

# Effects of contaminated toothbrush in oral health

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## **ABSTRACT-**

*Microbes survive in a wide range of habitats, like toothbrush bristles regardless of where they are stored after being unsterilized. The most common technique for maintaining good oral hygiene is tooth brushing. By scraping plaque and other soft debris from the teeth, tooth brushes become contaminated with bacteria, blood, saliva and oral debris. Toothbrushes are a place for the transfer of microbes, retention and growth. There could be a source of infection with these infected toothbrushes. This article discusses the oral microbial flora and how the contaminated toothbrush affects oral hygiene.*

**KEYWORDS:** *Contaminated tooth brush, Microbial flora, Tooth brushing, Oral hygiene*

## **INTRODUCTION:**

Oral hygiene is a necessary practice for a healthy living<sup>1</sup>. Some kind of cleaning tool has been developed to clean and preserve teeth; but the exact origin of these teeth cleaning devices is unknown<sup>1</sup>. The early devices used in teeth cleaning include twig brush, tooth stick, also known as toothpick, and charcoal plantain stalk<sup>1</sup>. The toothbrush is analysed by scraping oral biofilm and soft debris from the mouth as the most efficient tool to clean teeth and tongue surfaces<sup>1</sup>. The human oral cavity consists of a number of different habitats, including teeth, gingival sulcus, tongue, hard and soft palate and tonsils, and it also acts as a tube connecting the external tract and digestive tract and respiratory tract of the human body, providing adequate space for colonisation of microorganisms<sup>2,3</sup>. The microbes residing in mouth is referred to as oral microflora or oral microbiome<sup>2,3</sup>.

Microbial contamination of toothbrush bristles occurs after initial usage and microbial load increases with repeated application<sup>1</sup>. The microbes that contaminate toothbrush bristles emerge from oral cavities, hands, and moist environments<sup>1</sup>.

## **ORAL CAVITY AS A MICROBIAL HABITAT:**

Saliva is continually bathed in the mouth, and this has a great impact on the mouth's ecology<sup>2</sup>. The average pH of saliva is pH 6.75-7.25, which speeds up the development of many microorganisms, and the ionic composition of saliva enhances its buffering properties and the capacity to remineralize enamel<sup>2</sup>. The major organic constituents of saliva are proteins and glycoproteins such as amylase, mucin, immunoglobulins (mainly sIgA), lysozyme, lactoferrin and sialo-peroxidase<sup>2</sup>. These impact the oral flora by<sup>2</sup>:

1. To create a conditioning film (the acquired pellicle) to which microorganisms can attach themselves, adsorbing oral surfaces, especially teeth<sup>2</sup>.
2. Serving as the main source of nutrients (carbohydrates and proteins) that increase the development without causing a detrimental decrease in pH of the resident microflora<sup>2</sup>.
3. Directly binds to the bacterial surface to cover the antigens of bacteria, attempting to make the organism show up more host-like<sup>2</sup>.
4. Collating microorganisms and thus facilitating their mouth clearance by swallowing; saliva stream may also wash away cells that are weakly adherent to it<sup>2</sup>.

5. Retarding, through their function as components of host defence, the attachment and growth of certain exogenous microorganisms<sup>2</sup>.

Ecological problems inside the oral cavity will also affect the emergence and tooth loss, the placement of prostheses and dental hygiene such as scaling, polishing and restoration<sup>2</sup>. Transient variability in oral ecosystem can be due to the rate and shape of food consumed, the duration of antibiotic treatment, and changes in saliva content and flow rate<sup>2</sup>.

### PRINCIPAL MICROBES SEEN IN ORAL CAVITY OF HEALTHY INDIVIDUALS<sup>2</sup>:

#### GRAM POSITIVE COCCI AND RODS<sup>2</sup>:

COCCI:	RODS:
<ul style="list-style-type: none"> <li>Streptococcus (<i>Streptococcus mutans</i>, <i>Streptococcus sanguis</i>, <i>Streptococcus mitis</i>)</li> <li>Stomatococcus</li> <li>Peptostreptococcus</li> <li>Abiotrophia</li> </ul>	<ul style="list-style-type: none"> <li>Corynebacterium</li> <li>Lactobacillus</li> <li>Actinomyces (<i>Actinomyces bifidus</i>, <i>Actinomyces israeli</i>, <i>Actinomyces naeslundii</i>, <i>Actinomyces odontolyticus</i>)</li> <li>Propionibacterium</li> <li>Eubacterium</li> <li>Pseudoramibacter</li> </ul>

#### GRAM NEGATIVE COCCI AND RODS<sup>2</sup>:

COCCI:	RODS:
<ul style="list-style-type: none"> <li>Neisseria</li> <li>Moraxella</li> <li>Veillonella (<i>V. alcalescens</i>, <i>V. parvula</i>)</li> </ul>	<ul style="list-style-type: none"> <li>Campylobacter</li> <li>Capnocytophaga</li> <li>Fusobacterium</li> <li>Haemophilus</li> <li>Leptotrichia</li> <li>Prevotella</li> <li>Selenomonas</li> <li>Treponema (<i>T. denticola</i>, <i>T. oralis</i>, <i>T. macrodentium</i>)</li> </ul>

#### SITE AND PREDOMINANT MICROBIAL GROUPS<sup>2</sup>:

SITE:	MICROBIAL GROUPS:
Cheeks, Palate, Lips	Streptococci, Veillonella, Neisseria
Tongue	Actinomyces, Streptococci, Veillonella, Obligate anaerobes, Simonsiella
Teeth	Actinomyces, Eubacterium, Haemophilus, Streptococci, Veillonella.

#### DEVELOPMENT OF RESIDENT MICROBIAL FLORA<sup>2</sup>:

- New born** contains only epithelial cells for colonization<sup>2</sup>.
- 3<sup>rd</sup> days of life** *S.oralis*, *S.mitis*, *S.salivarius* appear<sup>2</sup>.
- 7 months of life** - *Prevotella melaninogenica* was the most frequently isolated anaerobe, being recovered from 76% of infants. Other commonly isolated bacteria were *Fusobacterium nucleatum*, *Veillonella* spp., and non-pigmented *Prevotella* spp, *Capnocytophaga* spp., *P. loescheii*, *P. intermedia*, *E. corrodens* and *Wolinella* are also seen<sup>2</sup>.
- During the **first year of life** - members of the genera *Neisseria*, *Veillonella*, *Actinomyces*, *Lactobacillus*, and *Rothia* are commonly isolated, especially after tooth eruption<sup>2</sup>.

- Any bacteria can be optimally acquired only at certain ages. Studies of the transmission of mutans streptococci to children at 19-31 months have established a clear 'infectivity window'. This creates the possibility during this crucial time of targeting preventive interventions to minimise the risk of infant colonization<sup>2</sup>. Indeed, reducing the carriage of streptococci mutans in mothers will reduce the transfer of these potentially cariogenic bacteria to their offspring and postpone the onset of caries<sup>2</sup>.
- *S. streptococci mutans* and *S. Sanguis* only occur in the mouth after a tooth eruption or when artificial devices such as acrylic obturators are placed in children with cleft palates<sup>2</sup>.

#### **MICROBES SEEN IN CONTAMINATED TOOTH BRUSH:**

Microorganisms that studies have found to be of pathogenic importance in contaminating toothbrush bristles include *Peptostreptococcus*, *Eubacterium* species, *Betahemolytic streptococci*, *Enterococci*, *Lactobacilli*, *Staphylococcus aureus*, *Serratia marcescens*, *Escherichia coli*, *Klebsiella* spp., *Enterobacter cloacae*, *Enterobacter aerogenes*, *Enterococcus faecalis*, *Candida albicans*, *Staphylococcus epidermidis*, and *Pseudomonas aeruginosa*<sup>3</sup>.

#### **FACTORS INFLUENCING MICROBIAL CONTAMINATION IN TOOTH BRUSH BRISTLES:**

- The dominant factor in the growth of microbes on toothbrush bristles has been delineated by the environmental conditions<sup>1</sup>. For eg: Short distance from the toilet, humidity in the bathroom influenced the development of microbes on the toothbrush and sink, toothbrush storage containers, interaction with other items, and moisture that may be related to toothbrush contamination<sup>1</sup>.
- If the tooth brush is apparently exposed to the bathroom environment, were heavily infected with *Enterobacteriaceae* and *Pseudomonadaceae* species<sup>1</sup>.
- It was established that potential pathogenic microbes, methicillin-resistant *S. aureus*, vancomycin-resistant *Enterococcus* spp., and *Acinetobacter* spp, tends to increase the risk of infection in the patients admitted in ICU<sup>1</sup>.
- It has been documented that the oral cavity has the highest concentration of various microbial communities. In addition, the use of contaminated fingertips to touch the toothbrush bristles before or after their use plays an important role in toothbrush microbial contamination<sup>1</sup>.

#### **CONTAMINATION OF MICROBES IN TOOTHBRUSH BRISTLES AND RISK OF INFECTION:**

Few studies have shown that there has been a substantial association between the existence of *Klebsiella* and *Pseudomonas* and uncapped toothbrushes, while *Enterococcus*, *Micrococcus*, *E. coli*, *Bacillus*, *Streptococcus* were also isolated in capped and uncapped toothbrushes<sup>1</sup>. Another research revealed that isolated *Candida Albicans*, *Candida krusei*, *Candida dubliniensis* and *Candida glabrata* from the newest sterile toothbrush used over 2 months under a close survey evaluating their storage habits and toothbrush distance from the toilet<sup>1</sup>. In vivo study shows that *S. mutans* were found to be associated with bristles of used toothbrushes, leaving users at higher risk of acquiring various infections<sup>1</sup>. Another study showed that during multi-bracket (MB) orthodontic therapy, toothbrush bristles were more intensively infected with *S. mutans*, irrespective of the nature of the bristle, and substantially higher on toothbrush bristles used by MB patients<sup>1</sup>. This resulted in the high incidence of caries and gingivitis in MB-patients<sup>1</sup>. Dysbacteriosis can be caused by the prolonged use of mouthwash, antibacterial toothpaste, and throat tablets and may also adversely affect oral health<sup>4</sup>. As we know, *Streptococcus* and *Prevotella* are effective oral disease- stimulating pathogens, so the residual substances in toothbrushes can help prevent their growth because there are more antimicrobial compounds in toothbrushes than in the oral cavity, due to the increased fluidity of the oral cavity<sup>4</sup>. As a means of microbial transport, retention and growth, contaminated toothbrush has been described<sup>5</sup>. It may be the cause of reinfection of a person with pathogenic bacteria, or it may be the source of environmental microorganisms<sup>5</sup>. Oral cavity reinfection is likely to occur due to injuries to the gingiva that may occur during tooth brushing. By brushing with a dirty brush, new microorganisms are introduced while drastically reducing the present natural flora<sup>5</sup>. The area of the tooth-brush where the tufts are connected is particularly vulnerable to severe contamination<sup>5</sup>. Fluids and food debris can be brought into the gaps between tufts by capillary action; this can result in bacterial growth<sup>5</sup>. When the toothbrush is trimmed, there is an irregularly shaped lumen at the bristle end<sup>5</sup>. In this core, fluids may be drawn by capillary action, allowing the growth of bacteria<sup>5</sup>. Even the bristles

break longitudinally, raising the bacterial contamination<sup>5</sup>. Within 24 hours of use, tooth brushes can be highly contaminated with microorganisms, particularly *S. mutans*<sup>5</sup>.

Streptococci emerge from the plaque found in the bristles of the tooth brush. *S. Mutans* are usually observed in oral cavities and, because of their exceptional acid and acidic properties and their capacity to bind and aggregate in large numbers in the presence of sucrose on tooth surfaces, are the most common etiological agent in the formation of dental caries<sup>5</sup>. The combination of plaque and acid leads to dental decay. Dental caries is triggered to initiate *S. Mutans* is the most frequent bacterial species found in extirpated cardiac valve tissues and atheromatous plaques and are also involved in the pathophysiology of certain cardiovascular diseases<sup>5</sup>. *S. Mitis* is a widely seen commensal organism in the oral cavity. Usually, *S.mitis* is mainly a causative organism in odontogenic infection and endocarditis and has been identified in some cases as respiratory pathogens<sup>5</sup>.

*S. Salivarius* is the main oral cavity commensal bacterium in humans. While performing dental procedures or during brushing, it can reach the blood stream by accident<sup>5</sup>. It is a bacterium that took the role of moderator, enabling the insertion of bacteria harmful to the health of the oral cavity<sup>5</sup>. In addition, it is found that when this bacterium reaches the bloodstream, it can cause septicemia in neutropenic patients<sup>5</sup>. Some studies showed that toothbrush are highly contaminated with normal use and nearly 70% of the tooth brushes became highly contaminated with pathogenic micro-organism after use<sup>6</sup>. The oral cavity is the area with the largest number of different microbial communities (more than 700 species of bacteria, 400 of which are present in periodontal pockets); *Staphylococcus* sp., *Streptococcus* sp., *Neisseria* sp., *Bacteroides* sp., *Actinomyces* sp., *Treponema* sp., *Mycoplasma* sp can colonise particularly. These microorganisms can stay in toothbrush bristles and include organisms that are not normally associated with oral flora, such as the family *Enterobacteriaceae*<sup>7</sup>. *Staphylococcus aureus* refers to the oral microflora (found in 5% of the toothbrushes examined), due to the risk of causing not only a variety of oral diseases, and also opportunistic infections<sup>7</sup>, further attention should be given<sup>7</sup>. Despite a minimal reduction in their number, *Staphylococcus aureus* and *Escherichia coli* will stay active for 6 days, while *Pseudomonas aeruginosa* and *Klebsiella* can stay for 72 hours, but 6 days after the use of the toothbrush they were not isolated<sup>7</sup>. *Peptostreptococcus*, *Eubacterium* species, beta-hemolytic streptococci, staphylococci, enterococci, pseudomonads and other enteric species are the microorganisms with possible periodontal pathogenic significance<sup>7</sup>. The microbiological finding shows the superiority of the *Enterobacteriaceae* family members (*Serratia* spp, *E. coli*, *Klebsiella* spp, *Enterobacter cloacae*, *Enterobacter aerogenes*) and *Enterobacter aerogenes*. Superinfectious organisms, such as multiple drug-resistant species of *Enterococcus faecalis* and enteric gram-negative species, pseudomonads and *Candida albicans*, may also colonise periodontal areas, particularly in patients with immunocompromised and geriatric patients, and in patients with previously prolonged or excessive antibiotic therapy<sup>7</sup>. The source of faecal bacteria and microbes transmitted by aerosols in the air is toothbrushes stored in wet environments, such as bathrooms and exposed toilets<sup>8</sup>. Since people traumatise very much with their toothbrush, their trauma could become a possible entry for organisms in the portal<sup>8</sup>. It is also clear that it is important to re-evaluate current toothbrushes that were fundamentally designed years ago<sup>8</sup>.

#### PREVENTION:

1. Chlorhexidine is a chemical antiseptic for both gram positive and gram-negative bacteria possessing bacteriostatic and bactericidal properties<sup>5</sup>. It destroys the micro-organisms cytoplasmic membrane and disrupts the integrity of the cell membrane, causing cytoplasmic protein and nucleic acid to leak and precipitate, killing micro-organisms<sup>5</sup>. It has been discovered that overnight soaking of a toothbrush in chlorhexidine gluconate is good at preventing microbial contamination<sup>5</sup>.
2. An efficient disinfectant has been reported to be sodium hypochlorite<sup>5</sup>.
3. The effective chemicals for tooth brush disinfection are 0.12 % chlorhexidine gluconate and 1% sodium hypochlorite<sup>5</sup>.

#### RECOMMENDATIONS FOR TOOTHBRUSH CARE:

- To avoid cross-infection, do not share toothbrushes<sup>8</sup>.
- Don't cover the toothbrushes. This contributes to moisture preservation and prevents toothbrushes from drying, allowing microorganisms to shape a so-called self-contained ecosystem<sup>8</sup>.

- To avoid moisture, the brushes should never be kept in damp conditions such as the bathrooms, toilets<sup>8</sup>.
- Translucent bristles can be preferred to coloured bristles because they have a 50 % lower bacterial count than coloured bristles<sup>8</sup>.
- To remove any residual residue and toothpaste, clean the toothbrush with tap water after brushing<sup>8</sup>.
- Replace tooth brushes every 2–3 months. This could reduce the number of bacteria that patients are exposed to<sup>8</sup>.
- Rinsing with antibacterial mouth rinse before brushing will prevent or reduce the growth of bacteria<sup>8</sup>.
- Use disposable toothbrushes. Price can be a bigger problem for long-term usage. After usage, soaking the toothbrush in an antibacterial mouth rinse will minimise microbial growth on toothbrushes<sup>8</sup>.
- There are many commercially available toothbrush sanitizers (Germ Terminator, Purebrush and Essensia) and brush sprays (Brushtox) on the market, claiming to have a complete atmosphere without germs<sup>8</sup>.

### CONCLUSION:

There seems to be little public knowledge that the use of a tooth brush could be tainted, considering the millions of tooth brushes sold worldwide. Millions of microorganisms, which may have been the root cause of many unexplained diseases, live on a dirty toothbrush. Finally, we want to stress that cleaning the oral cavity with a dirty toothbrush will do more harm than good. It is therefore necessary for any human to disinfect his or her brush at regular intervals, thus avoiding re - infection and helping to maintain good oral hygiene and general well-being.

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