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Short Communication

Toothbrushes as fomites

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The role of toothbrushes in the cleanliness of the oral cavity cannot be overemphasized, but its importance as fomites in our homes cannot also be underestimated. This research was aimed at determining the probable role of toothbrush as fomite and quantifies the level of bacteria associated. A total of twenty toothbrushes of the same brand and type used by different individuals were collected and processed using standard microbiological techniques. Results from this study, revealed that none of the toothbrushes were found to be bacteria free. The isolated bacterial flora of toothbrushes were *Escherichia coli* and *Enterococcus* species 2 (10%), *Staphylococcus aureus* and *Staphylococcus saprophyticus* 4 (20%), and *Pseudomonas aeruginosa* 8 (40%). In all, twenty strains of bacteria belonging to five different species were recovered from the toothbrushes. It was concluded, that toothbrushes can serve as fomites in various homes especially, if proper care and use of this device is not implemented.

Key words: Toothbrushes, fomites, bacteria, oral cavity.

INTRODUCTION

Toothbrushes play an essential role in oral hygiene (Sogi et al., 2002; Frazelle and Munro, 2012) and are generally found in community and hospital settings (Frazelle and Munro, 2012). However, there are evidences to support the fact that toothbrushes in regular use can become heavily contaminated with microorganisms (Kozai et al., 1989; Malmberg et al., 1994; Veran et al., 1996). Contamination is the retention and survival of infectious organisms that occur on animate or inanimate objects (Frazelle and Munro, 2012).

Toothbrushes have been shown to be contaminated at the oral cavity environment and from hands, aerosol and even from the storage environments (Scott et al., 1982; Taji and Rogers, 1998; Munro, 2012). Glass (1992) suggested that contaminated toothbrushes may play a role in both systemic and localized diseases. The possibility of these devices being associated with transmission of severe health problems such as heart disease, arthritis, bacteremia and stroke have also been well documented (Warren et al., 2001; Sammons et al., 2004).

In view of these reports, this research was conducted to assess the level of bacterial contamination of toothbrushes used in various homes, its possible role in disease transmission and ways of circumventing such contaminations.

MATERIALS AND METHODS

Samples collection

Prior to the time of this research, twenty students from the Department of Microbiology, Olabisi Onabanjo University, were recruited and requested to follow their normal oral hygiene practices for a four week period, after giving them a new toothbrush of the same brand and type plus a mini bag for keeping their brushes. The selection of these students was based on the fact that after examination, they were found to be free of any open carious lesions, periodontal disease and mucosal abnormalities. Each of the participants was also preinformed to brush their teeth twice per day. When the time elapsed, the toothbrushes were collected in

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Table 1. Distribution of bacteria on toothbrushes.

Toothbrush	Organisms				
	PA	SA	SS	EC	ES
1	+	-	-	-	-
2	-	+	-	-	-
3	-	-	+	-	-
4	+	-	-	-	-
5	-	+	-	-	-
6	-	-	+	-	-
7	+	-	-	-	-
8	-	+	-	-	-
9	-	+	-	-	-
10	-	-	+	-	-
11	+	-	-	-	-
12	+	-	-	-	-
13	-	-	+	-	-
14	+	-	-	-	-
15	+	-	-	-	-
16	-	-	-	+	-
17	-	-	-	-	+
18	+	-	-	-	-
19	-	-	-	-	+
20	-	-	-	+	-
N	8	4	4	2	2

+/-: Presence/Absence; PA: *Pseudomonas aeruginosa*; SA: *Staphylococcus aureus*; SS: *Staphylococcus saprophyticus*; EC: *Escherichia coli*; ES: *Enterococcus species*; N: Number of occurrence of each organism on toothbrushes.

different sterile paper bag and processed within 18 h of the last use.

Processing and microbiological analyses

Each toothbrush was decapitated and the head transferred aseptically into a tube containing 10 ml of sterile 0.1% Nutrient broth (NB). The contents were allowed to stay for at least 30 min before being vortexed for 60 s at low speed. Ten fold serial dilutions in 0.1% Nutrient broth were then prepared and 0.1 ml of appropriate dilutions were spread plated onto Nutrient and MacConkey Agar and incubated aerobically for 24 h. Representative colonies from appropriate plates were Gram stained and further characterized as described earlier (Cheesborough, 2005).

RESULTS

Table 1 depicts the occurrence of the isolated bacteria on toothbrushes. Out of the twenty toothbrushes used for this study, none was found to be bacteria free.

Pseudomonas aeruginosa was found on eight of the twenty toothbrushes, *Staphylococcus aureus* and *Staphylococcus saprophyticus* were found on four, while both *Escherichia coli* and *Enterococcus* species were found on two. In all, a total of twenty strains of bacteria belonging to five different species were isolated from the twenty toothbrushes investigated (Table 2).

Table 2. Prevalence of bacteria on toothbrushes.

Organism	n	%
Pseudomonas aeruginosa	8	40
Staphylococcus aureus	4	20
Staphylococcus saprophyticus	4	20
Escherichia coli	2	10
Enterococcus species	2	10
Total (N)	20	100

DISCUSSION

Toothbrushes investigated were found to be extensively contaminated with variety of microorganisms (Verran et al., 1996; Taji and Rogers, 1998; Contreras et al., 2010). Heavy bacterial contamination of the toothbrushes may represent a risk factor to inducing transistory bacteremia (Sconyers et al., 1973; Svanberg, 1978) especially in children, immunosuppressed patients, pregnant women and elderly people (Contreras et al., 2010). The occurrence of *P. aeruginosa* as the most prevalent in this study is not surprising, as this organism has previously been reported by other workers (Taji and Rogers, 1998; Contreras et al., 2010). This organism and *Staphylococci* species ability to survive on toothbrushes may not be unconnected to their biofilm producing potential (Aguilar et al., 2001). This characteristic makes them to easily adhere to surfaces including prosthetic devices. The presence of biofilm on organism may be a significant virulence factor for some strains of *staphylococc*i (Mack et al., 2000), as it gives them ability to inhibit chemotaxis, phagocytosis, phagocyte oxidative response and amytogen lymphocyte proliferation (Arciola et al., 1991). The excretion of this glycocalyx cover by some strains of organisms helps them resist humoral and cell mediated immunological response, as well as antibiotics (Suhelja and Seza, 2006).

E. coli on toothbrushes is an indication that contamination is not from the sub gingival niche (Contreras et al., 2010). This is because, its presence does not correlate with data from the sub gingival colonization. Also, it can be hypothesized that a relatively short distance from the toilet, that is, toothbrushes storage conditions and bathroom humidity may be the probable source of this organism (Barker and Bloomfield, 2000; Kagan et al., 2002). *Enterococci* spp. which was also isolated from toothbrushes in this study, has been reported as the most frequent causes of nosocomial infections, particularly in intensive care units. These organisms are transmitted from one patient to another primarily on the hands of

hospital personnel, some of which may carry this organism in their gastrointestinal tract (Brooks et al., 2007). According to them, these organisms may cause endocarditis, meningitis and bacteremia. The fact that, none of the toothbrushes harbour *Lactobacillus* species, *Streptococcus mutans* and *Actinomyces odontolyticus* stressed that toothbrush is not the source of these important dental caries agents. In conclusion, the results have shown that toothbrushes may serve as fomites in our home, thereby allowing for systemic infection. It is therefore, very imperative, that appropriate care of the toothbrushes must be taken in order to avoid it serving as a vehicle for the transmission of infection.

One species of microbe was extracted from the toothbrushes in the study due to the storage environment of each of the toothbrushes. Also, bacterial isolates from each of the toothbrushes represents those isolate that were capable of surviving under the storage environmental condition.

The intention of this paper is to create awareness on the possible role of toothbrushes serving as fomite in our homes.

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