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Efficacy of Various Disinfectants on Bacterial and Fungal Contamination of Clamping Tweezers

R. A. M. Hamzah* and Hayder F. Saloom

College of Dentistry, University of Baghdad, Baghdad, Iraq

**Corresponding e-mail: ang_jol2000@yahoo.com*

ABSTRACT

Background: *Orthodontics is outstanding among the medical branches with a higher number of predisposing factors for cross-infection. Awareness of efficient sterilization techniques is considered to be a very important subject.* ***Aim:*** *To investigate the efficacy of various disinfection methods on orthodontic clamping tweezers contaminated with bacteria and Candida albicans.* ***Materials and method:*** *Staphylococci, Streptococci and Candida albicans cultivated from the sample of the whole saliva were taken from one patient after 3 months of braces placement. The broth was prepared of Streptococcus and Staphylococcus, and Candida albicans to obtain 10^6-10^7 CFU/ml. The peaks of 25 clamping tweezers were cut to get 50 pieces; the ends of these pieces were polished. Total 25 pieces of clamping tweezer peaks were divided into 5 groups with 5 pieces in each tube exposed to the broth of Streptococcus and Staphylococcus mixture for 5 minutes. The other 25 clamping tweezers pieces were also divided in the same manner and exposed to the broth of Candida albicans for 5 minutes. The 25 pieces of each group were subdivided into 5 groups, 4 of which were disinfected with Saniswiss biosanitizer I, desident cavicide, glutaraldehyde 2%, peracetic acid 0.25%, and the 5^{th} group was autoclaved.* ***Result:*** *All the disinfection methods used showed no growth of staphylococci and streptococci. However, when the tweezers were contaminated with Candida albicans, disinfection with desident cavicide solution showed growth of candida on Sabouraud's agar while the use of an autoclave, glutaraldehyde 2%, peracetic acid 0.25% and biosanitizer I, recorded no growth on Sabouraud's agar.* ***Conclusion:*** *Autoclave, peracetic acid, glutaraldehyde and biosanitizer I can be used to effectively eliminate Streptococcus, Staphylococcus and Candida albicans.*

Keywords: *Staphylococci, Streptococci, Candida albicans,* Clamping tweezers

INTRODUCTION

Fighting infections in dental offices have been a great challenge to dentists and researchers. Most of the time, germs have been able to compromise safety measures, thereby exposing professionals and patients to risk. On the other hand, lack of care by some professionals with regard to safety has favored the intensification of the infection. Of dental specialties, orthodontics is outstanding among those with a higher number of predisposing factors for cross-infection [1]. The concern about the transmission of infectious-contagious disease between the dental patients, orthodontists, dental plaque and dental office personnel, dental office and dental laboratory has brought the importance of the control of cross infection back into the limelight. Orthodontics is at an ever greater risk to exposure of serious pathogens and must take adequate precaution to guard themselves against their transfer [2].

Humans are colonized by diverse populations of bacteria and fungi when in a healthy state and in the setting of disease. Among the microbial population *Streptococcus, Staphylococcus* and *Candida albicans* are most commonly detected in association with humans [3].

Streptococcus is a genus of coccus Gram-positive bacteria, they grow in chains or pairs, most are oxidase-negative and catalase-negative, and many are facultative anaerobes commonly found in the human oral cavity and are a significant contributor to tooth decay. Oral streptococci have both harmless and harmful bacteria. However, under special conditions, commensal streptococci can become opportunistic pathogens, initiating disease and damaging the host. Imbalances in the microbial biota can initiate oral diseases [4]. *Staphylococcus* is a genus of Gram-positive bacteria which appear round (cocci), and form grape-like clusters. *Staphylococcus* genus includes at least 40 species.

Most are harmless and reside normally on the skin and mucous membranes of the humans and other organisms. Found worldwide, they are a small component of soil microbial flora [5].

Candida albicans is opportunistic pathogenic yeast that is a common member of the human gut flora. It does not proliferate outside the human body. It is detected in the gastrointestinal tract and mouth in 40%-60% of the healthy adults. It is usually a commensal organism, but it can become pathogenic in immunocompromised individuals under a variety of conditions. *C. albicans* is the most common fungal species isolated from biofilms. *C. albicans* is easily cultured in the lab and can be studied both *in vivo* and *in vitro.* Depending on the media different studies can be done as the media influences the morphological state of *C. albicans* [6].

PATIENTS AND METHODS

Unstimulated whole saliva was taken from one patient with good oral hygiene after 3 months of braces placement. Staphylococci, streptococci, and *Candida albicans* were cultivated from the sample to prepare a broth to obtain 10^6-10^7 CFU/ml of *Streptococcus* and *Staphylococcus* and *Candida albicans*.

The peaks of 25 clamping tweezers from Ortho Technology Company (United State of America) were cut manually to get 50 pieces; the ends of these pieces were polished by polishing wheels. Total 25 pieces of clamping tweezer peaks were divided into 5 groups with 5 pieces in each tube exposed to broth prepared to obtain 10^6-10^7 CFU/ml of *Streptococcus* and *Staphylococcus* mixture for 5 minutes. The other 25 pieces of clamping tweezers were also divided in the same manner and were exposed to the broth of *Candida albicans* for 5 minutes. Each group of the 25 pieces was subdivided into 5 groups, 4 of which were disinfected with disinfectant solutions and the 5^{th} group was sterilized by autoclave as follow:

- Saniswiss biosanitizer I: 20 ml for 1 L of water during 15 minutes
- Desident cavicide disinfectant: 30 ml in 1 L of water for 30 seconds
- Glutaraldehyde: 2% for 30 minutes
- Peracetic acid: 0.25% for 10 minutes
- Autoclaving at 15 lb pressure, 121°C for 15 minutes

The remaining bacteria and fungi were identified after using various disinfectants by immersion of the pieces in sterile saline solution in the test tubes (5 pieces in each tube) for 5 minutes with agitation then centrifugation of the saline solution at 10,000 rpm for 10 minutes, and then the microbial deposit of the *Streptococcus* and *Staphylococcus* group was cultured on blood agar and nutrient agar, the *Candida albicans* group was cultured on Sabouraud's agar.

RESULTS

Treatment of clamping tweezers with different disinfectant methods after contamination with *Streptococcus* and *Staphylococcus,* the broth readings were: the pieces of clamping tweezers contaminated with mixture of *Streptococcus* and *Staphylococcus* broth were soaked in a prepared solution of biosanitizer I for 15 minutes, it revealed no growth of bacteria on blood agar and nutrient agar, also the clamping tweezers that were contaminated with mixture of *Streptococcus* and *Staphylococcus* broth, was soaked in a prepared solution of desident cavicide for 30 seconds, which showed no growth of bacteria on blood agar and nutrient agar. Similarly, the pieces of tweezers that was contaminated and soaked in a prepared solution of glutaraldehyde 2% for 30 minutes which showed no growth of bacteria on blood agar and nutrient agar. There was no growth of the bacteria also for the clamping tweezers that were soaked in a prepared solution of peracetic acid 0.25% for 10 minutes and the pieces were placed in an autoclave for 15 minutes at 121°C (Table 1 and Figure 1).

Table 1 Effect of different means of sterilization and disinfection on the bacterial growth on bracket clamping tweezers

Sterilization/Disinfection means	State of bacterial growth	
	Growth (%)	No growth (%)
Glutaraldehyde	0%	100%
Peracetic acid	0%	100%
Biosanitizer	0%	100%
Cavicide Desident	0%	100%
Autoclave	0%	100%

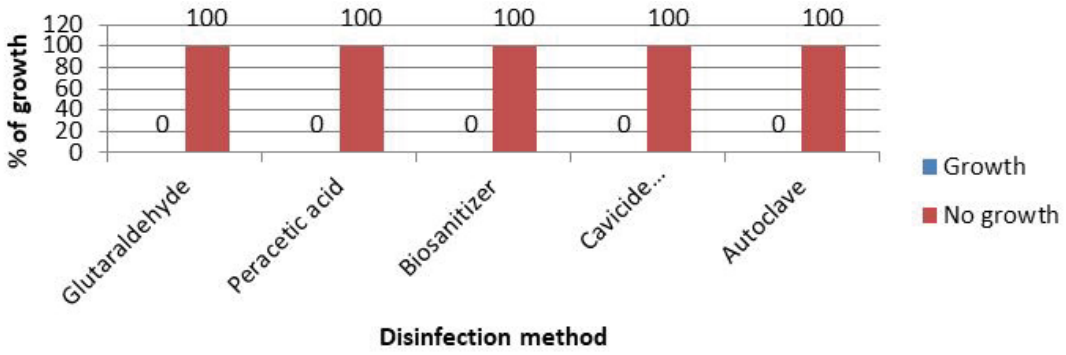

Figure 1 Bar chart presenting the percentage of bacterial growth on clamping tweezers after different disinfection methods

Treatment of clamping tweezers with different disinfectant methods after contamination with *Candida albicans* broth results were: Pieces of the tweezers soaked in a prepared solution of biosanitizer I for 15 minutes, glutaraldehyde 2% for 30 minutes, peracetic acid 0.25% autoclaved for 15 minutes at 121°C for 10 minutes revealed no growth on Sabouraud agar. While clamping tweezers contaminated with *Candida albicans* broth, were soaked in a prepared solution of desident cavicide for 30 seconds showed growth of *Candida albicans* on Sabouraud agar (Table 2 and Figure 2).

Table 2 Effect of different means of sterilization and disinfection on the fungal growth on bracket clamping tweezers

Sterilization/Disinfection means	State of fungal growth	
	Growth	No growth
Glutaraldehyde	0%	100%
Peracetic acid	0%	100%
Biosanitizer	0%	100%
Cavicide Desident	100%	0%
Autoclave	0%	100%

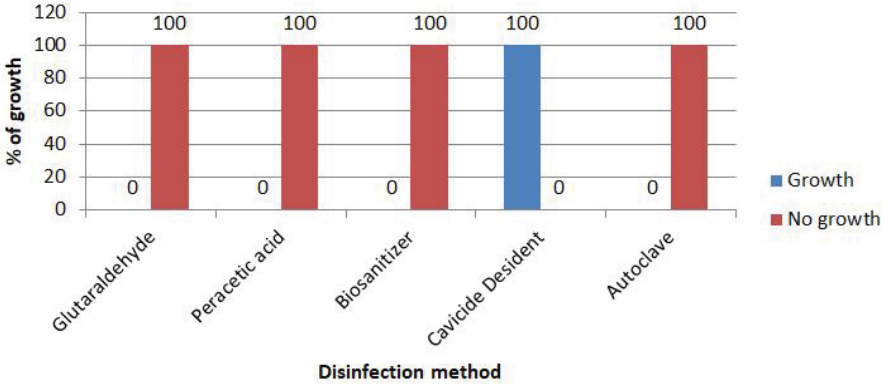

Figure 2 Bar chart shows the effect of sterilization and disinfection on the fungal growth on bracket clamping tweezers

DISCUSSION

In the present study *Streptococcus, Staphylococcus* and *Candida albicans* were isolated and identified from one patient and they were included in the infection control experimentally by exposing them to different disinfectant procedures as *Streptococcus* and *Staphylococcus* are commonly isolated bacteria, similarly, *Candida albicans* was also reported frequently in oral specimens of dental patients [7,8]. The aim of this study was to investigate the effect of various disinfectants on clamping orthodontic tweezers contaminated with *Streptococcus, Staphylococcus* and *Candida* broth as it represents the most common oral bacterial and fungal species commensals in reaction to disinfectants. This study evaluated the efficacy of 5 methods for disinfection of the contaminated clamping tweezers 10 times, including autoclave, glutaraldehyde 2%, peracetic acid 0.25%, desident cavicide solution, and biosanitizer I solution.

All the disinfection methods used showed no growth of *Staphylococci* and *Streptococci,* but when the tweezers were contaminated with *Candida albicans*, disinfection with desident cavicide solution showed growth of candida on Sabouraud agar while the use of an autoclave, glutaraldehyde 2%, peracetic acid 0.25% and biosanitizer I recorded no growth on Sabouraud agar.

Biosanitizer I disinfectant used in 2% dilution for 15 minutes eliminated the bacteria and *Candida albicans*. Chlorhydrate polyhexamethylene biguanide that forms the basic component of biosanitizer I act on the cell envelope and kills the microorganism [9]. The prepared solution of desident cavicide for 30 seconds to eliminate staphylococci and streptococci as it inactivates the microorganisms by alkylating the amino and sulfhydryl groups of proteins. However, it was unable to eliminate the candida probably due to insufficient time of exposure.

It was autoclaved for 15 minutes at 121°C, it eliminated the tested microbiota as it destroys the microorganisms by irreversible coagulation and denaturation of enzymes and structural proteins. Many performed studies verified the effectiveness of autoclave in the killing of the microorganisms [10,11].

In addition, the glutaraldehyde 2% for 30 minutes did eliminate the tested bacteria and fungi, it's biocidal activity result from the alkylation of sulfhydryl, carboxyl, hydroxyl and amino groups of microorganisms which lead to alteration in RNA, DNA, and protein synthesis [12]. In the same field, glutaraldehyde was found to be an effective disinfectant for orthodontic pliers which is in agreement with the result of this study [13].

Glutaraldehyde considered as an effective agent in the elimination of *P. aeruginosa, S. aureus,* and *S. salivarius* after 30 minutes of immersion of the contaminated pliers. Peracetic was effective as a disinfectant, the use of 0.25% peracetic acid for 10 minutes destroyed the tested microbiota as it functions by disrupting the cell wall permeability and denaturing the proteins [14,15]. Using 2% glutaraldehyde and 0.25% peracetic acid were effective in inhibiting the growth of *S. mutans, S. aureus* and *Candida albicans* on orthodontic pliers peracetic acid were efficient in the elimination of *Staphylococcus* [16-18].

CONCLUSION

Autoclave, peracetic acid 0.25%, glutaraldehyde 2% and biosanitizer I can be used to effectively eliminate *Staphylococci*, *Streptococci* and *Candida albicans*. Cavicide was capable of eliminating the bacteria but not the candida.

DECLARATIONS

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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