

Antiseptic Ability of Tea Tree Oil in Hand Hygiene among Dental Students Attending King Khalid University

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Abstract

Introduction: The aim of infection control unit among dental schools is to ensure a safe working area and prevent disease transmission or occupational infection among DHPs or patients. Tea Tree Oil (TTO) has a stimulating effect on hormone secretion, blood circulation, and immune system as well as its strong antimicrobial effect against oral microorganisms.

Aim: Aim of this study is to evaluate the antiseptic ability of TTO compared to standard alcohol based hand sanitizers using Agar fingertip impression plates.

Materials and Methods: The study was designed to collect random Agar fingertip impression plate for bacteria incubation from dental students, at different study levels. A total of 105 students participated to give 4 fingertip impression. Sample 1 and 2 were taken from right and left thumbs before using and hand sanitizer. After incubation period of 24 hours, samples were retrieved for colony forming units CFUs counting.

Results: The mean values of CFUs before handwash were 25.74 and 25.79 in TTO and alcohol groups respectively. In TTO group the CFUs was significantly reduced from 25.74 to 12.78 and in alcohol swab group the CFUs was reduce from 25.79 to 1.41 with P value of > 0.0001. In TTO group, the mean reduction was 12.96 (50%) while in alcohol group the mean reduction was 24.38 (94.5%).

Conclusion: Alcohol based antiseptics remain the best for handwash and hygiene between patients. TTO showed excellent results in decreasing bacterial count however, it is still less than alcohol based antiseptics. TTO can be a good alternative to alcohol for those whom suffer from skin problems. Adherence to infection control need to be closely monitored and infection control unit must follow the new updates in hand hygiene.

Keywords: Hand Hygiene; Tea Tree Oil; Alcohol; Antiseptic

Introduction

Dental health personnel (DHP) are at high risk of exposure to cross-infection with blood-borne pathogens especially when associated with accidental injuries during handling sharp or fine instruments [1]. Safety measures and adherence to infection control guidelines

must be taken seriously. Dental schools are responsible to teach students in a safe working environment, provide appropriate infection control guidelines and protect patients as well as DHPs [2].

The aim of infection control unit among dental schools is to ensure a safe working area and prevent disease transmission or occupational infection among DHPs or patients [3]. Ensuring complete awareness and compliance to guidelines is crucial for infection prevention. Several studies have shown that dentists and dental students are not always properly adhere to infection control guidelines [2,4-6].

Tea Tree Oil (TTO) is will know as melaleuca oil because it is extracted from the tree *Melaleuca alternifolia* that grows in Australia. It has been widely known by its antiseptic, antifungal, antiviral and antibacterial effects [7]. TTO has a stimulating effect on hormone secretion, blood circulation, and immune system and currently used in cosmetics products [8].

Several studies have shown excellent antimicrobial ability of TTO against oral microorganisms and 162 of bacterial clinical isolates [7,9-11]. It also has been widely used in periodontics to reduce gum swelling and infection as well as to control bad breath, plaque formation and bleeding [11].

Aim of the Study

Aim of this study is to evaluate the antiseptic ability of TTO compared to standard alcohol based hand sanitizers using Agar fingertip impression plates.

Methodology

The study protocol was approved by research committee of college of dentistry at King Khalid University. The study was designed to collect random Agar fingertip impression plate for bacteria incubation from dental students, at different levels of study before beginning any clinical procedure. A total of 105 students participated in the study and signed an informed consent. Each participant was asked to give 4 fingertip impression (2 each thumb). Sample 1 and 2 were taken from right and left thumbs before using hand sanitizer. Sample 3 and 4 were taken from the same thumbs after using alcohol based sanitizer and Tea Tree Oil (TTO) sanitizer. Alcohol and TTO sanitizers were used in right and left thumbs alternatively to eliminate the bias of dominant hand. Each participant samples were transferred into agar media that is labelled accordingly for incubation and bacteria growing tests.

After incubation period of 24 hours at humidity of 80% and temperature of 37°C, samples were retrieved for colony forming units (CFUs) counting. CFUs were recorded for baseline records (sample 1 and 2 in right and left thumbs) as well as after using Alcohol based and herbal based sanitizers (sample 3, 4 in right and left thumbs).

Data were then sent for statistical analysis. Mann Whitney U test was used to compare independent samples of baseline colony count (sample 1 and 2). Wilcoxon Signed-Rank Test was used to compared paired data (baseline and after using sanitizer) within Tea Tree Oil and Alcohol groups.

Results

A total of 105 students participated in the study. All samples were taken from participants before the start of their clinical sessions. Table 1 showed the distribution of participants according to their level of study and dominant hand.

CFUs in TTO and alcohol sanitizer were measured and compared at the baseline level (before using the sanitizers). Table 2 compared the mean values of CFUs before handwash which were 25.74 and 25.79 in TTO and alcohol groups respectively. This indicated equal distribution of subjects at the baseline level since the P value (0.633) was not significantly different.

	Groups	Frequency	%
Student Level	Level 8	21	20.0
	Level 9	25	23.8
	Level 10	18	17.1
	Level 11	27	25.7
	Level 12	14	13.3
	Total	105	100.0
Hand Dominance	Right	101	96.2
	Left	4	3.8
	Total	105	100.0

Table 1: Descriptive Statistics (students distribution according to their study level and dominant hand).

Groups	N	Mean	SD	Mean Rank	Mann-Whitney U	Z-Value	P-Value
TTO-Before Handwash	105	25.74	45.321	103.50	5303	-0.477	0.633
Alcohol-Before Handwash	105	25.79	40.792	107.50			

Table 2: Comparison of CFUs counts before handwash between TTO and Alcohol Swab Hand sites by Mann Whitney U test.

*Statistical significance at 5% level

CFUs were compared within group before and after using the sanitizers. Table 3 showed a significant reduction in CFUs after using both TTO and alcohol sanitizers. In TTO group the CFUs were significantly reduced from 25.74 to 12.78 while in alcohol swab group the CFUs were reduce from 25.79 to 1.41 with P value of > 0.0001.

Groups	N	Mean	SD	Mean Ranks	Z	P-Value
TTO-Before Handwash	105	25.74	45.321	48.95	-4.769	0.000*
TTO-After Handwash	105	12.78	22.528	51.52		
Alcohol-Before Handwash	105	25.79	40.792	50.77	-8.081	0.000*
Alcohol-After Handwash	105	1.41	4.638	44.00		

Table 3: Comparison of CFUs counts within groups before and after handwash by Wilcoxon Signed-Rank Test.

*Statistical significance at 5% level.

Table 4 compared the reduction of CFUs within groups before and after using the sanitizers. In TTO the mean reduction was 12.96 (50%) while in alcohol group the mean reduction was 24.38 (94.5%). Figure 1 showed the amount of reduction of CFUs in TTO and alcohol group before and after using the sanitizers respectively.

Groups	N	Mean	SD	Mean Differences	Percentage reduction
TTO-Before Hand wash	105	25.74	45.321	12.962	50.3
TTO-After Hand wash	105	12.78	22.528		
Alcohol-Before Hand wash	105	25.79	40.792	24.381	94.5
Alcohol-After Hand wash	105	1.41	4.638		

Table 4: Comparison of reduction in CFUs counts within groups.

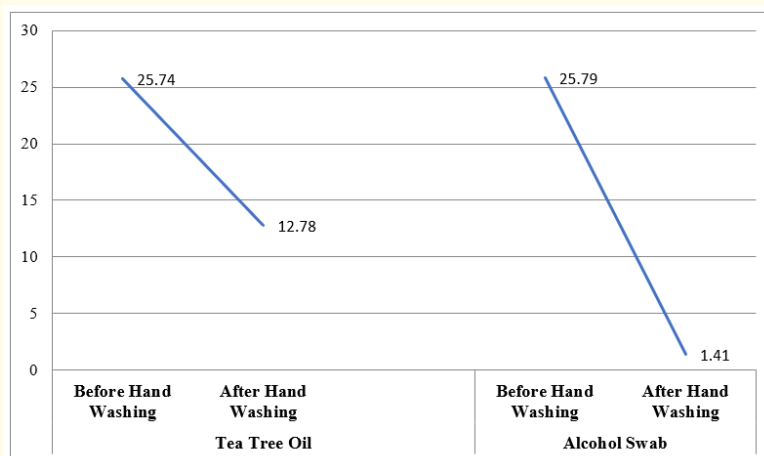


Figure 1: Comparison of reduction in CFUs counts within groups.

Discussion

Hand hygiene and disinfections has been a concern in medicine as early as 19th century. A French pharmacist introduced chlorine as handwash solutions and recommended moisturized hands when treating patients with contagious diseases [12]. In 1847, Ignaz Semmel-wis found in his study that the use of chlorine solution as a handwash between patients was more effective in reducing the mortality rate in obstetrics and gynecology clinic. This represents the first evidence indicating that handwash with antiseptic agents between patients may reduce transmitting diseases between patients [13].

Knowledge of normal skin flora is essential to understand the objective of hand hygiene. Skin is normally colonized by different count and species of bacteria. Bacterial count is 1×10^6 CFUs/cm² in the scalp, 5×10^5 CFUs/cm² in the axilla, 4×10^4 CFUs/cm² on the abdomen and 1×10^4 CFUs/cm² on the forearm [14]. Total bacteria count on medical personnel is approximately 4.5 CFUs/cm². Transit flora that colonize the superficial layer of the skin are easy to remove by routine hand wash, however, resident flora colonize deep in the skin layers are more resistant to remove. Transit flora are more associated with cross infection among health workers and patients while resident flora are less likely to cause such infections [15]. Our study showed a very high bacteria number among students in the dental clinics which was around 25 of CFUs per group while it is way less in the literature [14,15]. This indicates that our dental students must follow the rules and regulations of infection control unit as well as infection control unit must revise the protocol and modify it when necessary. Also, infection control unit must teach the students the importance of hand hygiene between patients and strictly follow up with them.

Pathogens can be transmitted from one patient to another through health care professionals if handwash and antiseptics were inadequate, inappropriate or entirely omitted. *Streptococcus aureus* is the prototype of bacteria that is commonly found on intact areas of skin [16]. People with diabetes, undergoing dialysis or with chronic dermatitis are more likely to have increased number of bacteria on their skin [17]. Gowns, patients' beds as well as dental chairs and other object that comes in direct contact with patient can easily become contaminated with patient flora. Some of these pathogens are with high resistance to antiseptics [18,19]. Agar fingertip impression study [20] showed that the incubated bacteria count ranged from 0-300 CFUs. It showed that patients with direct contact and respiratory tract care were with the most contaminated fingertips. They also concluded that the duration of patient treatment was strongly associated with contamination. Our study was about dental students and it showed similar results in regard to the CFUs counts.

Hand antisepsis reduces the incidence of infection transmission [21]. Infection rate was lower when using antiseptic handwash compared to plain soap [22]. In contrast, workload and crowded patients was associated with more infection [23,24]. Alcohol based hand antiseptic contains isopropanol, ethanol or n-propanol products. Alcohol solution containing 60%-95% are most effect and their antimicrobial ability is by denaturing protein [25,26]. Alcohol has excellent *in vitro* bactericidal activities as well as hepatitis B and C virus [26,27]. Gram negative bacteria were transferred from patient's skin to the catheter via hand of nurses in only 17% of experiment after using alcohol based antiseptic had rubs while it was 92% after using plain soap and water [28]. In our study we found that alcohol based swab reduce the bacteria count by 94% while in the TTO group it was reduced to only 50%. Although TTO was way less that alcohol based swab, however, it significantly reduce the number of isolated pathogens.

Frequent use of alcohol based antisepsis can cause irritation and dryness of the skin, thus skin care and conditioning is needed [29]. At the site of broken skin or wounds, even alcohol antiseptic containing emollients can cause stinging sensation [30]. According to surveys, approximately 25% of nurses reported symptoms of dermatitis and 85% reported skin problems [31]. Furthermore, allergic reaction to alcohol antiseptics has been reported. Another issue is that alcohol is flammable and must be stored in reduced temperature area away from any fire sources [32]. This may be an issue since the use of flam is common in dentistry.

Previous studies have shown the antimicrobial activity and anti-inflammatory effect of TTO in treating viral and bacterial infections [9]. TTO is proved to have a rapid bactericidal effect against *Staphylococcus aureus* using a 1 in 60 dilution of Melasol TTO [10]. It has been shown that TTO does not cause dermatological problems and does not affect the normal distribution of skin flora [33]. In our study TTO reduced the bacterial count from 25.74 to 12.78. CFUs which is approximately 50% reduction. This was significant reduction however it was also significantly less effective that alcohol based swab where the reduction was around 94%. In our study we used commercially readily available TTO. This may have a great effect on altering the main antimicrobial formal of original TTO that was used in other studies.

Conclusion

In conclusion, alcohol based antiseptics remain the best for handwash and hand hygiene between patients. TTO showed excellent results in decreasing bacterial count however, it is still less than alcohol based antiseptics. TTO can be a good alternative to alcohol for those whom suffer from skin allergies, have broken skin areas and have dry skin. Adherence of dental students to infection control need to be closely monitored as well as infection control unit at the school must follow the new updates in hand hygiene.

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