



Suction Hoses of Dental Units as a Potential Source of Microbial Contamination

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ABSTRACT

Objectives: Dental units are necessary tools for modern dentistry. Microbial contamination of dental units is thought to be the result of biofilm formation in various parts of the unit. We aimed to identify the total microbial count in the suction hose of dental units, and detect the presence of *Pseudomonas aeruginosa*. **Methods:** Random sampling of suction hoses of dental units in Birjand, Iran, was performed in dental clinics on the first (n = 115) and last (n = 115) working days of the week. Total viable counts of bacteria and detection of *P. aeruginosa* were performed on plate count agar and cetrimide agar, respectively. Plates were incubated at 37 °C for 48 hours. **Results:** None of the samples were free from bacterial contamination. *P. aeruginosa* was detected in 22.6% and 18.3% of samples taken on the first and last working days, respectively. **Conclusions:** Suction hoses were heavily contaminated with bacteria, especially opportunistic pathogens, and current disinfection does not adequately control the contamination.

The dental chair unit (DCU) is an essential item in modern dentistry. The DCU consists of the dental chair, a pedestal unit providing supply, instrument controller, ancillary attachments, and suction system.¹ The suction system removes saliva, blood, debris, and other solutions. High and low volume suction hoses are two components of the suction system. Due to its nature, the DCU suction system, including suction hoses, can become contaminated with oral microorganisms. It is also a good environment for biofilm formation and propagation due to the wetness of the suction system. Disinfection of these systems is essential.^{2,3} Furthermore, some bacteria present in the biofilm may not be affected by disinfection.³ Moreover, biofilm bacteria are mostly resistant to surfactants and antibiotics, and if pathogens exist can lead to infections.³

One of the bacteria usually present in biofilm is *Pseudomonas aeruginosa*. *P. aeruginosa* is a gram-negative bacillus that is occasionally found in the intestinal tract and regarded as a significant

opportunistic pathogen. Immunocompromised patients may suffer from infections caused by this bacterium.⁴ *P. aeruginosa* caused infections in immunocompromised patients (those with diabetes, HIV, alcoholism, etc.) treated at units harboring these organisms.⁵ Exposure to aerosols dispersed by biofilm can cause a threat to the pulmonary system of human beings.⁵ Mostly, *P. aeruginosa* bacteria had multidrug resistance (MDR) to commonly used antibiotics and disinfectants.⁶ Microbial biofilm initiates major medical concerns that are realized in dental units.

Most studies have been carried out on the dental unit water system (DUWS) of dental teaching hospitals. To the best of our knowledge, there is no study in Iran and limited studies in other countries to determine the microbial contamination of suction hoses. We sought to determine the total microbial count of the suction hose of dental units on the first and last working days of the week, and the occurrence of *P. aeruginosa* in the suction hoses to determine the hygiene status of DCUs in Birjand, Iran.^{1,2}

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METHODS

Two hundred and thirty samples of suction hoses were obtained from 13 dental clinics (dental school, dentistry polyclinic of university, private clinic, and public clinics) of the city of Birjand, Iran, between March and June 2018 on the first ($n = 115$) and last ($n = 115$) working days of the week. The dental unit is fed with chlorinated tap water. Both suction hoses were sampled using moistened cotton swabs to a depth of 10 cm. Before sampling, the suction tip and filter were disassembled, and the internal area was swabbed using both back and forth and perpendicular strokes. Each swab was placed in the labeled tubes containing 3 mL of normal saline 95%. Samples were placed in a cooler box and delivered to the laboratory within one hour.

Total viable counts (TVC) of bacteria were performed on decimal dilutions of the samples. After vortexing the tubes containing swabs, 1 mL of each sample and diluted ones were pour plated in plate count agar (PCA; Merck, KGa Darmstadt, Germany) and incubated at 37 °C for 48 hours and colonies were counted with a colony counter.

P. aeruginosa was only isolated as a representative of opportunistic pathogens. Each sample with 100 μ L was streaked on plates containing MacConkey agar medium and incubated at 37 °C for 48 hours. From each plate with bacterial growth, gram-negative colonies with a positive reaction in catalase and oxidase tests were selected and streaked on the cetrimide agar plates (Merck KGaA, Darmstadt, Germany) and incubated at 42 °C for 48 hours. For identification of *P. aeruginosa*, colonies with bluish-green pigment were inoculated in triple sugar iron agar, oxidative/fermentative, citrate, SIM, and MR-VP tubes and incubated at 37 °C for 24 hours.

The normality of data was tested using Kolmogorov-Smirnov test, and the Mann-Whitney test was used to assess the difference in the two days of sampling ($p < 0.050$). Kruskal-Wallis test was used to determine the variation of sampling location ($p < 0.050$). The post-hoc Mann-Whitney test with Bonferroni adjustment was used for pairwise comparison of sampling location ($p < 0.010$).

RESULTS

The TVC of suction hoses was measured in the first and last working days, and the detection of *P. aeruginosa* was performed as a representative of

Table 1: Total viable count of suction hoses in the first and last working days.

Number of samples		Bacterial count, cfu/mL
First working day	Last working day	
24	13	< 30
15	21	30–300
40	41	300–250 000
36	40	TNTC (250 000– > 650 000)

TNTC: too numerous to count.

Table 2: Total viable count (TVC) of suction hoses in different sampling locations.

Location	Mean TVC, cfu/mL
Dental school	1.6×10^2
University dentistry polyclinic	4.4×10^4
Private clinic	3.4×10^4
Public clinics	6.5×10^5

opportunistic pathogens. TVC in the first and last working days were 235×10^3 cfu/mL (colony forming units per milliliter) and 232×10^3 cfu/mL, respectively [Table 1]. The TVC difference in the two sampling days was not significant ($p > 0.050$ and $p > 0.520$, respectively). *Pseudomonas* spp. was isolated from 34.0% of the samples; 21.0% of the total samples were contaminated with 22.6% and 18.3% of samples taken on the first and last working days infected with *P. aeruginosa*, respectively.

According to the sampling location, the dental school and public clinics had the lowest and highest count of bacterial contamination, respectively. Suction hoses of the dental school had a significantly lower level of contamination than the university dentistry polyclinic ($p < 0.010$). TVC of public clinics were considerably higher than the dental school and university polyclinic ($p < 0.010$) [Table 2]. Private clinics had the highest contamination with *P. aeruginosa* and dental schools had the lowest.

DISCUSSION

All samples were contaminated with viable bacteria. About 68.0% of the samples were heavily contaminated (> 300 cfu/mL viable count). More than 50.0% of water samples of dental units had a

bacterial count of > 200 cfu/mL.⁴ Also, 70.5% and 82.4% of air/water syringe and high-speed drills had more than 200 cfu/mL bacterial count.⁴

The TVC on the first working day (235×10^3 cfu/mL) was more than the last working day (232×10^3 cfu/mL), which was in agreement with the results of other studies.⁷ The microbial population in DUWS reached values of up to 26×10^4 cfu/mL. In all participating clinics, microbial count among the different days of the week had no significant difference.⁸ This finding may be due to unsuccessful disinfection of dental units after the last working day and propagation of bacteria over the weekend, as in our study disinfection of dental units was not performed by researchers and was the responsibility of the administrators of clinics and performed according to the Center for Disease Control and Prevention (CDC) guideline.⁹ Another study reported ineffective disinfection to control bacterial contamination in the DCU suction systems.² This phenomenon can be attributed to the nature of bacterial biofilm, which is more resistant to disinfectants than planktonic organisms.¹⁰ Also, it may relate to the less contact time of disinfectant with the interior of suction hoses.² It was observed that there was 101–500 cfu per culture plate bacterial growth in up to 19% of high and 37% of low volume suction hoses.¹¹

We isolated *P. aeruginosa* from 21.0% of samples. Another study reported that pseudomonas was detected in 13 out of 50 (26%) DUWSs. *P. aeruginosa* was isolated in three DUWSs (6%).³ A dental education center in Jordan reported that 86.7% of DUWSs were contaminated with *P. aeruginosa* before the start of the first working day, and the level of contamination was reduced to 73.3% after two minutes of flushing in the middle of the day.¹² In another study, 33% of DUWS were contaminated with *P. aeruginosa*.⁸ In our study, *P. aeruginosa* was detected in both sampling times, suggesting an inadequacy of disinfection in the last working day. Dental units of the dental school of Montreal University showed that none of the 121 waterlines of dental units was free from bacterial contamination.¹³

In an investigation of suction hoses of dental units in a dental hospital, of the 41 DCUs sampled, all had heavy bacterial contamination (> 500 and > 1000 cfu/swab).² Twenty-five were contaminated with *P. aeruginosa*.² *P. aeruginosa* persistently colonized

the DUWS.¹⁴ Water supplies of the units regarded as a source of bacterial contamination. The sanitizing of DUWS is of significant importance, both medically and legally.¹⁵ A significant reduction of water contamination was observed after filtration of the DUWS.¹⁵ Our results showed that suction systems with a higher TVC had a higher contamination rate with *P. aeruginosa*, which was in agreement with other studies.^{4,13} *P. aeruginosa* was a frequently isolated pathogen from medical devices.¹⁶

P. aeruginosa can cause infections if derived from DUWSs. Contamination with *P. aeruginosa* creates a risk for patients and dentists and their staff.³ Although, in our study, dental units were equipped with water filters, a high rate of contamination was observed, which could be due to ineffective filtering systems.

The presence of *P. aeruginosa* in the suction hoses creates some public health concerns as some studies reported the entrance of liquid from the low volume suction hose to the mouth of the patient.^{17,18} Backward flow of oral fluids and biofilm-derived microorganisms from contaminated suction hoses to the patient's mouth can be a potential source of cross-contamination and cross-infection.² As *P. aeruginosa* mostly propagate in moistened environments, suction hoses are a suitable place for their replications. Boyle et al,¹¹ presented a new disinfection system for effective decontamination of suction systems of dental units.

CONCLUSION

Suction hoses of dental units had a high level of bacterial contamination and significant contamination with *P. aeruginosa*. This significant bacterial contamination of suction systems with opportunistic pathogens could be related to improper or unsuccessful disinfection of the dental units and filtering systems of the water. There are limited published reports on the status of bacterial contamination of suction hoses of dental units, and this needs further investigation.

Disclosure

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