

## Evaluating the Decontamination Effect of Different Toothbrush Sanitization Techniques

Aysha Shibin AR, HT Ajay Rao, Neha Haswani, Sham S. Bhat, Sundeep Hegde

Department of Pedodontics and Preventive Dentistry, Yenepoya Dental College, Mangalore, Karnataka, India

### Address for Correspondence:

Dr. Sham S. Bhat, Professor and Head, Department of Pedodontics and Preventive Dentistry, Yenepoya Dental College, Mangalore, Karnataka, India.

### ABSTRACT:

**Background:** Tooth brushing plays an important role in personal oral hygiene and effective plaque removal. Over the years it has proved to be an efficient means of mechanical plaque control. But it is often left unnoticed that the tooth brushes get heavily contaminated. This contamination implicates the possibility of reinfection of a patient by toothbrushes harboring pathogenic microorganisms.

**Aim:** The purpose of this study is to evaluate and compare the antibacterial effect of ultraviolet toothbrush sanitizer, microwave and normal saline in the reduction of *Streptococcus mutans* count on the toothbrush heads after tooth brush sanitization.

**Methodology:** 30 children aged 10-14 years were included in this study. Similar toothbrushes and toothpastes were distributed to all the subjects and were instructed to use it twice a day for 7 days. Sample toothbrushes were collected in sterile packs, numbered and sent for microbial analysis for streptococcus mutans count. In the second phase, these toothbrushes were subjected to the 3 different sanitization methods, with 10 samples in each group. Group 1- Ultraviolet tooth brush holder. Group 2- Microwave. Group 3 – Normal saline. At the end of each sanitization procedure the toothbrushes were immediately sent for a second round of microbial analysis to check for the reduction in streptococcus mutans count.

**Statistical analysis:** The obtained data were analysed using one-way ANOVA, Bonferroni test and paired t-test.

**Results:** There was a statistically significant drop of streptococcus mutans count post sanitization with both UV tooth sanitizer as well as microwave. However normal saline did not prove to be a satisfying decontamination agent with insignificant reduction.

**Conclusion:** Both microwave and UV light holder can be used as decontamination agents since both the methods showed good efficiency.

**Keywords:** Microwave, Sanitization, *Streptococcus mutans*, Tooth brush, Ultraviolet.

### INTRODUCTION

It is a known fact that our oral cavity harbours a wide variety of microorganisms, streptococcus mutans being the most virulent among them all. Oral hygiene was in practice as early as 3000 BC by the Sumerians.<sup>1</sup> Toothbrush is the most commonly used aid to maintain oral hygiene. Tooth brushing plays an important role in personal oral hygiene and effective plaque removal.<sup>2</sup> Over the years it has proved to be an efficient means of mechanical plaque control. But it is often left unnoticed that the tooth brushes get heavily contaminated. This contamination implicates the possibility of reinfection of a patient by

toothbrushes harboring pathogenic microorganisms.<sup>2</sup> The micro organisms that accumulate on the tooth brushes get transmitted to the individual, which further cause diseases like dental caries, gingivitis, stomatitis and even infective endocarditis compromising the general health of the patient. Unfortunately, proper care of toothbrush is often neglected.<sup>3</sup> We need to remember the potential transmissibility of bacteria into the hard and soft tissues of the oral cavity and overall body while using the toothbrush.<sup>4</sup> Procedures for the decontamination of toothbrushes would prevent the risks of reinfection or infection by

other pathogenic microorganisms from the environment. Over the years, numerous methods of toothbrush sanitization have been put forward, like exposure to ultraviolet light and microwaves, disinfectant tablets, and immersion in solutions. Although methods for tooth brushing are described in the literature, procedures for maintaining the cleanliness of toothbrushes are rarely discussed.<sup>3</sup>

The purpose of this study is to evaluate and compare the antibacterial effect of ultraviolet toothbrush sanitizer, microwave and normal saline in the reduction of Streptococcus mutans count on the toothbrush heads after tooth brush sanitization.

## **MATERIALS AND METHODS**

### ***Inclusion Criteria:***

- 1.Children with good general health
- 2.Children in the age group of 10-14 years
- 3.Children with fair oral hygiene

### ***Exclusion Criteria:***

- 1.Children with relevant medical condition and is not on any medication.
- 2.Children with clinical evidence of gross caries or periodontal disease

### ***Materials:***

- Tooth brushes
- Tooth paste
- UV toothbrush holder
- Microwave
- Normal saline
- Sterile packs

### ***Methodology:***

The study was conducted after receiving the ethical clearance from the University. Thirty children aged 10-14 years were included in this study. The study was conducted after the informed consent was obtained from a Residential Institution in Mangalore. Similar toothbrushes and toothpastes were distributed to all the 30 subjects and were instructed to use it twice a day for 7 days. They were also advised not to clean the toothbrush in hot water or take any other additional efforts to clean their respective toothbrushes. After a week of usage the sample toothbrushes were collected in sterile packs, numbered and sent

for microbial analysis for streptococcus mutans count. In the second phase, these toothbrushes were subjected to the 3 different sanitization methods, with 10 samples in each group.

Group 1 - Ultraviolet tooth brush holder.

Group 2 - Microwave.

Group 3 - Normal saline.

Toothbrushes in Group 1 were kept in UV light toothbrush holder for 8 minutes, Group 2 toothbrushes were subjected to microwave irradiation were the contaminated toothbrushes were immersed in beaker containing sterile water and was exposed to microwave irradiation at 2450 Mhz for 2minutes and Group 3 samples were immersed in normal saline for 12 hours. At the end of each sanitization procedure the toothbrushes were immediately sent for a second round of microbial analysis to check for the reduction in streptococcus mutans count.

### ***Microbial Analysis Procedure:***

Pre-sanitization - The handles of the toothbrushes were cleaned with surgical spirit. The toothbrushes were individually immersed into sterile test tubes containing 2ml sterile normal saline and vortexed for two minutes. The test tubes were incubated for 1hour at 37°C and further plated on Mitis Salivarius agar by pour plate method. The plates were again incubated at 37°C for 24 hours. Colony morphology was noted. Streptococcus mutans were identified and counted with the help of digital colony counter.

Post-sanitization - The same procedure were repeated to check for the reduction in streptococcus mutans count.

**Statistical Analysis:** The obtained data were analysed using one-way ANOVA, Bonferroni test and paired t-test.

## **RESULTS**

Prior to sanitization, the total CFU in each group was very high which declined after disinfecting with the 3 different sanitization

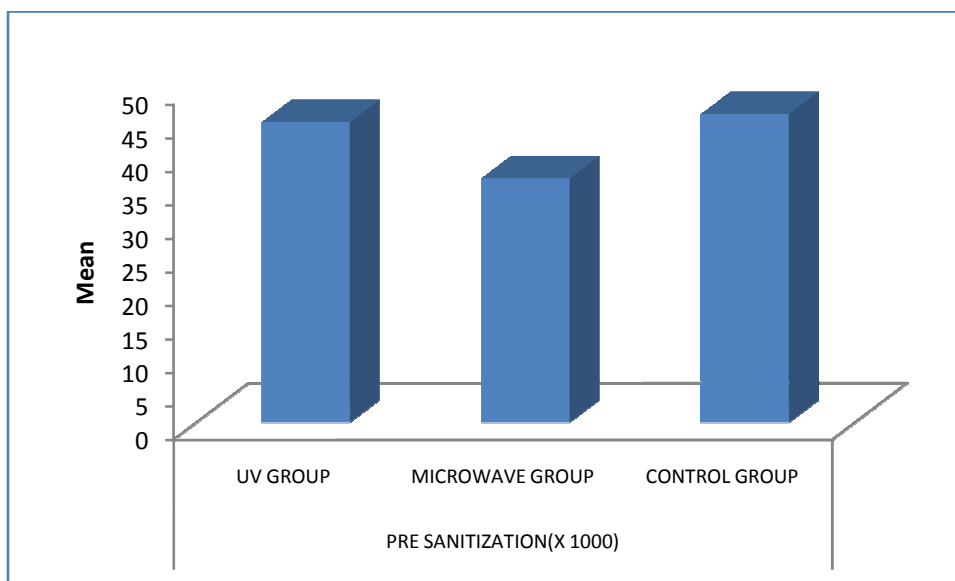
techniques. UV tooth brush sanitizer and microwave irradiation showed significant reduction in the bacterial count. There was again a significant difference among the UV group and the microwave group. Microwave irradiation was seen to be less effective than that of UV toothbrush holder. UV technique stood out to be the best method of sanitization of tooth brushes in comparison to that of normal saline and microwave .

It was found that there was a statistically significant drop of streptococcus mutans

count post sanitization with both UV tooth sanitizer as well as microwave. However normal saline did not prove to be a satisfying decontamination agent with insignificant reduction. Although microwave attributed to the decontamination, UV light holder proved to be the better method of disinfecting the toothbrushes with a statistically significant difference when compared to microwave irradiation.

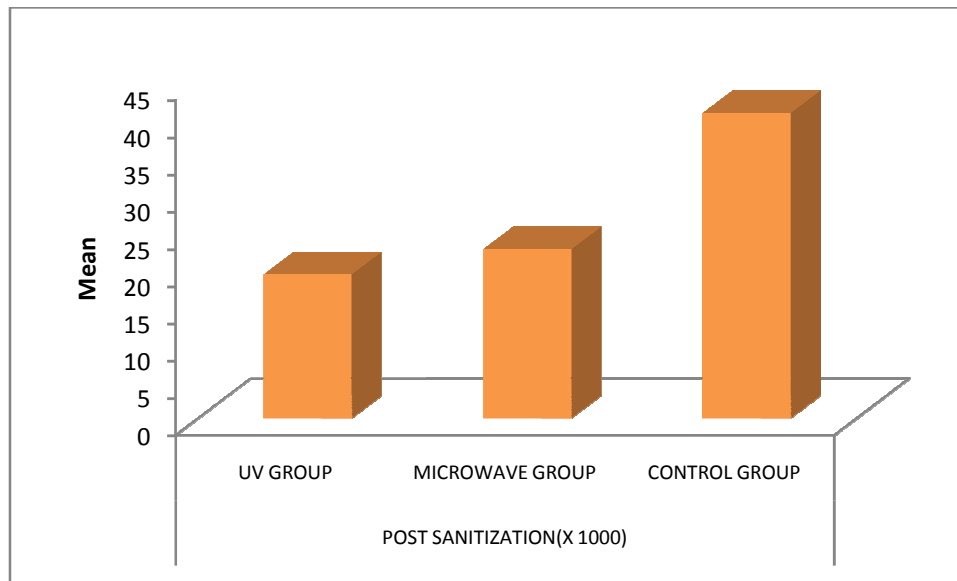
Pre Sanitization(X 1000)

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA F value	p value
				Lower Bound	Upper Bound		
UV GROUP	10	44.80	11.85	36.32	53.28	3.386	.055
MICROWAVE GROUP	10	36.40	7.69	30.90	41.90		NS
CONTROL GROUP	10	46.00	6.55	41.32	50.68		



Post Sanitization

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA F value	p value
				Lower Bound	Upper Bound		
UV GROUP	10	19.30	6.38	14.74	23.86	24.615	P<0.001
MICROWAVE GROUP	10	22.70	7.76	17.15	28.25		HS
CONTROL GROUP	10	41.00	8.07	35.23	46.77		



Comparison of Change (Pre To Post)

CHANGE(X1000)

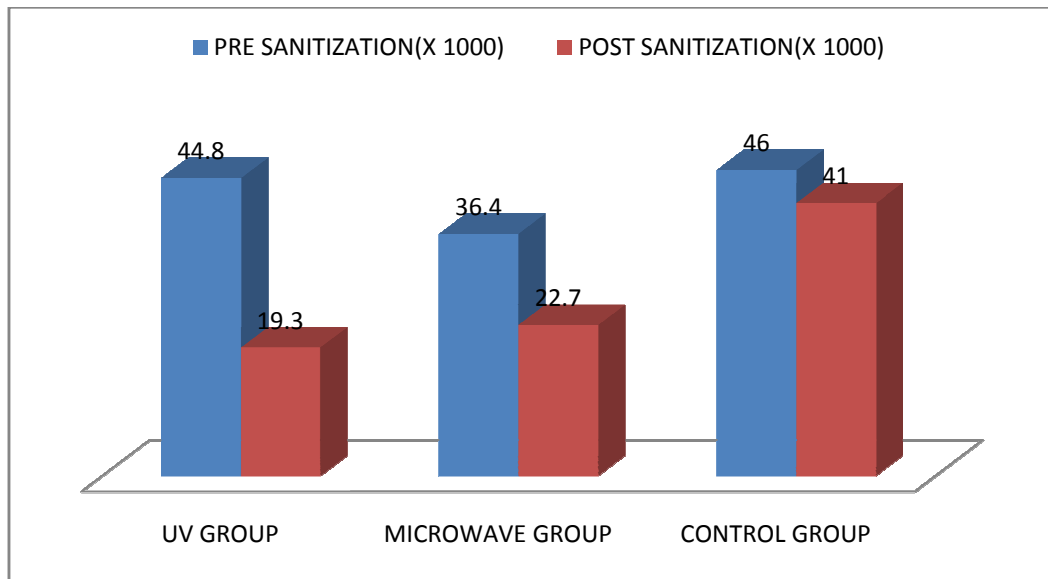
	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA F value	p value
				Lower Bound	Upper Bound		
UV GROUP	10	25.50	11.28	17.43	33.57	16.927	P<0.001
MICROWAVE GROUP	10	13.70	6.40	9.13	18.27		
CONTROL GROUP	10	5.00	4.42	1.84	8.16		

Multiple Comparisons

Bonferroni  
: CHANGE(X1000)

		Mean Difference	Std. Error	p	
UV GROUP	MICROWAVE GROUP	11.80000	3.53669	.007	HS
	CONTROL GROUP	20.50000	3.53669	p<0.001	HS
MICROWAVE GROUP	CONTROL GROUP	8.70000	3.53669	.046	sig

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		t value	p
					Lower Bound	Upper Bound		
UV GROUP	PRE SANITIZATION(X 1000)	10	44.80	11.85	36.32	53.28	7.15	p<0.001
	POST SANITIZATION(X 1000)	10	19.30	6.38	14.74	23.86		
MICROWAVE GROUP	PRE SANITIZATION(X 1000)	10	36.40	7.69	30.90	41.90	6.77	p<0.001
	POST SANITIZATION(X 1000)	10	22.70	7.76	17.15	28.25		
CONTROL GROUP	PRE SANITIZATION(X 1000)	10	46.00	6.55	41.32	50.68	3.58	.006
	POST SANITIZATION(X 1000)	10	41.00	8.07	35.23	46.77		



## DISCUSSION

Toothbrush is the most commonly used and most feasible means of aid for overall oral health of a person. But the contamination of the toothbrush has often been neglected. The existence of intra-oral translocation of bacteria was first examined by Edmund et al. in 1975. Svanberg found that toothbrushes can be heavily infected by mutans streptococci after 24hours.<sup>9</sup> Glass et al stated that microorganisms not only adhere to and reproduce on used toothbrushes but also have the ability to transmit organisms responsible for both local and systemic diseases. The bristles can harbour inherent microorganisms, further increasing the bacterial contamination.<sup>2</sup> Various methods have been implemented for the decontamination of toothbrushes over the years which includes chemical disinfectants like 0.12% chlorhexidine gluconate, 1% sodium hypochlorite, Virkon, Listerine, Cepacol; Toothbrush spray disinfectant like brushtox; Ultra violet toothbrush sanitizers; Microwave sanitization. According to Olmez et al, both chlorhexidine mouth wash and spray had the ability to disinfect the toothbrushes if maintained for 2 hours.<sup>7</sup> Devine et al had quoted that an ideal disinfectant agent should have characteristics like fast rate of action, affordability, non-toxic and ease of use.

The present study was mainly conducted to focus on the importance of disinfection of

decontamination of toothbrushes and also to compare the efficiency of uv toothbrush holder and microwave irradiation in toothbrush sanitization. With respect to the results of the current study normal saline had an insignificant decontamination effect even after storage of toothbrush in saline for 12hours which is in contrast to the results of Poonam et al where they have got a significant reduction in the mean number of colony-forming bacterial units.



Pursonic UV light toothbrush holder was used in the present study as one of the test group. It consisted of a sanitizer cabinet, UV tube, front cover for the UV chamber, hang brackets to hold in the toothbrushes and toothpaste. The device operates on 4 x 1.5V AA size batteries. The UV lamp lights for 5-8 minutes to sanitize and kill the germs and it automatically shuts

off after sanitization. It is believed that UV light inactivates microorganisms by damaging the DNA of the microorganisms by disrupting the chemical bonds. The potential of the technique can also vary based on the exposure time and the intensity of the UV light being used. Low intensity UV rays are not effective against all microbes.<sup>2</sup> Boylan et al have reported that a UV light toothbrush holder can effectively reduce an average of 86% total cultivatable bacteria on a toothbrush.<sup>11</sup> However studies have suggested that longer exposure to UV light can further lead to complete deactivation of microorganisms. The Group 2 sanitization technique used in this study is the microwave irradiation. A general explanation for this is the thermal effect of the microwave exposure on the microorganisms. Microwave exposure ruptures the cell membrane leading to leakage of nucleic acids and protein from cells. P. Behfarnia et al found that not only the microwave could not be effective in reducing bacterial growth such as candida, but also it increased its growth rate. The inconsistency can be due to the difference in power, frequency or the duration of irradiation of the device. They have also emphasized on the effect of frequency and modulation of microwave radiation on growth of candida.<sup>5</sup> In the present study we found significant reduction in streptococcus mutans level ( $p < 0.001$ ).

In this study, both UV light sanitizer as well as the microwave method have proved to be efficacious in reducing the streptococcus mutans load on the toothbrushes. On comparison, the decontamination effect by UV rays showed more promising results than the microwave exposure. Normal saline being statistically insignificant ( $p < 0.006$ ) is not highly recommended. Microwave being used as a domestic means can be more accessible to the population and can be recommended. But again it depends on the acceptability of the users. The study concludes that UV light toothbrush holder can be used as an effective decontamination technique as it is user

friendly, rapidly effective and non-toxic. However, its cost effectiveness has to be addressed before it is advised

## **CONCLUSION**

Both microwave and UV light holder can be used as decontamination agents since both the methods showed good efficiency in the reduction of streptococcus mutans. UV light is a better option for sanitizing the toothbrushes.

## **REFERENCES**

1. Ankola AV, Hebbal M, Eshwar S. How clean is the toothbrush that cleans your tooth? *Int J Dent Hyg* 2009;7(4):237-40.
2. Gujjari SK, Gujjari AK, Patel PV, Shubhashini PV. Comparative evaluation of ultraviolet and microwave sanitization techniques for toothbrush decontamination. *J Int Soc Prev Community Dent* 2011;1:20-6.
3. Tomar P, Hongal S, Saxena V, Jain M, Rana K, Ganavadiya R. Evaluating sanitization of toothbrushes using ultra violet rays and 0.2% chlorhexidine solution: A comparative clinical study. *J Basic Clin Pharm* 2015;6(1):12-8.
4. Beneduce C, Baxter KA, Bowman J, Haines M, Andreana S. Germicidal activity of antimicrobials and VIO light Personal Travel Toothbrush sanitizer: an in vitro study. *J Dent* 2010;38(8):621-25.
5. Behfarnia P, Talebi A, Sameti A, Nia AM. Evaluating the Disinfecting Effect of Microwave and 0.1% Sodium Hypochlorite on Contaminated Toothbrushes. *J Res Dent Sci* 2014;11(3):155-61.
6. Bhat S, Hegde KS, George RM. Microbial contamination of tooth brushes and their decontamination. *J Indian Soc Pedo Prev Dent* September 2003;21(3):108-11.
7. Aysegul O, Elgin IE, Gulcin A, Nedim S. The Efficacy of Chlorhexidine Spray vs Mouthwash in the Microbial Contamination of Child Toothbrushes. *J Dent Child (Chic)* 2007;74(3):177-81.
8. Belanger-Giguere K, Giguere S, Belanger M. Disinfection of toothbrushes contaminated with *Streptococcus mutans*. *Am J Dent* 2011;24(3):155-58.

9. Svanberg M. Contamination of toothpaste and toothbrush by streptococcus mutans. Scand J Dent Res 1978;86:412-4.
10. Glass RT. The infected toothbrush, the infected denture, and the transmission of disease: A review. Compendium 1992;13:592-4.
11. Boylan R, Li Y, Simeonova L, Sherwin G, Kreisman J, Craig RG, et al. Reduction in bacterial contamination of toothbrushes using the Violight ultraviolet light activated toothbrush sanitizer. Am J Dent 2008;21:313-7.

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