The effect of chlorhexidine and triclosan on undisturbed plaque formation for 72 hours duration

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ABSTRAK

Mengontrol plak adalah cara utama untuk mencegah penyakit periodontal. Klorheksidin adalah obat kumur *gold standard*, tetapi mempunyai efek samping yang membatasi penggunaannya. Triklosan, yang tidak memiliki efek samping, ingin diketahui efisiensinya dibandingkan dengan klorheksidin. Tujuan penelitian ini adalah untuk meneliti efek dari klorheksidin dan triklosan pada plak yang dibiarkan tumbuh selama 72 jam. Dua grup sukarelawan, klorheksidin dan triklosan, masing-masing beranggota 14 orang, diinstruksikan untuk tidak membersihkan gigi secara mekanis selama 72 jam, dan berkumur 2 kali sehari selama 1 menit dengan 15 mL sesuai grupnya. Akumulasi plak diukur setelah 24, 48, dan 72 jam menggunakan skor Modifikasi Quigley Hein. Skor plak median antara kedua group pada 24 jam perbedaannya tidak bermakna ($p = 0,625$), tetapi pada 48 dan 72 jam perbedaannya bermakna ($p = 0,007$ dan $0,017$). Skor plak median antara 24 dan 72 jam pada subjek yang menggunakan klorheksidin perbedaannya tidak bermakna ($p = 0,109$), sedangkan triklosan perbedaannya tidak bermakna ($p = 0,003$). Disimpulkan bahwa klorheksidin lebih efektif mengontrol pembentukan plak dibandingkan dengan triklosan.

Kata kunci: klorheksidin, triklosan, plak gigi, *undisturbed plaque*

ABSTRACT

Plaque control is the main method for preventing periodontal diseases. Chlorhexidine is a gold standard mouthrinse but it has a side effect which limits its use. Triclosan which does not have side effects was used to evaluate its efficacy against chlorhexidine. This experiment aimed to evaluate the effect of chlorhexidine and triclosan on undisturbed plaque formation for 72 hours. Two groups, chlorhexidine and triclosan, respectively consists of 14 volunteers refrained from all mechanical oral hygiene measures for the following 72 hours and rinsed instead twice daily for 1 minute with 15 mL of either chlorhexidine or triclosan. The plaque accumulation was assessed after 24, 48 and 72 hours using Modified Quigley-Hein Score. The median plaque score between both groups on day 1 was not significantly different ($p = 0.625$), but the score on day 2 and day 3 were significantly different ($p = 0.007$ and 0.017 respectively). The score between day 1 and day 3 on subjects using chlorhexidine was not significantly different ($p = 0.109$) unlike on subjects using triclosan ($p = 0.003$). The conclusion was chlorhexidine is more effective in controlling plaque formation compared to triclosan.

Key words: *chlorhexidine, triclosan, dental plaque, undisturbed plaque*

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INTRODUCTION

Dental plaque is defined clinically as a structured, resilient, yellow-grayish substance that adheres tenaciously to the intraoral hard surfaces. Recent technical advances have led to the recognition that dental plaque is a biofilm. Dental plaque, an adherent, bacterial biofilm that forms on all hard and soft tissue, is the principal etiologic agent in caries and periodontal diseases. Dental plaque may be readily visualized on teeth after 1 to 2 days with no oral hygiene measures. The plaque is typically observed on the gingival third of the tooth surface, in cracks, pits and fissures in the tooth structure, under overhanging restorations, and around malaligned teeth. The location and rate of plaque formation vary among individuals, and determining factors include oral hygiene as well as host factors such as diet or salivary composition and flow rate.¹

Modern dentistry emphasizes the importance of dental plaque control to improve oral health and the main method for preventing periodontal diseases. Mouthrinse with antiplaque agents have a long history as an important adjunct for the oral care needs of patients. Antimicrobial agents have been formulated in mouthrinse with the function of reducing plaque formation either by direct bactericidal action (i.e., killing) upon plaque and salivary microorganisms or by bacteriostatic action (i.e., growth inhibition) upon plaque and salivary microorganisms.²

Chlorhexidine is the current gold standard of antiplaque agent.³ The molecule is symmetric with two 4, chlorophenyl rings and two biguanide groups linked by a hexamethylene chain. Chlorhexidine appears to kill bacteria by altering the permeability of the cell membrane of the bacteria. This alteration causes the bacterial cell to leak, which eventually kills the bacteria. However, chlorhexidine digluconate, useful in oral

compositions, has side effects, which limits its use in oral compositions, and requires high levels of alcohol for sufficient solubility in the carrier.⁴

Triclosan (2, 4, 4'-trichloro-2'-hydroxy diphenyl ether) is a broad-spectrum antibacterial agent, which is widely used in mouthrinse and toothpastes. Triclosan targets the cytoplasmic membrane of both Gram-negative and Gram-positive microorganisms. Studies indicate that triclosan is effective in reducing plaque and gingivitis. Besides, triclosan does not have major side effects and patients can get them at the pharmacy.⁵

The objective of this study was to determine the plaque-reducing efficacy of triclosan compared to chlorhexidine on undisturbed plaque formation for 72 hours.

MATERIALS AND METHODS

This randomize, double-blind clinical study was approved by the institution's review board. All dental staffs, dental students and dental surgery assistant trainee who are healthy and between 20 to 30 years old were invited to participate. Twenty eight participants (14 subjects were chlorhexidine groups and 14 subjects were triclosan groups) were selected and agreed to participate in this study. Participants who wore removable appliances and took any antibiotic for the last 3 months were excluded.

After informed consent was obtained, all participants received a scaling and dental prophylaxis on day 0 to remove all plaque deposits to make sure the plaque score is zero. Then the oral rinses were dispensed for each participant. Both chlorhexidine and triclosan groups received 1 wrapped bottle (double-blind study) which contains 90 mL of oral rinse (either 0.2% chlorhexidine or 0.03% triclosan) and were meant for 72 hours. All subjects were instructed to

swish and rinse the allocated mouthrinse for 1 minute twice a day, once after waking up in the morning and before going to bed. Subjects were told to refrain from all mechanical oral hygiene procedures on lingual and palatal side of tooth but subjects still can brush the other parts of teeth without using any toothpaste. Subjects were also asked to avoid ingesting oral rinse and not to dilute the mouthrinse.

Subjects were asked to come to dental clinic everyday for 3 days. They were given 1 disclosing tablet and asked to chew the tablet for 30 seconds and thoroughly wiped the dye to all the tooth surfaces using tongue and finally expectorated the excess. After removing all the food debris using water spray, the lingual and palatal surfaces of all teeth, except for the third molars, were scored using Modified Quigley-Hein Score.⁶ The plaque was observed by indirect vision, by using mouth mirror and dental light.

The term undisturbed plaque is ideally used to describe plaque that continuously forms on the tooth surfaces without being interfered by mechanical oral hygiene, for example tooth brushing, flossing, etc.

Data was tabulated and then median plaque score between the two groups was analyzed statistically using Mann-Whitney test, and then continued by

analyzed median plaque score between the days using Wilcoxon signed ranks test.

RESULTS

A summary of the age and sex distribution of the sample is presented in table 1. Both groups, chlorhexidine and triclosan groups were balanced with respect to these characteristics. Throughout the study, there were complaints of alteration in taste from participants of chlorhexidine group. Two participants in triclosan group defaulted from follow up and were excluded from the study. At the end of the study, the final participants were 26, 14 in chlorhexidine group and 12 in triclosan group.

Table 2 presents the comparison of median plaque score after 24, 48 and 72 hours between chlorhexidine and triclosan groups. The median plaque score on day 1 showed that chlorhexidine and triclosan groups were not significantly different ($p= 0.625$). Both groups showed approximately similar plaque accumulation on day 1. But the median plaque score on day 2 and on day 3 of chlorhexidine and triclosan were significantly different ($p= 0.007$ and 0.017 respectively). The data show that triclosan group has more plaque accumulation compared to chlorhexidine group.

Table 1. Sample profile (26 participants)

Variables	Mean (SD)	Frequency (%)
Age (year)		
Chlorhexidine	23.00 (0.234)	
Triclosan	22.67 (0.376)	
Gender		
Chlorhexidine		
Male		5 (35.7%)
Female		9 (64.3%)
Triclosan		
Male		2 (16.7%)
Female		10 (83.3%)

SD = Standard deviation

Table 2. Comparing numerical variables between different mouthrinses used, using Mann-Whitney test

Variable	Chlorhexidine (n=14)	Triclosan (n=14)	Z statistic*	p value*
	Median (IQR)	Median (IQR)		
Plaque score after 24h	1.2024 (0.3822)	1.2464 (0.7529)	- 0.49	0.625
Plaque score after 48h	1.3810 (0.2589)	1.6028 (0.3154)	- 2.68	0.007
Plaque score after 72h	1.5238 (0.6740)	1.9690 (0.6524)	- 2.39	0.017

* Mann-Whitney test

Figure 1. The median plaque score after 72 hours of chlorhexidine and triclosan were significantly different (p=0.017).**Table 3.** Analysis of the changing of plaque scores after using different mouthrinses

Variables	Plaque score on day 1 – day 3		Z statistic*	p value*
	Median	(IQR)		
Chlorhexidine	-0.1200	0.8809	-1.60	0.109
Triclosan	-0.5600	0.6762	-2.98	0.003

* Wilcoxon Signed Ranks Test

Figure 1 shows the comparison of median plaque score after 72 hours between chlorhexidine and triclosan group. The median plaque score between both groups are significantly different.

Table 3 presents the differences of the median plaque score after 24 and 72 hours of each group. The median plaque score change of chlorhexidine group was not significantly

different ($p= 0.109$). The median plaque score change of triclosan group was significantly different ($p= 0.003$).

DISCUSSION

In this study, mouthrinses containing chlorhexidine and triclosan were used unsupervised for 72 hours and without regular oral hygiene practice. Both chlorhexidine and triclosan showed an increasing pattern of plaque accumulation, with chlorhexidine mouthrinse being more effective in controlling plaque formation.

The experimental design was similar to the design employed by Arweiler et al., (double-blind study) in that the subjects received meticulous scaling and professional tooth cleaning prior to study and refrained from all mechanical hygiene measures and rinsed instead with allocated mouthrinses.⁷ The presence and amount of dental plaque was scored using Modified Quigley Hein Score which is similar to the study by Sekino et al.⁸

This research hypotheses is that chlorhexidine is more effective than triclosan in controlling plaque formation when use alone without any oral hygiene measures. Originally, this study will compare mean plaque score on day 1, 2 and 3 between chlorhexidine and triclosan groups, but normality assumption is not satisfied and sample was not enough. Therefore, non-parametric test was used. Mann-Whitney Test was used to analyze the data.

The median plaque score on day 1 showed that chlorhexidine and triclosan groups were not significantly different ($p= 0.625$). Both groups showed approximately similar plaque accumulation on day 1. The median plaque score for chlorhexidine group was 1.2024 and for triclosan group was 1.2464. But there were

drastically changes in the median plaque score on day 2 and day 3. The median plaque scores on day 2 and day 3 of chlorhexidine and triclosan were significantly different ($p= 0.007$ and 0.017 respectively). The data shows that triclosan group had more plaque accumulation compared to chlorhexidine group. The median plaque scores for chlorhexidine group on day 2 and 3 were 1.3810 and 1.6028 respectively. Whereas the median plaque scores for triclosan group on day 2 and day 3 were 1.5238 and 1.9690 respectively.

Besides that, this study also planned to compare the mean plaque score on day 1 and day 3 for each group. From this analysis, the progression of plaque accumulation after using chlorhexidine or triclosan without any mechanical tooth cleaning measures could be obtained. The data did not meet the assumption of Paired-t test assumption. Therefore, the non-parametric test, Wilcoxon Signed Ranks Test, was used to analyze the data.

The median plaque score change of chlorhexidine group was not significantly different ($p= 0.109$). I observe that the plaque score increased but not significantly. Plaque accumulation on day 1 and day 3 was more or less similar. The median plaque score difference between day 1 and day 3 was -0.1200 . The median plaque score change of triclosan group was significantly different ($p= 0.003$). I observe that the plaque score significantly increased. The median plaque score difference between day 1 and day 3 is -0.5600 .

In the study by Arweiler et al., the plaque index was assessed after 24 (PI 1) and 96 hours (PI 2). The results showed that the amine-fluoride-triclosan solution reduced the plaque accumulation when compared to the placebo group solution. The verum reached a 36.5% ($p<0.05$) and a 39.8%

reduction ($p < 0.0001$) in PI 1 and PI 2, respectively.⁷ This was less than the reductions found with the positive control that is the 0.2% chlorhexidine (54.2% and 71.1% reduction in PI 1 and PI 2). However, the significant differences between both active solutions were only established for PI 2 (after 96 hours).

In this study, subjects were allowed to brush their teeth only on labial, buccal, and occlusal surfaces without toothpastes. Toothpastes usage was totally not allowed because its might contain triclosan or chlorhexidine which could interfere the result.

The subjects in chlorhexidine group complaint of alteration in taste but felt that their teeth are cleaner. This was similar with previous study by Keijser et al.⁹ No complaint receives from subjects in triclosan group.

In this study Modified Quigley Hein Score was used. This score was chosen because it is a more sensitive index compared to Oral Hygiene Index (Greene & Vermillion 1960),¹⁰ simpler to apply compared to Rustogi Modification of modified Navy Plaque Index 1972¹¹ and was used before in study by Sekino et al.⁸

CONCLUSION

The data derived from my study indicate that chlorhexidine is more effective than triclosan in controlling plaque formation. The superiority of chlorhexidine can be detected at 48 and 72 hours. Within group chlorhexidine, during 24, 48 and 72 hours there was not significantly difference in plaque score.

SUGGESTION

Since chlorhexidine have adverse effects in taste alteration, triclosan can be used as an alternative mouthrinse for reducing plaque accumulation.

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