried out for all other phases consecutively.

All the subjects (n=40) were given new set of purchased Ajanta Dentocare toothbrushes, which were dipped in antimicrobial solution i.e., 3% neem for 12 hours. Subjects were asked to brush their teeth after rinsing the toothbrushes twice in running tap water and were asked about the acceptability (taste perception) of that toothbrush which was dipped in 3% neem antimicrobial solution. For 7 days they had to record the taste perception on scale from acceptable to non acceptable.

The same procedure was repeated with new set of toothbrushes after one week (wash out period) with 2% triclosan and subsequently with 0.2% chlorhexidine gluconate and 1% sodium hypochlorite with one week gap in between each solution tested for acceptability in all study subjects.

### STATISTICAL ANALYSIS

Data was entered in Microsoft excel and analysis was done using SPSS software (version 11). Categorical data was analyzed by Chi square test. In all above tests "p" value of less than 0.05 was accepted as indicating statistical significance with confidence interval of 95%.

### RESULTS

In total, the number of subjects proposed for study was 40, with equal distribution of males (n=20) and females (n=20) in age groups between 12-15 years. The power required detecting the difference for the study, 1-β was 0.85. the scale which was recording the taste perception for analysis was grouped into acceptable or not acceptable.

The table 1 shows that 30(75%) subjects accepted the toothbrushes of phase 2 for tooth brushing where as 25% did not accept the toothbrushes. 87.55 (n=35) subjects accepted the toothbrushes for brushing from phase 3. 30% (n=12) subjects had problem in using the toothbrushes of phase 4 and 90% (n=36) subjects readily accepted the toothbrushes of phase 5 for tooth brushing. The overall acceptance was 80.6% having no problem in using the toothbrushes and non-acceptance being 19.4%. There was no statistical difference among different phases in accepting the toothbrushes for brushing ( $\chi^2=7.16$ ,  $p=0.07$ ). On comparison between different antimicrobial solutions it was shown that (table 2), there was no statistical significance between phase 2 and phase 3 ( $p=0.16$ ), phase 2 and phase 4 ( $p=0.62$ ), phase 2 and phase 5 ( $p=0.08$ ), phase 3 and phase 4 ( $p=0.06$ ) and phase 3 and phase 5 ( $p=0.16$ ) in accepting the toothbrushes for brushing. But, subjects accepted phase 5 toothbrushes more when compared to phase 3 toothbrushes for brushing, which was statistically significant ( $p=0.03$ ). When compared between males and females the acceptability was higher in males than females (males 80%, females 20%) though no statistical significance was obtained ( $p=0.02$ ).

**Table-1.** Distribution of subjects for acceptability of toothbrushes after decontamination in different phases.

Phases	Acceptable		Not Acceptable		Total
	n	%	n	%	
2	30	75		25	40
3	35	87.5	10	12.5	40
4	28	70	5	30	40
5	36	90	12	10	40
			4		
<b>Total</b>	<b>129</b>	<b>80.6%</b>	<b>31</b>	<b>19.4%</b>	<b>160</b>

Chi-square,  $\chi^2=7.16$ ,  $p=0.07$ , NS

### DISCUSSION

Dental caries and periodontal disease continues to plague most of the world's population. Thus, more effective public health and preventive measures are needed to address this worldwide problem. The risk of cross infection and reinfection of teeth because of microorganisms on toothbrushes makes it relevant to



investigate methods of toothbrush care. One solution might be single use of toothbrushes, or atleast renewing toothbrushes regularly. Many patients have reported psychological, economical and environmental barriers to change their toothbrushes as recommended by ADA<sup>[17,18]</sup>. Hence, an easy and cost effective alternative approach might be preferable.

In the present study, soaking of toothbrushes for a period of 12 hours in disinfecting solutions was employed as brushing recommended two times a day and was the only study of 12 hours as compared to other studies which were 24 hours<sup>[21]</sup>, 20 hours<sup>[18]</sup>, 30 minutes<sup>[21]</sup> and 20 minutes<sup>[19,21]</sup>. The antimicrobial solutions used in the present study as toothbrush disinfectants are discussed:

**Neem** is widely available in most rural areas of developing countries possessing various medicinal properties and is inexpensive. Neem contains trimethylamine, chlorides, nimbodin, azadarachitin, lectin, fluorides in large amounts and silica, sulfur, vitamin C, tannins, saponins, flavenoids and sterols in small quantities<sup>[26-28]</sup>. In a study, 3% neem showed to be an effective toothbrush disinfectant against SM on toothbrush bristles (86% reduction).<sup>[22]</sup>

**Triclosan** is a broad spectrum antimicrobial presently being used in various formulations of dentifrices and mouthwashes. Triclosan based dentifrice<sup>[29]</sup> was also shown to be effective with a range of 2-100 cfu and 40% of the toothbrushes still had SM counts which was different from another study (80.8%).

**Sodium hypochlorite** commonly used as a household bleaching agent, is easily accessible and economical. Sodium hypochlorite presents antimicrobial activity with action on bacterial essential enzymatic sites<sup>[30]</sup>. The results from various study reports of its toothbrush disinfectant properties were varying<sup>[18,19]</sup>, which showed 100% (0 cfu) and 98% reduction in SM cfu.

**Chlorhexidine** is a cationic agent, which exhibits broad-spectrum antimicrobial effect and is a benchmark control in various studies. A study results were 100% reduction of SM cfu from toothbrush bristles in other studies, were in two studies had used 0.2% chlorhexidine with a soaking period of 24 hours<sup>[19]</sup> and 20 minutes<sup>[20]</sup> and the other two studies<sup>[18,19]</sup> used 0.12% chlorhexidine solution with soaking period of 20 hours immediately after brushing.

A well-known fact of these antimicrobial solutions is bitter and altered taste especially with neem and chlorhexidine solutions. In a study of Ernst et al. (1998) approximately 33% of the people claim that alcohol-containing CHX mouthrinses are of poor taste. It has been proposed that the salt taste appears to be preferentially affected, leaving food and drinks with a rather bland taste. An alcohol-containing CHX mouthrinse may even alter the taste perception for up to 4 h<sup>[23-25]</sup>.

Hence, an auxiliary study was done were in subjects were their own controls. All the study subjects were provided with new toothbrushes dipped in the

antimicrobial solutions used in this study for 12 hours. To avoid any carryover effect the subjects were given the dipped toothbrushes with a gap of 1 week between each solution tested. As the chlorhexidine solution has the side effect of staining toothbrushes, the subjects were asked about to reason for non acceptability. The subjects were asked whether these toothbrushes were acceptable for use or not. 25% of subjects had problem using toothbrushes dipped in 3% neem solution due to altered taste and 30% subjects had problem with chlorhexidine dipped toothbrushes in which 24% had problem with staining and 6% with taste. The acceptability was comparatively higher for toothbrushes dipped in 1% sodium hypochlorite (90%) followed by 2% triclosan (87.5%).

The 3% neem taste can be altered to reduce the bitter taste by adding additives (additive concept) while preparation of neem solution. Various techniques are suggested like mixing with sufficient quantity of honey, addition of salt to the sour things making the combination more palatable and addition of the pleasant aromatic drugs like Usheera, Chandana, Ela, Twak, etc masked the unbearable taste and smell of the neem<sup>[31,32]</sup>.

Further investigations are necessary taking into account the biochemical taste evaluation, longitudinal data and with larger field trials. It can be concluded that, all solutions were acceptable for toothbrush decontamination. The preference of taste perception was high for sodium hypochlorite followed by triclosan, neem and then chlorhexidine solution.

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