



EVALUATION OF THREE POTENTIAL TOOTHBRUSH DISINFECTANTS: A RANDOMIZED CONTROLLED TRIAL AMONGST DENTAL COLLEGE STUDENTS IN KANPUR CITY, INDIA

Dental Science

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ABSTRACT

Aim: The aim of the present study was to evaluate the effectiveness of three disinfectants as toothbrush decontaminants-4.5% vinegar, 3% sodium hypochlorite, and 0.2% chlorhexidine gluconate.

Material and methods: 60 participants in the age group of 20-30 years were divided into 4 groups. Group I (4.5% vinegar), group II (3% sodium hypochlorite), group III (0.2% chlorhexidine gluconate) and group IV (tap water), which served as the control group. Each participant was provided with a new toothbrush, instructions were given and toothbrushes were collected after brushing for seven days. Toothbrushes were sent to the laboratory for determining total colony count.

Results: 4.5% vinegar was most effective followed by 3% sodium hypochlorite and 0.2% chlorhexidine gluconate and tap water.

Conclusion: We concluded that vinegar was most effective disinfectant when compared with others.

KEYWORDS

INTRODUCTION

The use of toothbrushes for maintaining oral hygiene have been known since centuries. Their bristles rub against teeth and gingival surfaces to disrupt dental biofilm, thereby preventing caries and periodontal diseases.¹ Therefore, toothbrushes get contaminated by microorganisms from oral cavity and also from surroundings in which they are stored.² Within two days of brushing, toothbrush contamination occurs by disease causing bacteria, viruses and fungi.³ Caudry et al found that toothbrushes are heavily contaminated with normal use.⁴ Mehta et al found that 70% of their study toothbrushes got contaminated with microorganisms after use.⁵ Most people use plain water to rinse their toothbrush. This reduces microbial load, although complete elimination does not occur.⁶

Toothbrushes are mostly stored in bathrooms. Humid condition in bathrooms harbour many pathogenic micro-organisms, which facilitate microbial growth and cross-contamination. Glass found that increased humid condition can increase bacterial survival on toothbrushes.⁸ Contaminated toothbrushes can cause dental caries, gingivitis, stomatitis, arthritis, bacteremia and stroke thus affecting oral and general health. Therefore, many oral and systemic diseases can be controlled by reducing oral microbial load.⁹ Thus, it is of utmost importance to maintain proper oral hygiene, which cannot be possible by using contaminated toothbrushes.

Different methods for toothbrush disinfection have been investigated previously.^{10,11,12} However, the present study was undertaken to compare efficacy of three disinfectants which are economical and easy to use on a daily basis.

MATERIAL AND METHODS

Study participants

The present study was conducted among students of Rama Dental College, Hospital and Research Centre in the city of Kanpur, Uttar Pradesh, India. Ethical clearance was taken from Institutional Review Board of the institution. All participants gave written informed consent before start of the study. The participants were aged between 20-30 years with plaque score ranging from 0.1 to 1.9, DMFT score 0 and without any oral or systemic diseases. Subjects were excluded if they were undergoing orthodontic treatment, taking antibiotic medication within 3 months of study, those using tongue cleaner, mouthwash and tobacco users.

Study procedure

The study included sixty volunteers who were chosen by lottery method and randomly assigned into four groups. Each group consisted of fifteen participants. Coded toothbrushes were distributed to the participants. They were instructed to brush twice daily for 2 minutes using Modified Bass technique for seven days. Participants had to rinse brushes with plain water after brushing and store in upright position in

living rooms so that brush should come in contact with air and not with any other external object. After a week, toothbrushes were collected in sterile plastic bags and sent to the laboratory for investigation.

Blinding

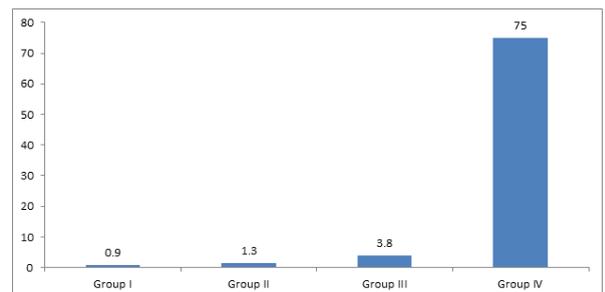
The study subjects remained blind regarding the procedures after collection of toothbrushes. Microbiologist and statistician remained blind regarding the disinfectant solutions.

Lab procedure

In the laboratory, group I was dipped in 4.5% vinegar, group II in 3% sodium hypochlorite, group III in 0.2% chlorhexidine gluconate and group IV in tap water for 12 hours. Following this, each toothbrush was kept in a test tube containing peptone solution. The brushes were incubated for 5 hours, tenfold dilutions were made and 10 μ l spread on nutrient agar. The inoculated plates were incubated at 37°C for 24 hours under aerobic conditions. Following this, total colony count was determined in CFU/ml.

RESULTS

The toothbrushes in control group contained highest number of microorganisms. The total bacterial population was least in group I i.e. 0.9x10⁶ CFU/ml which was treated with 4.5% vinegar, followed by group II (3% sodium hypochlorite) showing bacterial count as 1.3x10⁶ CFU/ml. In group III (0.2% chlorhexidine gluconate) the total colony count was 3.8% followed by tap water at 75 x 10⁶ CFU/ml. The data obtained showed 4.5% vinegar as most effective disinfectant.



Graph showing total colony count of each group

DISCUSSION

The present study demonstrated the effectiveness of three disinfectants which were chosen due to their cost-effectiveness and ease of use.

The presence of acetic acid in vinegar exerts bactericidal effect, which can kill strains such as E. Coli, S. aureus.¹³ Acetic acid can reduce both intracellular and extracellular pH, thereby interfering with cell membrane's integrity and thus inhibiting microbial growth.¹ The

results are in accordance with studies conducted by Raj V.B et al¹³ and Basman A et al⁶ who found vinegar to be most effective disinfectant followed by sodium hypochlorite and chlorhexidine gluconate.

Sodium hypochlorite is used worldwide in endodontic treatment for bactericidal properties. When sodium hypochlorite comes in contact with water, hypochlorous acid is formed which has an active chlorine. Active chlorine is a strong oxidising agent. Therefore, it causes irreversible oxidation of -SH groups of enzymes, which disrupts metabolic activity of bacterial cell. Chlorine may also form toxic complexes by reacting with cytoplasmic components to N-chloro compounds.¹⁴ Basman A et al have found 2% sodium hypochlorite to be effective disinfectant which can kill various strains of microorganisms specially *S.mutans* and *E.Coli*.⁶ Study by Nelson Filho P et al have shown similar results.¹⁵

Chlorhexidine is a chemical antiseptic with bactericidal and bacteriostatic properties to both gram-negative and gram-positive microbes. It disrupts cell membrane integrity of bacteria and damages cytoplasmic membrane. As a result, there is leakage and precipitation of nucleic acids and cytoplasmic protein, destroying microorganisms.¹⁶

Control group showed highest number of microorganisms which implies that rinsing with water and air-drying is not effective method for toothbrush decontamination.

However, there are some limitations in this study. Microbial contamination of each group was not assessed before treatment with various agents, so comparison between before and after treatment with disinfectants was not possible. Further, this study assessed microbial decontamination after 12 hours. Therefore, the effect of various time intervals was not assessed. However, there are other studies^{15,17} in which effect of time interval was established.

CONCLUSION

Toothbrushes which play a pivotal role in fighting against tooth decay can itself lead to dental diseases as well as many other systemic diseases, if not properly stored and maintained. In this study, 4.5% vinegar proved to be most effective followed by 3% sodium hypochlorite and 0.2% chlorhexidine gluconate. Establishing an easy and economical method for disinfecting a toothbrush would be an effective way to prevent the continuation of reinfection of oral diseases. However, further research is recommended on the effect of various concentrations of test agents.

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