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Received 01 Apr 2018.
Revised 01 June 2018.
Accepted 25 July 2018.
Published Online 15 Aug 2018

The Effect of Dental Unit Waterline Flushing on the Quality of Water in Dental Teaching Center in Malaysia

Abstract—The aim of this study to assess the efficiency of flushing method of Dental Unit Waterline (DUWL) system in reducing the number of microorganism. Water samples were taken before and after two minutes of flushing from air-water syringes system in ten randomly selected dental units in a Dental Teaching Centre. These samples were immediately transferred to the microbiology laboratory in the cool box within 8 hours for the heterotrophic plate count (HPC) test. Paired t-test was used to analyse number of microbe before and after flushing. The numbers of colony forming unit (CFU) ranged from 13,000 to 120,000CFU/ml in unflushed samples, and 3,000 to 15,000CFU/ml in flushed samples. The mean HPC post-flushing was lower than pre-flushing [8360.00 (4561.48) vs 63300.00 (44587.12) CFU/ml]. The mean HPC between pre- and post-flushing was significantly different (P=0.004, 95% CI 22039.52, 87840.48). The coliform count from the control was 140 CFU/ml. In conclusion, flushing method of DUWL system significantly reduces the number of microorganisms in the dental unit. However, the level of microorganisms still does not meet the standard guideline by Environmental Protection Agency for safe drinking water, which should be below 500 CFU/ml. In our opinion, the duration of flushing should be increased and additional chemical treatments of the dental units should be implemented to ensure the safety of patients and dental personnel.

***Keywords*—Dental Unit Waterline, microorganism, flushing**

1 INTRODUCTION

Biofilm is a collection of microorganism that adhere to moist surface by slimy matrix that can survive in various environment. Biofilm could be found in natural environment, industrial and health care equipment including dental unit waterline (DUWL). Microorganism can exist in two forms; single free and in clusters. Initially, the single microorganism will adhere to the surface of the tubing which later it proliferates to become more complex with slimy protective layer [1].

DWUL is ideal for biofilm formation because of the narrow tubing that would encourage water stagnation. DWUL is part of the dental chair and water is being used as coolant for handpieces, scaler and water syringe. The outgoing water may get contaminated when the planktonic bacteria break through the biofilm. Patient, dentist and dental personnel are at risk of this opportunistic microorganism which escape from biofilm into the aerosol [1]. There are numerous types of water-borne microorganisms from these biofilms but most of them are not pathogenic to patient with healthy immune system [2,3]. However, organisms such as *Pseudomonas and Legionella,* can be harmful to pregnant mothers, elderly, graft recipient and patient with immune-deficiency and other immune system problems [4]. *As there are many immune-compromise patients being treated in General Dental Practice, it is very important to ensure the DWUL provides safe water supply.* Centres for Disease Control and Prevention (CDC)'s *Guidelines for Infection Control in Dental Health-Care Settings* stated that the outgoing water from DWUL must at least meet the standard guideline by Environmental Protection Agency (EPA) for safe drinking water which contains the microbe less than 500 CFU/mL.

Dental chair manufacturers have responded to the challenge of meeting the standards of the EPA. At present, they are many methods being used to ensure the water supply from DWUL is safe for dental patients. Therefore, this study was aimed to assess the efficacy of flushing method in reducing the number of microorganisms in the DUWLs at a Dental Teaching Centre.

2 METHODS

This study samples were taken from a dental surgery in a Dental Teaching Centre. Prior

permission to conduct the study was obtained from the authority. All the dental chairs have self-contained water system. Ten dental chairs were randomly selected and labelled for this study. Samples were collected from the air/water syringe and labelled according to the dentals chairs after treating few patients at midday, and another water samples were taken from the same dental chairs after 2 mins of flushing. A sample of water was taken from the water distiller as the control of this study. These samples were immediately transferred to the microbiology lab in a cool box within 8 hours, for the heterotrophic plate count (HPC) test. The plates were incubated at 37°C for 48 hours and estimation of the colony count per 100/ml was made. Then, the data was analysed by SPSS version 22.0, using paired t-test

3 RESULTS

Table 1 showed the numbers of colony forming unit (CFU) ranged from 13,000 to 120,000CFU/ml in unflushed samples, and 3,000 to 15,000CFU/ml in flushed samples.

The mean HPC post-flushing was lower than pre-flushing [8360.00 (4561.48) vs 63300.00 (44587.12) CFU/ml] as shown in Table 2. The mean HPC between pre- and post-flushing was significantly different (P=0.004, 95% CI 22039.52, 87840.48). We are 95% confident that the mean difference of HPC between pre- and post-flushing will be between 22039.52 and 87840.48 CFU/ml. The coliform count from the control was 140 CFU/ml.

4 DISCUSSION

In the present study, we would like to assess the efficacy of flushing in reducing the number of microorganisms in DUWL. The high number of microorganisms before flushing ranging from 13,000 to 120,000 CFU/ml could be due to the suck back of patient's saliva into the DUWL [5]. Despite the anti-retraction valve being fixed in the dental unit system, the valve could be ineffective with time [6]. Even the control; which was supposed to be sterilised distilled water, revealed some microorganisms. The warm and high humidity of the environment may encourage the proliferation of microorganism in the distilled water container as well as in the DUWL [6]. Perhaps the distilled water container should be cleaned regularly to ensure there is no biofilm formation, source of microorganism. The mean HPC before flushing is significantly reduced by flushing which is similar as reported by Mansourian [7] but in contrast to Santiago [8] and Rice [9]. Even though the number of organisms in this study was significantly reduced, the quality of water still did not meet the standard guideline by Environmental Protection Agency (EPA) for safe drinking water which should not contain microorganisms at or more than 500 CFU/ml. Since the dental chairs in this study have been used for several years, flushing the DUWL has not efficiently reduced the number of organisms up to the EPA standard guideline, this could be due to the already matured and well established biofilm after being used for a long time [10].

Table 1: Level of contamination of dental unit water lines before and after flushing

No. of dental unit	CFU/ml before Flushing	CFU/ml after Flushing
Control	140 cfu/ml	
1	120,000	3,000
2	14,000	3,000
3	13,000	5,000
4	100,000	7,000
5	20,000	9,600
6	50,000	14,000
7	36,000	14,000
8	110,000	6 ,000
9	50,000	15,000
10	120,000	7,000

Table 2: Change of level of contamination before and after flushing

Variable	Pre-flushing Mean (SD)	Post-Flushing Mean (SD)	Mean difference (95% CI)	t-statistic (df)	p-value
Heterotrophic Plate Count (HPC)(CFU/ml)	63300.00 (44587.12)	8360.00 (4561.48)	54940.00 (22039.52, 87840.48)	3.778(9)	0.004

Although flushing does not remove the biofilm, it is still an important procedure to transiently reduce the level of microorganism due to the suck-back effect from the patient [10]. Flushing of the DUWL at the beginning and end of working day as well as in between patients, at minimum of 20-30 secs are recommended by American Dental Association (ADA) [11].

5 CONCLUSION

Flushing of DUWL alone is not sufficient in reducing the level of microorganisms, additional chemical treatments must be used. Mechanical scrubbing and chemical treatments of the distilled water container should be done periodically to prevent the formation of biofilm. Monitoring of the microbe quantity and type of microorganisms should be done regularly within a period of time to ensure patient's and personnel's safety.

ACKNOWLEDGEMENT

We would like to express our special thanks of gratitude to the Dental Teaching Centre for allowing us to conduct the study and all the staff who have directly and indirectly helped us with this project.

CONFLICTS OF INTEREST

The authors report no conflicts of interest. The authors are responsible for the content and writing of the paper.

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