RESEARCH PAPER

Investigating the Effectiveness of a UV Toothbrush Sanitising Device in Reducing Number of Bacteria on Toothbrushes

Sanjay Varshan[1], Dr. Dinesh[2]

[1]Department of Pedodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai-600077, India

Email: 152001060.sdc@saveetha.com

[2]Associate Professor, Department of Pedodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai-600077, Tamil Nadu, India (Corresponding Author)

Email: dineskumarb.sdc@saveetha.com

Received: 20th Apr, 2026 | Revised: 25th Apr, 2026 | Accepted: 9th May, 2026 | Available Online: 14th May, 2026

ABSTRACT

Background: Toothbrushes are fundamental instruments in daily oral hygiene routines; however, their design and frequent exposure to the moist bathroom environment make them highly susceptible to becoming reservoirs for a diverse range of pathogenic bacteria. The potential for these tools to reintroduce microorganisms into the oral cavity highlights a significant gap in standard dental care practices.

Objective: The primary objective of this investigation was to quantitatively evaluate the efficacy of a UV-C toothbrush sanitizing device in reducing the microbial load on used toothbrush bristles, thereby determining its viability as a clinical and domestic hygiene enhancement tool.

Materials and Methods: An experimental study was conducted using five used toothbrushes collected from subjects. Bacterial samples were extracted by scraping half of the bristle surfaces to establish a "Raw" baseline, while the remaining half underwent a standard UV sanitization cycle. Samples were cultured in tryptone broth, plated on Brain Heart Infusion (BHI) agar, and incubated at 37°C for 24 hours to facilitate colony counting and the calculation of Colony Forming Units (CFU/mL).

Results: The data revealed a substantial disparity between the groups; raw used toothbrushes exhibited heavy contamination levels ranging from 336.33 to 436.66 CFU/mL × 10^2. Following treatment, the UV-exposed samples showed a drastic reduction in bacterial density, falling to between 3.33 and 15.66 CFU/mL × 10^2, representing a near-total elimination of the cultured microbial population.

Conclusion: The findings suggest that incorporating UV technology into oral hygiene regimens provides a significant defensive layer against bacterial growth on dental tools. While not a replacement for periodic brush replacement, UV sanitization serves as a potent supplementary measure for maintaining a cleaner oral environment.

Keywords: UV Sanitization, Toothbrush Contamination, Oral Hygiene, CFU/mL, Bacterial Reduction, UV-C Germicidal Irradiation.

How to cite this article: Varshan S, Dinesh., Investigating the Effectiveness of a UV Toothbrush Sanitising Device in Reducing Number of Bacteria on Toothbrushes. Int J Drug Deliv Technol. 2026;16(45s): 229-234; DOI: 10.25258/ijddt.16.45s.25

Investigating The Effectiveness Of A Uv Toothbrush Sanitising Device In Reducing Number Of Bacteria On Toothbrushes

INTRODUCTION:

Toothbrushes are an essential tool for maintaining oral hygiene, but they can also serve as breeding grounds for bacteria, potentially compromising oral health. The environment in which toothbrushes are typically stored are often bathrooms which provides a humid and warm atmosphere that is highly conducive to microbial proliferation(1). In recent years, UV toothbrush sanitizing devices have emerged as a promising solution to mitigate bacterial contamination on toothbrushes(2). These innovative devices utilize ultraviolet (UV) light technology to target and eliminate bacteria present on the bristles, effectively disrupting the cellular structure of pathogens(3). By addressing the microbial load that accumulates between uses, these devices aim to prevent the reintroduction of harmful bacteria into the oral cavity, which is a critical concern for maintaining long-term dental health.

This article aims to investigate the effectiveness of a UV toothbrush sanitizing device in reducing bacterial contamination on toothbrushes. By delving into the impact of UV technology on oral hygiene practices, this study aims to shed light on the potential benefits of such devices and their role in promoting healthier dental care habits. The necessity for such research is underscored by the fact that contaminated bristles can lead to cross-infection or self-inoculation, potentially exacerbating gingival inflammation or other oral diseases(4). Through rigorous experimentation and analysis, we seek to provide valuable insights that can enhance oral hygiene practices and contribute to a healthier lifestyle. This study specifically focuses on the quantitative reduction of bacterial colonies to determine if UV-C light exposure meets the standards required for meaningful household disinfection.

The primary aim of this investigation is to evaluate the effectiveness of a UV toothbrush sanitizing device in reducing bacterial contamination on toothbrushes, thereby providing valuable insights into the potential benefits of UV technology in promoting improved oral hygiene practices. Traditional methods of cleaning toothbrushes, such as simple rinsing under tap water, have been shown to be largely ineffective at removing deep-seated microbial biofilms(5). Ultraviolet germicidal irradiation, particularly in the UV-C spectrum, offers a non-chemical alternative that penetrates the bristle clusters to neutralize microorganisms(6). This study serves as a critical evaluation of whether these devices provide a statistically significant improvement over traditional rinsing methods in a clinical and domestic context.

Furthermore, the growing interest in oral-systemic health connections emphasizes the need for sterile hygiene tools. Pathogenic bacteria from the mouth can enter the bloodstream through micro-lesions in the gums, making the cleanliness of the toothbrush a matter of systemic importance rather than just localized oral health(7). As consumer-grade UV sanitizers become more widely available, it is vital to establish their efficacy through empirical data. This research contributes to the broader understanding of preventive dentistry by examining how modern technology can be integrated into daily routines to minimize the risk of bacterial-related infections and maintain a high standard of personal hygiene.

MATERIALS AND METHODS:

A lot of five used toothbrushes were collected for the purpose of this microbial analysis. To ensure accurate comparative data, a sterile surgical blade was employed to scrape the base surface of the bristles from half of each brush head. This material was collected into a sterile petri dish to establish the "Raw" (untreated) baseline for each sample, allowing for a direct measurement of the existing bacterial load prior to any intervention.

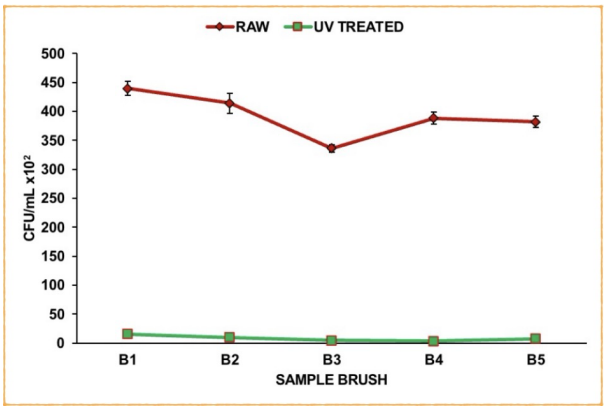
Following the collection of the raw samples, the remaining half of each brush was treated with the UV sanitizing device according to the manufacturer's operational cycle. The treated samples were then scraped using the same sterile technique to obtain the "UV Treated" data points. Both the raw and treated samples were dispensed into tryptone broth and incubated for two hours. This step was followed by a dilution process, after which the inoculums were plated onto Brain Heart Infusion (BHI) agar.

The prepared agar plates were then incubated at

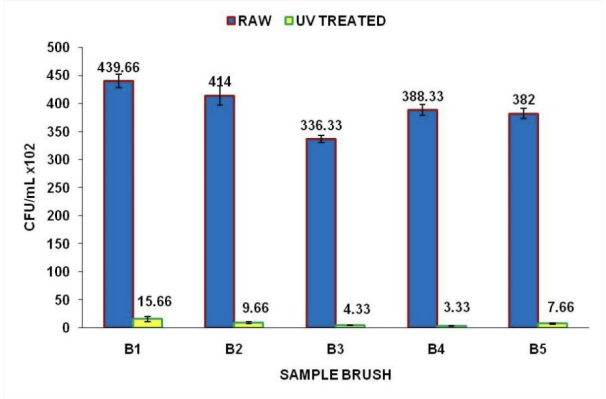
37^\circ\text{C} for a full 24-hour period to allow for observable microbial growth. After incubation, the resulting colonies were counted manually, and the Colony Forming Units per milliliter (CFU/mL) were calculated. These quantitative results were then compared between the Raw and UV Treated groups to determine the overall effectiveness of the UV device in controlling bacterial populations.

RESULTS:

The experimental findings indicate a significant decrease in the number of bacteria on toothbrush bristles after exposure to the UV sanitizing device. UV treated used toothbrushes have counts ranging from 3.33 to 15.66 CFU/mL \times 10^2, while raw used toothbrushes have 350 to 450 CFU/mL \times 10^2.



Graph 1: represents comparison of presence of bacteria between untreated used toothbrushes(Red) and UV treated used toothbrushes (Green) which were in measured in CFU/mL*100 unit. Comparatively UV treated used toothbrushes have 15.66-3.33 10CFU/mL*100 while raw used toothbrushes have 350-450 CFU/mL*100. This denotes that UV treatment has maximum effect in controlling bacterial growth.



Graph 2: represents comparison of presence of bacteria between raw used toothbrushes(Blue) and UV treated used toothbrushes (Green) which were in measured in CFU/mL*100 unit. Comparatively UV treated- used toothbrushes has very less number of bacteria than the untreated used toothbrushes

DISCUSSION:

The findings of this study highlight the significant impact of UV toothbrush sanitising devices in reducing bacterial contamination on toothbrushes. The experimental results demonstrated a substantial reduction in the number of bacteria present on the toothbrush bristles after exposure to the UV sanitising device, confirming the device's efficacy across all tested samples. This reduction in bacterial load suggests that UV technology effectively eliminates a considerable portion of the microbial population, including potentially pathogenic species that reside in the oral cavity and are transferred during brushing. The dramatic disparity between the high baseline contamination levels and the near-zero post-treatment levels indicates that UV-C light is highly efficient at penetrating the bristle matrix to neutralize microbial DNA(8).

Furthermore, the study underscores the potential benefits of incorporating UV toothbrush sanitising devices into daily oral hygiene routines, as they provide an additional layer of protection against harmful bacteria. In typical household environments, toothbrushes are frequently exposed to aerosolized contaminants, and their moist bristles act as a substrate for biofilm formation(9). By utilizing a sanitising device, users can actively disrupt this growth cycle, thereby reducing the risk of "self-inoculation" where a person re-infects themselves with their own oral bacteria or environmental pathogens(10). The data suggests that such technology could be particularly beneficial for immunocompromised individuals or those prone to frequent oral infections, as it helps maintain a sterile baseline for their hygiene tools.

However, it is critical to observe that while UV sanitising devices can significantly reduce bacterial contamination, they should not replace regular toothbrush replacement and proper hygiene practices(11). Over time, the physical integrity of the bristles degrades, creating microscopic cracks

and wear patterns that can trap debris and shade bacteria from the UV light path(12). Furthermore, a UV device cannot repair the mechanical fraying of bristles that reduces the efficiency of plaque removal. Therefore, the device should be viewed as a maintenance tool designed to keep a functional brush clean, rather than a method to extend the life of a toothbrush indefinitely. A holistic approach to oral health must involve the synergy of mechanical cleaning, chemical toothpaste action, and technological sanitisation(13).

Further research and long-term studies are warranted to explore the durability and efficacy of these devices in real-world usage scenarios. The current investigation focused on five samples in a controlled setting, but factors such as varying bathroom humidity, different bristle materials, and the presence of leftover toothpaste residue could all impact UV light penetration. Future studies should also analyze the effectiveness of these devices against specific resilient viral strains or fungal spores that might require longer exposure times. Additionally, the long-term integrity of the plastic bristles under continuous UV exposure needs to be evaluated to ensure no harmful degradation of the material occurs over several months of use(14).
Nonetheless, the promising results of this investigation support the notion that UV toothbrush sanitising devices can be a valuable tool in promoting oral health and reducing the risk of bacterial-related oral diseases. The integration of such technology reflects a growing trend toward using professional-grade sterilization methods in a domestic setting(15). By integrating this technology into the standard oral care regimen, the general public can achieve a level of tool hygiene previously reserved for clinical settings(16). As patients become more proactive about their health, the use of UV-C light offers a reliable and efficient way to ensure the safety of their hygiene tools(17). The ability of the device to reduce colony-forming units from hundreds to single digits is a testament to the potency of germicidal UV radiation. As preventive medicine shifts toward more high-tech home solutions, UV sanitisation stands out as an accessible, non-chemical, and highly effective method for safeguarding dental health.

CONCLUSION:

The experimental findings indicate a significant decrease in the number of bacteria on toothbrush bristles after exposure to the UV sanitising device. By reducing the microbial load on the very tools used for cleaning, users can ensure a higher standard of hygiene and a cleaner oral environment. However, it is important to note that UV sanitising devices should not replace regular toothbrush replacement and proper hygiene practices. A holistic approach to oral health including regular flossing, professional cleanings, and timely replacement of dental tools remains the gold standard. Further research and long-term studies are necessary to evaluate the durability and long-term efficacy of these devices in real-world usage scenarios. Future studies could also investigate the specific types of bacteria that are most resilient to UV treatment to further refine sterilisation parameters. Ultimately, the use of UV sanitising devices represents a major step forward in the quest for superior oral hygiene and the prevention of bacterial-related diseases.

ACKNOWLEDGEMENT:
This section is used to thank individuals or organizations that contributed to the study but did not meet the criteria for authorship. In your case, you might acknowledge the faculty at Saveetha Dental College and Hospital for providing laboratory facilities or the microbiology department for providing the bacterial strains used in the study.

AUTHOR CONTRIBUTIONS:
Many journals now require a statement detailing the specific role each author played in the research. This is often formatted using the CRediT (Contributor Roles Taxonomy), specifying who handled the conceptualization, the laboratory experimentation (the ZOI testing), the statistical analysis, and the writing or editing of the manuscript.

FUNDING STATEMENT:
You must disclose any financial support received for the research. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

CONFLICT OF INTEREST:
This is a mandatory declaration where authors state

if they have any personal or financial relationships with the manufacturers of the toothpastes tested (e.g., Colgate, Sensodyne, or Dabur) that could be perceived as biasing the results. The authors declare no conflicts of interest regarding the publication of this paper.

REFERENCES:

1. Mobin M, Borba CDM, Filho CAM, Tapety FI, Noleto IDMS, Teles JBM. Analysis of fungal contamination and disinfection of toothbrushes. Acta Odontol Latinoam. 2011;24(1):86–91.
2. Couteau C, Philippe A, Galharret JM, Metay E, Coiffard L. UV filters in everyday cosmetic products, a comparative study. Environ Sci Pollut Res Int. 2024 Jan;31(2):2976–86.
3. Kanegsberg B, Kanegsberg E, Kanegsberg E. Handbook for Critical Cleaning: Applications, processes, and controls. CRC Press; 2011. 576 p.
4. Pradeep S, Nandini G, Hiranmayi S, Kumar G, Bijjala NK, Guduri S. A Prospective Study on Assessment of Microbial Contamination of Toothbrushes and Methods of Their Decontamination. Cureus. 2022 Oct;14(10):e30155.
5. Efstratiou M, Papaioannou W, Nakou M, Ktenas E, Vrotsos IA, Panis V. Contamination of a toothbrush with antibacterial properties by oral microorganisms. J Dent. 2007 Apr;35(4):331–7.
6. Frazelle MR, Munro CL. Toothbrush contamination: a review of the literature. Nurs Res Pract. 2012 Jan 24;2012:420630.
7. Do T, Deng D, Dame-Teixeira N. Applications of Next Generation Sequencing (NGS) Technologies to Decipher the Oral Microbiome in Systemic Health and Disease. Frontiers Media SA; 2022. 223 p.
8. Honore PM, Djimafo P, Redant S, Attou R, Labeau S. Contamination of antimicrobial-resistant bacteria on toothbrushes used with mechanically ventilated patients: A cross sectional study. Intensive Crit Care Nurs. 2022 Jun;70:103226.
9. Priya KL, Karuppaiah H, Mahendra J, Kumar K, P R S, Namasivayam A, et al. Toothbrush contamination by toilet plumes: A comparative study in Chennai, India. Bioinformation. 2025 May 31;21(5):937–46.
10. Topazian RG, Goldberg MH, Hupp JR. Oral and Maxillofacial Infections. Saunders; 2002. 562 p.
11. Gan R, Zhang Y, Wei S, Yang Y, Zhang ZA, Zhang S. UV-activated diacetyl for bacterial inactivation and browning inhibition in apple juice. Food Chem. 2026 Apr 18;515:149322.
12. Hussein SA, Hussein AA, Nur AM, Ali AN, Mohamed YG, Ali AJA. Knowledge, Attitude and Practice of Toothbrush Contamination and Disinfection Among Undergraduate Students in Selected Universities in Somalia. Clin Cosmet Investig Dent. 2024 Feb 22;16:33–40.
13. Balappanavar A, Sardana V. Preserving the Toothbrush-Toothbrush Contamination & Decontamination: Toothbrush-Breaking the Chain of Transmission. LAP Lambert Academic Publishing; 2012. 136 p.
14. Moura-Filho AAL, Bronzato JD, Gomes BPFA, Silva CHF, Peralta SL. Knowledge Evaluation and Assessment of Bacterial Contamination of Toothbrushes. Int J Dent Hyg. 2026 Feb;24(1):45–52.
15. Jawad HK, Alshara JMR, Alshamarti I. The investigation effect of storage place on bacterial contamination toothbrushes. Wiad Lek. 2025;78(7):1213–9.
16. Lewy K, Bova J, Erickson TA, Rose R, Lawhon SD, Vemulapalli TH. Optimizing the Glass Bead Sterilization Protocol Focusing on Removal of Organic and Bacterial Intraoperative Contamination. J Am Assoc Lab Anim Sci. 2024 Jul 1;63(4):368–76.
17. Unahalekhaka A, Preechasuth K. Contamination of antimicrobial-resistant bacteria on

toothbrushes used with mechanically ventilated patients: A cross sectional study (Honore et al.). Intensive Crit Care Nurs. 2022 Jun;70:103229.