

Toothbrush bristles, a harbor of microbes and the risk of infection

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Abstract

Microbes survive in a wide variety of environments, including toothbrush bristles regardless where they are kept once they are unsterilized. Toothbrush bristles serve unintentionally a great source of favorable condition for the growth and survival of microorganisms. Conducting a literature review of previous studies, we explored the microbial contamination of toothbrush bristles occurrence, and the risks this poses for disease infections in susceptible individuals in this review article.

Keywords: Contamination, environment, microbial infection, oral cavity, susceptible individual, toothbrush bristles

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INTRODUCTION

Oral hygiene is undoubtedly an essential practice for healthy living. There has been some type of cleaning instrument to clean and preserve teeth; although, the exact origin of these teeth cleaning devices is unknown. The early devices used in cleaning the teeth include the twig brush, tooth stick, also known as the toothpick, and plantain stalk with charcoal.^[1] The historical forerunner of modern toothbrush could be the Babylonian fiber brush, called the “chew stick,” which was used as early as 3500 BC. It is a wooden stick cut to 5 or 6 inches in length with one-end macerated into bristle-like structures to about one-quarter of an inch.^[1] Modern toothbrushes are used by both developing and developed countries for oral hygiene; nevertheless, chewing stick remains common to people in most urban and rural areas of developing countries to clean the teeth.^[1,2] The toothbrush is studied to be the most efficient tool for

cleaning the teeth and tongue surfaces by removing oral biofilm and soft debris out of the mouth.^[3] Previous studies have identified toothbrush bristles as the predominant retention hub of microorganisms, therefore, posing a reason for greater risk of bacterial infection and associated diseases.^[4,5] Microbial contamination of toothbrush bristles occurs after the initial use and increase of microbial load with repeated use.^[6-9] The microbes that contaminate toothbrush bristles originate from oral cavities, hands, and moist environment.^[10]

This review seeks to evaluate and provide a comprehensive overview of microbial contamination of toothbrush bristles occurrence, and the risks this poses for disease infections in susceptible populations.

To extract relevant studies, systematic reviews of the peer-reviewed literature were conducted. The electronic

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databases utilized were PubMed Central and Google Scholar, to identify the published literature having the key search terms toothbrush, microbial infections, contamination, and other appropriate phrases relevant to the topic.

Microbes of pathogenic importance

Although there are insufficient studies on toothbrush bristles microbial contamination, the negative consequences of microbial contamination and growth on the toothbrushes bristles to the oral and systemic health have been established.^[4] Microorganisms that studies have found to be of pathogenic importance in contaminating toothbrush bristles include *Peptostreptococcus*, *Eubacterium* species, *Beta-hemolytic streptococci*, *Enterococci*, *Lactobacilli*, *Staphylococcus aureus*, *Serratia marcescens*, *Escherichia coli*, *Klebsiella* spp., *Enterobacter cloacae*, *Enterobacter aerogenes*, *Enterococcus faecalis*, *Candida albicans*, *Staphylococcus epidermidis*, and *Pseudomonas aeruginosa*.^[4,11] With high microbial loads, stomatitis, dental caries, gingivitis, and infective endocarditis are diseases affecting both oral and general health in susceptible hosts, including older and immunocompromised individuals.^[4,12]

Microbial contamination of toothbrush bristles and the infection risks

A cross-sectional study carried out at the Hamdard University, Karachi, aimed at isolating the bacterial contaminants on used manual toothbrushes and to compare the type of bacterial growth in capped and uncapped toothbrushes determined that a substantial number of toothbrushes (85.8%) were found to have bacterial contamination, out of a total of 106 participants.^[13] A significant correlation was observed ($P < 0.05$) between the presence of *Klebsiella* and *Pseudomonas* and uncapped toothbrushes, although other microbes, *Enterococcus*, *Micrococcus*, *E. coli*, *Bacillus*, and *Streptococcus*, were also isolated in both capped and uncapped toothbrushes.^[13] In another cross-sectional studies involving 34 dentistry students as participants, Merino-Alado *et al.*, isolated *C. albicans*, *Candida krusei*, *Candida dubliniensis*, and *Candida glabrata* from the new sterile toothbrush used by each of the participants for continuous 60-day period under a close survey evaluating their storage habits and the distance of the toothbrush from the toilet (in centimeters).^[14]

Lee *et al.* in their studies evaluated the bacterial contamination of charcoal bristles compared to the noncharcoal bristles in used toothbrushes of ninety participants. It was determined although not statistically significant, the mean colony-forming units count for noncharcoal bristles toothbrush was almost double that of charcoal bristles toothbrush after 1 week of use, although charcoal toothbrushes are claimed to have antimicrobial properties due to the charcoal in the bristles that results in less bacterial contamination.^[15,16]

An *in vivo* study aimed at evaluating the viability of *Streptococci mutans* on toothbrushes bristles, and the production of extracellular polysaccharide related to drying time revealed that *Mutans streptococci* remained viable on toothbrush bristles for 44 h.^[17] This study showed that, *S. mutans* found to be associated with used toothbrushes bristles, leave users at higher risk of acquiring various infections. Another study determined that, during orthodontic therapy with multi-bracket (MB) appliances, toothbrush bristles were contaminated more intensely with *S. mutans* regardless of the bristle design, and significantly higher on toothbrush bristles that were used by the MB-patients. This resulted in the high occurrence of caries and gingivitis in the MB-patients.^[18]

A previous study evaluating the incidence of reported cases of dental caries, and periodontal disease was done involving families of 102 participants attending the dental clinics. The study determined that toothbrushes, particularly its bristles used by most participants during 1 month and apparently exposed to the bathroom environment, were heavily contaminated with *Enterobacteriaceae* and *Pseudomonadaceae* species.^[19]

A recent study conducted involving 40 participants at the Faculty of Dentistry, Skopje, and data analyzed at the Institute for Microbiology and Parasitology, Faculty of Medicine in Skopje showed that, there was much bacterial load of *E. coli*, *Klebsiella* spp., *E. cloacae*, *S. marcescens*, and *P. aeruginosa*. This was determined after the first month of daily toothbrush use by the participants.^[4]

Factors influencing toothbrush bristles microbial contamination

Environmental conditions have been delineated the dominant factor in the growth of microbes on toothbrush bristles. The studies carried out at dental clinics hypothesized that environmental factors pertaining to a short distance from the toilet, the toothbrush storage conditions, and the bathroom humidity influenced the growth of the microbes on the toothbrush.^[19] Pesevska *et al.* studies also showed that 85% of the participants who stored toothbrushes in bathrooms with toilets had more pathogenic microbial contamination of the tooth bristles than the remaining 15% of participants who stored toothbrushes in bathrooms without toilets.^[4] A study conducted in the intensive care unit (ICU) of a University teaching hospital explored environmental factors, including location, the distance of the toothbrush to the bathroom and sink, toothbrush storage containers, contact with other articles, and moisture that possibly related to toothbrush contamination.^[20] It was established that potential pathogenic microbes, methicillin-resistant *S. aureus*, vancomycin-resistant *Enterococcus* spp., and *Acinetobacter* spp.

in the ICU contaminated the toothbrushes, increasing the risk of infection in the patients.^[20]

Although not many studies have been done evaluating the role of oral cavities in influencing microbial contamination of toothbrush bristles, there was an appreciable level of microbial contamination of toothbrush bristles after their usage in cleaning the teeth.^[20] The oral cavity has been reported to have the highest concentration of different microbial populations.^[21] Furthermore, the use of contaminated fingers in touching the toothbrush bristles before or after its usage plays a significant role in the microbial contamination of the toothbrush.^[4]

CONCLUSION

Oral hygiene recommendations such as more frequent, at least once a month, replacement of toothbrushes,^[4,18,19] storing of toothbrushes adequately to avoid bristles contact, and away from the toilet to minimize bacterial contamination, therefore, reducing the risk of microbial transmission and translocation have been suggested.^[19,20] However, there is a greater risk of microbial infection to susceptible individuals having toothbrush playing a crucial role.

This review article highlights the microbial contamination of toothbrush bristles occurrence, and further provides the conceptualization of infection risks that users of a toothbrush are prone to. Although the limited research studies establish the presence of pathogenic microbes, by isolating them from toothbrush bristles, further studies should be done on characterizing the microbes isolated from toothbrush bristles and the oral and systemic diseases, these microbes cause to extend our understanding of the severity of the microbial contamination of toothbrush bristles.

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Conflicts of interest

There are no conflicts of interest.

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