



## **EVALUATION OF ANTIMICROBIAL EFFICACY OF ALOE VERA JUICE, LISTERINE AND SODIUM HYPOCHLORITE IN DISINFECTION OF DENTAL UNIT WATER LINES: AN IN VITRO STUDY**

**Suraj Ghanshyam Malpani., Vijaykumar L Shiraguppi., Bharat A Deosarkar.,  
Syed Mohammed Tayeeb and Ankur Pandey**

Gade layout, lakhala, washim.444505

### **ARTICLE INFO**

#### **Article History:**

Received 13<sup>th</sup> March, 2021

Received in revised form 11<sup>th</sup>  
April, 2021

Accepted 8<sup>th</sup> May, 2021

Published online 28<sup>th</sup> June, 2021

#### **Key Words:**

Dental Unit Water Lines, Aloe Vera juice,  
Listerine, Sodium Hypochlorite

### **ABSTRACT**

Dental unit waterlines may be heavily contaminated with micro-organisms and are potential source of infection for both practicing staff and immunocompromised patients. Contamination of dental unit waterlines could be inhibited with use of disinfectants.

**Aim:** To compare efficacy of aloe vera juice, listerine and sodium hypochlorite in controlling microbial contamination of dental unit water systems.

**Methodology:** After obtaining baseline water samples, the dental unit waterlines will be treated with aloe vera juice, listerine and sodium hypochlorite for one week. Water samples will be collected from 15 dental chair units from different departments. Water samples of 50 ml will be collected from outlet of airtar handpiece. Water samples were analysed for microbiological quality by total viable count method.

**Results:** Reduction in bacterial contamination after treatment with disinfectants has been found.

*Copyright©2021 Suraj Ghanshyam Malpani et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.*

### **INTRODUCTION**

Effective infection control is one of the cornerstones of good practice and clinical governance. Appropriate procedures to decontaminate handpieces, including autoclaving and handpiece replacement, between patients have been developed and implemented in dental practices. These procedures are aimed at reducing the likelihood of aerosol dissemination of pathogens within dental operatories and resulting infections. However, decontamination of handpieces, such as high-speed drills and syringes, does not remove the potential for exposure to pathogens that originate within the waterlines of dental units. Contamination of dental unit waterlines (DUWL) by microorganisms is a real problem that modern dentistry is facing that has yet to be completely resolved, even though the first report of contaminated water in dental lines was published as far back as in 1963 by Blake.[1]

Dental unit waterlines are 3–4 narrow polyurethane tubes that carry water to the handpiece, coolant and they are contaminated by the formation of biofilm along the inner lumen of the tubing wall.[2] Various methods are used for prevention of biofilm formation: By utilization of anti-retraction valves, Chlorination of water, Utilization of ozone and ultraviolet light system.

The most effective method is use of biocides or disinfectants like chlorhexidine gluconate, quaternary ammonium compound, povidine iodine, ethanol, hypochlorite, peroxide and glutaraldehyde.[3]

Hence, the purpose of the research was to assess bacterial infectivity of Dental Unit Water Lines before and following the use of aloe vera juice, listerine and sodium hypochlorite.

#### **Aim**

To compare efficacy of 5 % aloe vera juice, 5% listerine and 5.25% sodium hypochlorite in controlling microbial contamination of dental unit water systems.

#### **Objectives**

- To compare efficacy of 5 % aloe vera juice, 5% listerine and 5.25% sodium hypochlorite as disinfectants for dental unit waterlines.
- To assess the effectiveness of all the three disinfectants in reducing the bacterial contamination of dental unit waterlines.

### **MATERIALS AND METHODS**

The study was conducted in Saraswati Dhanwantari Dental College & Post – graduate Research Institute, Parbhani. Fifteen dental chairs were selected for the study. From these dental

\*Corresponding author: **Suraj Ghanshyam Malpani**  
Gade layout, lakhala, washim.444505

units 50 ml water were collected from outlet of two-way syringe and highspeed hand piece. Baseline samples were obtained at the start of the study.

Before sample collection, the end of each handpiece and two-way syringe was disinfected with 70 % alcohol to avoid other sources of contamination. A volume of 50mL of water was collected in sterile containers. Samples were stored in a refrigerator and processed at the laboratory within two hours. The total viable count was estimated to assess the microbial contamination in the dental unit water line.

The study was designed to determine the efficacy of different disinfectants on DUWLs. Thus each group of 5 dental chairs was treated with a particular disinfectant for a period of three weeks. Cross disinfection was also avoided by treating a single dental chair with a similar disinfectant each time. Disinfection is a process that eliminates many or all pathogenic microorganisms on inanimate objects with the exception of bacterial endospores.

Three disinfectants were diluted with distilled water to achieve 1: 100 dilution and their effect in reducing the microbial contamination in the dental unit waterlines was studied.

1. Aloe vera (Sample A): commercially available aloe vera juice was used in the present study. The aloe vera juice was subjected to microbiological analysis before the start of the study to rule out the chances of contamination and to ensure the efficacy of the disinfectant. The aloe vera juice was found to be sterile and was therefore included. Sample A was diluted with distilled water to achieve concentrations of 1: 100.
2. 5 % Listerine(Sample B) was also diluted at 1: 100.
3. 5.25 % sodium hypochlorite (Sample C) was similarly prepared to achieve 1: 100.

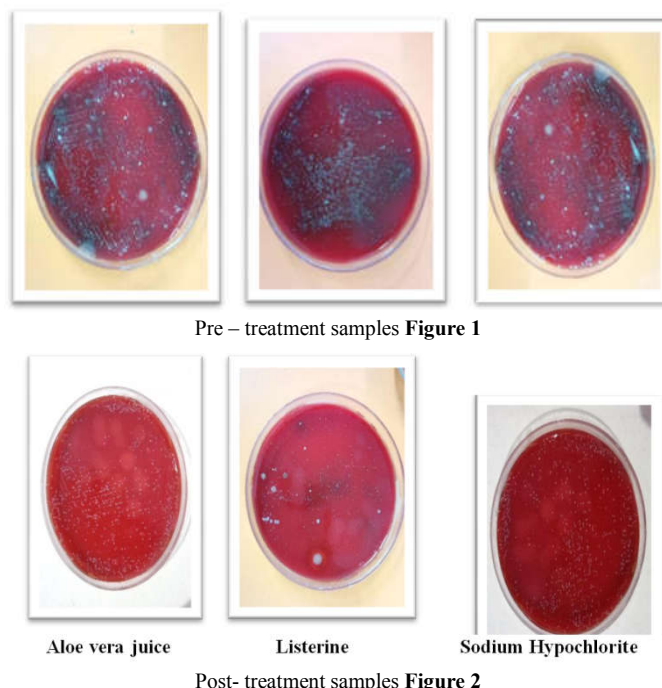
The three disinfectant Samples A, B, and C were added to the reservoir bottle of the 15 dental chairs from which baseline samples were obtained. Weekly disinfecting regimen was followed by adding 200 to 250mL of disinfectant in the reservoir bottle that supplied the dental unit and the solution was run through the system for two minutes. The disinfectants were added on the weekend just before the commencement of that day's work and the unit was then turned off and the disinfectant was left in situ. Water samples of 50mL from each treated unit's two-way syringe were collected in separate sterile containers under aseptic conditions and labelled before treating the first patient of the day and quantified for total viable counts.

It is a quantitative bacteriological analysis which enumerates total viable population capable of growing under a given set of conditions. Plate count is useful in determining the efficiency of water treatment. The plate count expresses the number of all colony forming bacteria in 1mL of water. It provides information about the amount and type of organic matter in the water which may be useful indicating the efficiency of the processes used for water treatment or the suitability of water.

## RESULTS

The study included collection of water samples from each unit beginning with baseline collection and after DUWL exposure to disinfectant. Results obtained were the mean TVC in the treated water samples. The data was entered into a database using Microsoft Excel 2007 spreadsheet software and was

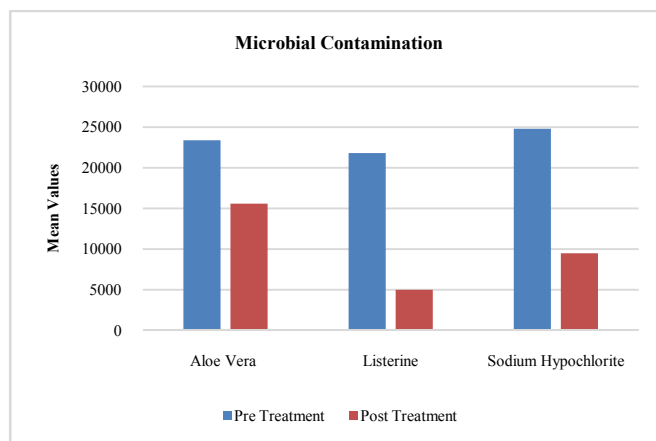
analyzed with Statistical Package for Social Sciences (SPSS) for Windows, version 26.0 (IBM Corp., Armonk, N.Y., USA). Confidence intervals were set at 95% and values of  $p < 0.05$  were interpreted as statistically significant. Wilcoxon signed rank test was applied to compare pre and post treatment of aloe vera juice, listerine and sodium hypochlorite in controlling microbial contamination of dental unit water systems.



**Table 1** Comparison of Pre and Post Treatment of microbial contamination of dental unit water systems

Microbial contamination	Mean	Std. Deviation	Z-value	p-value
Pre Treatment Aloe Vera	23400.0	2701.8	-2.03	0.04 (S)
Post Treatment Aloe Vera	15600.0	3361.5		
Pre Treatment Listerine	21800.0	2167.9	-2.03	0.04 (S)
Post Treatment Listerine	5000.0	790.5		
Pre Treatment Sodium Hypochlorite	24800.0	3114.4		
Post Treatment Sodium Hypochlorite	9500.0	1118.0	-2.03	0.04 (S)

Immediately after disinfection with sodium hypochlorite, hydrogen peroxide, and aloe vera, the output water from the disinfected dental chair units showed a high reduction in bacterial density (figure 1 - 2).



**Figure 3** Comparison of Pre and Post Treatment of microbial contamination of dental unit water systems

## DISCUSSION

Contamination of the dental unit water was reported from 1963 which are due to the proliferating bacteria, fungi, protozoa along the inner lumen of the dental unit waterlines – biofilm. Contaminated dental unit water used during treatment procedure is the serious threat to patients as well as the dental staff. These are attributed to the complexity of the dental unit, so the solution for this problem is to disinfect the dental unit waterlines.[11] Various disinfectant was such as chlorhexidine gluconate, sodium hypochlorite, and povidone-iodine are used in the dental unit waterlines. Analyzing the substantivity of the disinfectant gives us a clue about the time interval to perform the disinfection procedure in the dental unit waterlines.[2]

High concentration of water borne organisms causes multiple public health problems. Contamination of water lines could be inhibited by using some disinfectants. Removal of these substances from water delivered into patient's mouth may reduce the potential for posttreatment inflammatory episodes [4]. To date, there is no unique international regulation that establishes procedures for cleaning, control, and disinfection of DUWLs, and there are no limits for microbial concentrations. The Center for Disease Control (CDC) recommends monitoring water quality by using disinfection products and devices that guarantee microbiological quality standards, i.e.,  $\leq 500$  colony-forming units (cfu)/mL of heterotrophic water bacteria, the consultation of instruction manuals provided by the manufacturers for the maintenance of DUWLs, the use of sterile saline or sterile water for surgical procedures, and the performance of a flushing procedure between patients at the start of each working session. Therefore, DUWLs should be flushed, drained, and left disconnected during any temporary closure. Starting with this knowledge and following the adoption of a water safety plan for drinking water in dental units of Saraswati Dhanwantari Dental College have undertaken and the effect of aloe-vera based disinfectant, listerine and 5.25% Sodium hypochlorite in reducing the bacterial density was compared.

The ideal properties for an agent required to treat DUWL include low toxicity, low cost, ease of treatment, compatibility with a wide range of materials, and broad spectrum antimicrobial efficacy, especially against biofilms [4]. A disinfecting process should (i) kill bacteria in the water phase, (ii) kill biofilm-embedded cells, (iii) remove biofilm from the surface (as a "killed" biofilm can be a source of endotoxin and also allows rapid recolonization of a new and viable biofilm, which may occlude the tubing), (iv) be easily performed and offer continuous protection, thereby eliminating the root cause of poor dental unit water quality, and (v) provide continued efficacy during periods of nonuse, such as overnight and weekends. The disinfectant exhibiting these attributes would be easier to explain to patients and easier for practitioners to manage than the remedial treatment processes [4]. Considering the ideal properties of the disinfectant, herbal-based disinfectant like aloe vera was introduced which conforms with the antimicrobial properties. Aloe vera being a natural ingredient is said to be nontoxic and biodegradable.[4]

In the present study, the three disinfectants selected were found to be compatible with the DUWLs of the dental chair units used in the study. There was significant reduction in the

mean CFU count when DUWLs were treated with disinfectants each for a period of three weeks.

Aloe vera is found to have antimicrobial and antifungal properties. It consists of essential oil of *E. camaldulensis*, characterized by the presence of high concentrations of 1,8-cineole with well-documented antimicrobial activity. Essential oils are capable of affecting biofilm formation. They significantly decrease bacterial adhesion and affect bacterial viability in biofilms. The efficacy of aloe vera liquid as an antibacterial agent is shown to have a wide range of effectiveness against Gram-positive (Gram +ve) and Gram-negative (Gram -ve) bacteria due to an extract of the inner gel of the plant *Aloe barbadensis* Miller or *Aloe vera* (L.)

The study was designed in such a way that treating a dental chair with single disinfectant would prevent error due to carry-over effect. Listerine was proved to have superior disinfecting properties as compared to aloe vera juice and 5% NaOCl when used at 1:100 dilution. All the three disinfectants showed significant reduction in mean CFU/mL of water from DUWLs. Out of all, listerine was most effective disinfectant.

## CONCLUSION

Improving the water quality from dental unit water lines is of considerable importance. Every effort should be made to eliminate not only planktonic bacteria but also the biofilm within the water lines. This prevents the risk of crossinfection amongst treated patients and the dental staff who are regularly exposed to contaminated water and aerosols generated from using dental hand pieces. The development of herbal biocide in the form of aloe vera will prove to be a revolution in disinfecting dental unit water lines. Further research is advocated to test the efficacy and shelf life of aloe vera not only in disinfecting the dental unit water but also to be applied in other areas for use as hospital disinfecting solution.

## References

1. Garg SK, Mittal S, Kaur P. Dental unit waterline management: historical perspectives and current trends. *Journal of investigative and clinical dentistry*. 2012 Nov;3(4):247-52.
2. Shajahan IF, Kandaswamy D, Lakshminarayanan L, Selvarajan R. Substantivity of hypochlorous acid-based disinfectant against biofilm formation in the dental unit waterlines. *Journal of conservative dentistry: JCD*. 2017 Jan;20(1):2.
3. Shah S, Shah SS, Sheth T, Thakkar P. Orotol Plus: A DUWL Disinfectant. *International Journal of Oral Health Dentistry*. 2017;3(2):81-4.
4. Pareek S, Nagaraj A, Sharma P, Atri M, Walia S, Naidu S, Yousuf A. Disinfection of dental unit water line using aloe vera: in vitro study. *International journal of dentistry*. 2013;2013.
5. Lizzadro J, Mazzotta M, Girolamini L, Dormi A, Pellati T, Cristino S. Comparison between Two Types of Dental Unit Waterlines: How Evaluation of Microbiological Contamination Can Support Risk Containment. *International journal of environmental research and public health*. 2019 Jan;16(3):328.
6. Shajahan IF, Kandaswamy D, Srikanth P, Narayana LL, Selvarajan R. Dental unit waterlines disinfection using

- hypochlorous acid-based disinfectant. *Journal of conservative dentistry: JCD*. 2016 Jul;19(4):347.
7. Ji XY, Fei CN, Zhang Y, Zhang W, Liu J, Dong J. Evaluation of bacterial contamination of dental unit waterlines and use of a newly designed measurement device to assess retraction of a dental chair unit. *International dental journal*. 2016 Aug;66(4):208-14.
  8. Schel AJ, Marsh PD, Bradshaw DJ, Finney M, Fulford MR, Frandsen E, Østergaard E, Ten Cate JM, Moorer WR, Mavridou A, Kamma JJ. Comparison of the efficacies of disinfectants to control microbial contamination in dental unit water systems in general dental practices across the European Union. *Appl. Environ. Microbiol.* 2003 Jun 1;69(6):3327-32.
  9. Walker JT, Bradshaw DJ, Fulford MR, Marsh PD. Microbiological evaluation of a range of disinfectant products to control mixed-species biofilm contamination in a laboratory model of a dental unit water system. *Appl. Environ. Microbiol.* 2003 Jun 1;69(6):3327-32.
  10. Yabune T, Imazato S, Ebisu S. Assessment of inhibitory effects of fluoride-coated tubes on biofilm formation by using the in vitro dental unit waterline biofilm model. *Appl. Environ. Microbiol.* 2008 Oct 1;74(19):5958-64.

**How to cite this article:**

Suraj Ghanshyam Malpani *et al* (2021) 'Evaluation of Antimicrobial Efficacy of Aloe Vera Juice, Listerine And Sodium Hypochlorite In Disinfection of Dental Unit Water Lines: An In Vitro Study', *International Journal of Current Advanced Research*, 10(06), pp. 24589-24592.

\*\*\*\*\*