Contaminated Toothbrush: Potential Threat to Oral and General Health

***Mahantesha S.[1], Ashwini S.[2], Rima Jaiswal[3], Yashi Priya[4] and Manjusha M.V.[5]**

*Corresponding Author E-Mail: mahanperio@gmail.com

Contributors:

[1]Reader, [2]Professor and Head, [3,4] ExPost Graduate Student,[5]Post Graduate Student, Department of Periodontology, Faculty of Dental Sciences, M.S.Ramaiah University of Applied Sciences, Bangalore - 560054

Abstract

Background:-Toothbrushes which are important tool for maintaining oral hygiene daily can also hasten the growth of microorganisms if residues remain on the bristles. Toothbrush disinfection has received little attention which necessitates for disinfection methods which are rapidly efficacious, cost-effective, non-toxic and that can be executed easily.**Aim**:-The aim of the present study was to assess the efficacy of easily available disinfectants on toothbrush contamination. **Materials and Methods**:-A total of 20 samples were randomly divided into 4 groups, in which 5 samples were included in each group i.e. control group: saline solution and test group: 5 each in 0.2% chlorhexidine solution, 2% betadine solution, and vinegar respectively. Regularly used toothbrush from all the participants were dipped in double sterile distilled water to obtain the colony count pre-disinfection. Toothbrushes were then dipped in the test and control solution for 10 minutes, and were thereafter dipped in double sterile distilled water to obtain the colony count post-disinfection. The solution then obtained was cultured and analysed for colony forming units. **Statistical Analysis**: Data analysis was done using SPSS version 16.0. Mann Whitney test was used to compare mean values of CFU after disinfection with different disinfectants. **Results**:- There were statistically significant differences ($P < 0.05$) between the groups (Groups 2, 3 and 4) of all of the tested methods for the microorganisms. The maximum reduction was seen in betadine group (mean = 0.03 x 103), followed by chlorhexidine (mean=0.17 x 103) and vinegar group (mean=0.2 x 103).**Conclusion**:-From the results that were obtained, it could be inferred that an easily applicable substitute for the disinfection of toothbrushes are on counter-solutions based on the betadine test.

Keywords: *Tooth Brush Contamination, Disinfection, Betadine, Chlorhexidine, Vinegar*

1. INTRODUCTION

Toothbrushes are important tool for maintaining oral hygiene daily. But it can also hasten the growth of microorganisms if residues remain on the bristles.[1] Cobb was the first person who reported in 1920 that recurrent contaminations in the mouth are caused by toothbrush.[2] Moreover, toothbrushes are usually stored in the bathroom or near to the toilet and sink. This can be a breeding object to enteric bacteria which are dispersed by aerosols.[3] Millions of bacteria are released into the atmosphere from small drops from toilet. Several factors, including the long survival time of the microorganisms, storage circumstances, and toothbrush location, cause the reintroduction of potential pathogens and cross-Infection to the oral cavity.[4]

Contaminated toothbrushes may play an important role in many oral and systemic diseases, including septicaemia and gastrointestinal, cardiovascular, respiratory, and renal problems. This condition is specifically important for children, the elderly, and high-risk patients, including immunosuppressed individuals or those undergoing organ transplantation or chemotherapy.[5] Retention and colonisation of toothbrushes by microorganisms, if not controlled, may cause inflammatory reactions in the oral tissues.[6] Toothbrushes disinfection has received little attention despite possible associations with dental caries[7],

periodontal diseases or other diseases caused by fungi or viruses.[8,9] Contaminated toothbrushes intensifies the injuries to the oral tissues. Septicaemia post brushing can even occur. This necessitates for disinfection methods which are rapidly efficacious, cost-effective, non-toxic and that can be executed easily.[10]

Hence, the purpose of the study is to assess the efficacy of easily available disinfectants on toothbrush contamination.

2. MATERIALS AND METHODS:

Subject Population

It was a non-interventional, randomized, controlled trial. Toothbrushes were obtained from 20 healthy participants, selected from common bathroom of M.S Ramaiah hostel, Bangalore with at least 24 natural teeth, and no clinical signs of disease in the oral mucosa and healthy gingiva. The participants who were excluded from the study were : pregnant or lactating; had periodontal treatment or antibiotics in the previous 3 months; smoked tobacco; had a systemic disease that might disturb the periodontium, or who required pre-medication for dental treatment. Informed consent were obtained from all the participants.

Antimicrobial Solution

We evaluated three antimicrobial solutions: 0.2% chlorhexidine gluconate, 2% betadine solution and vinegar (5% acetic acid solution). Normal saline was used as a control solution.

Experimental Design

Participants were selected based on inclusion and exclusion criteria. A total of 20 samples were randomly divided into 4 groups, in which 5 samples were included in each group i.e. control group: saline solution and test group: 5 each in 0.2% chlorhexidine solution, 2% betadine solution, and vinegar respectively. Regularly used toothbrush from all the participants were taken from storage area and were dipped in double sterile distilled water to obtain the colony count pre-disinfection. Toothbrushes were then dipped in the test and control solution for 10 minutes, and was thereafter dipped in double sterile distilled water to obtain the colony count post-disinfection. The solution then obtained was cultured and analysed for colony forming units.

Culture Analysis

The smear was obtained using sterile swabs. These sterile swabs were dipped in 2 ml of brain heart infusion broth and were agitated sufficiently. These were then incubated at 370C for 2 hours. A 100µl of primary culturing was picked, struck onto the blood agar plates and incubated at 37^0C for 3 days. The colony thus formed were counted utilising digital colony counter. The counts thus obtained was calculated for CFU/ ml.

3. STATISTICAL ANALYSIS

Data analysis was done using SPSS version 16.0. Mann Whitney test was used to compare mean values of CFU after disinfection with different disinfectants

4. RESULTS

Statistically significant differences ($P < 0.05$) were found between the different methods (Groups 2,3,4) and control group (Group 1) for all of the tested bacteria. There were statistically significant differences ($P < 0.05$) between the groups (Groups 2, 3 and 4) of all of the tested methods for the microorganisms. The maximum reduction was seen in betadine group (mean = 0.03 x 103), followed by chlorhexidine (mean=0.17 x 103) and vinegar group (mean=0.2 x 103). The minimum reduction in the colony forming units were observed in the control group (saline). [Table 1& Fig 1]. Figure 2 shows toothbrush dipped in 4 different solutions namely saline, betadine, chlorhexidine and vinegar. Figure 3 shows colony forming units observed in betadine group pre and post-disinfection. Figure 4 shows colony forming units observed in chlorhexidine group pre and post-disinfection. Figure 5 shows colony forming units observed in distilled water group pre and post-disinfection.

Table 1. Colony forming units pre and post-disinfection among study groups

GROUP	Pre-disinfection	Post-disinfection	*P*
1	3.42×10^3	3.06×10^3	0.003
2	2.12×10^3	0.03×10^3	0.003
3	3.16×10^3	0.2×10^3	0.003
4	3.402×10^3	0.17×10^3	0.003

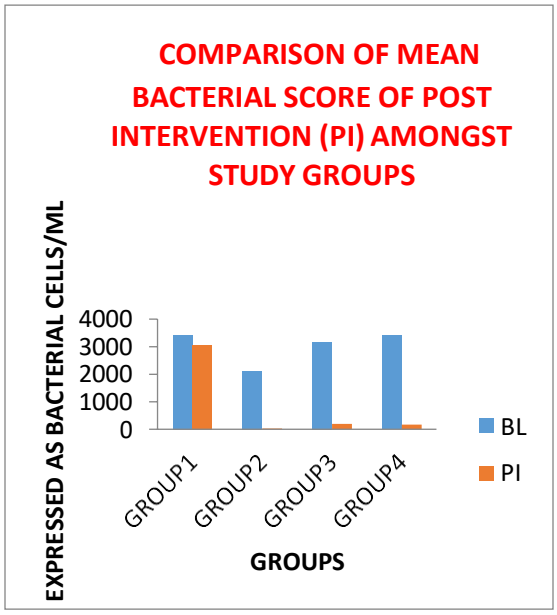

Fig. 1 Comparison of mean bacterial score of post intervention amongst study groups

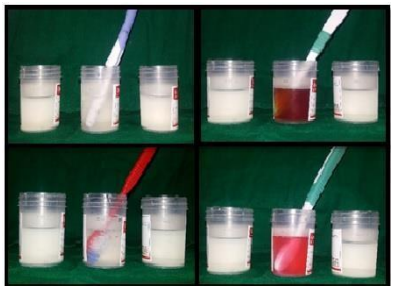

Fig. 2 Toothbrush dipped in 4 different solutions

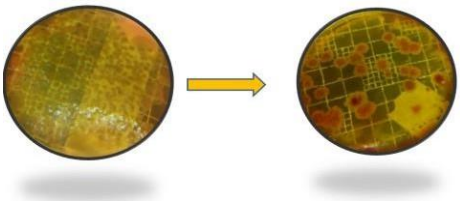

Fig. 3 Betadine group

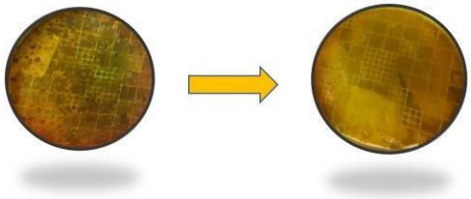

Fig.4 Chlorhexidine group

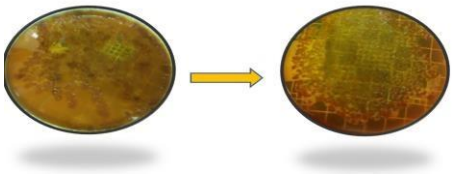

Fig. 5 Distilled water group

5. DISCUSSION

Studies have reported that toothbrushes become contaminated by several oral microorganisms after oral hygiene procedures, and contaminated toothbrushes may transmit bacteria involved in

oral and systemic diseases.[4,11,12] Only little attentiveness has been given for toothbrush disinfection even though lot of literature evidence is available.[11]

Toothbrushes not only harbour oral micro-organisms but are also exposed to enormous amount of environmental organisms because of storage habits. Toothbrushes which were used contain Candida, Corynebacterium, Pseudomonas and coliforms.[3] After using the toothbrush these microorganisms remain for more than 6 hours. The results obtained were correlated with the possibility of cross-infection. This is of most extreme importance, mainly among children and immunocompromised patients. It reinforces the role of the daily disinfection of toothbrushes.[13,14]

Candida albicans contamination is quoted as a vital source of mortality and morbidity In patients with AIDS, bone marrow transplantation and aggressive anti-neoplastic therapy.[15] There is link between S. aureus with several human infections as pneumonia, sepsis, osteomyelitis, and abscesses.[16]

Major causative agent of pharyngitis and tonsillitis is S. pyogenes.[17] A previous study described the persistence of group-A beta-hemolytic streptococci in toothbrushes and recommended that it could contribute to the persistence of these microorganisms in the oral pharynx and might account for the catastrophe of penicillin therapy in few cases of pharyngotonsillitis.[18]

The efficacy of different methods for disinfecting toothbrushes has been investigated in in vitro and in vivo studies. Methods such as chemical agents, brush sprays, UV light toothbrush sanitizers, modified brushes, MW ovens, and dishwashers have been suggested for disinfecting toothbrushes.[4,11,19,20] However most of these fail in terms of cost effectiveness, ease of implementation and hence patient's compliance. Hence, our study aimed at using on-counter disinfectant that are rapidly effective, cost effective, non toxic and can easily be implemented.

The use of povidone iodine in medicine is well established because of its antimicrobial properties. Yet, only after the introduction of povidone iodine in the 1960s, was it possible to employ this highly efficient microbicide to a wide variety of bacterial, fungal and viral infections.[21] Short durations of povidone-iodine contact with various periodontopathic bacteria provides effective in vitro killing.[22, 23] Also, povidone-iodine exhibits marked anti-cytomegalovirus activity[24], a herpesvirus implicated in the pathogenesis of periodontitis.[25] Emergence of povidone-iodine resistance microorganisms has not been reported to have been detected to date.[21] Similarly in this study, betadine showed maximum reduction in the colony forming units, which was in accordance to previous studies.

Chlorhexidine is a diphenyl compound that is active mainly against bacteria and exhibits limited activity against viruses. Chlorhexidine demonstrates substantivity to tooth surfaces and oral mucosa and exhibits low irritability.[26] 0.2% chlorhexidine exhibits little bactericidal activity against various enteric gram-negative rods[27] and microorganisms of experimental biofims[28]. In our study, 0.2% chlorhexidine was found to be less effective in reducing colony count when compared to betadine. However, the reduction in colony forming units was found to be statistically significant.

Considering the low toxicity and low cost, and easy availability, home used vinegar was tested containing 5% acetic acid. In order to treat oral inflammatory processes (as a mouthwash) and as an anti-septic for sores, this solution is used as a substitute[29]. However, in dentistry a significant reduction was observed in certain micro-organisms like S. aureus, S. mutans, S. pyogenes and C. albicans [11]. In our study too, significant reduction was seen in the colony count after dipping in vinegar solution. However, decrease was preceded by betadine and chlorhexidine.

There were few limitations of the study which included smaller sample size. However it could not have affected the result of the present study. Further in vivo and long term prospective trials

should be conducted to confirm the result of the present study.

6. CONCLUSION

From the results that were obtained, it could be inferred that the most successful, non-irritating, worthwhile, and an easily applicable substitute for the disinfection of toothbrushes are on counter-solutions based on the betadine test.

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