

# Microbial Contamination of Tray, Light Handle, and Dental Chair Handles before and after Disinfection with Deconex

Nafiseh Shamloo <sup>a</sup>, Mahsa Mir <sup>b</sup>, Hossein Godarzi <sup>c</sup>, Mahshid Namdari <sup>d,e</sup>, Fariba Rafiei<sup>c</sup>, Mojdeh Hakemi-Vala <sup>c</sup>

<sup>a</sup>Associate Professor, Dept. of Oral & Maxillofacial Pathology, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

<sup>b</sup>Student of general dentistry, School of Dentistry, Shahid Beheshti University of Medical Sciences Tehran, Iran.

<sup>c</sup>Professor, Dept. of Microbiology, School of Medicine, Shahid Beheshti University of Medical Sciences Tehran, Iran.

<sup>d</sup>Assistant Prof. Dept. of Community Oral Health, School of Dentistry, Shahid Beheshti University of Medical Sciences Tehran, Iran.

<sup>e</sup>Assistant Prof. Dept. of Biostatistics, School of Allied Medical Sciences, Shahid Beheshti University of Medical Sciences Tehran, Iran.

<sup>f</sup>PhD candidate of medical bacteriology, Dept. of Microbiology, School of Medicine, Shahid Beheshti University of Medical Sciences Tehran, Iran.

Correspondence to Mojdeh Hakemi-Vala (email: m.hakemi@sbmu.ac.ir).

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**Objectives** Surfaces commonly touched during dental procedures can serve as a reservoir of microorganisms and lead to cross-infection. The aim of the present study was to assess the microbial contamination of tray, light handle and dental chair handles before and after disinfection with Deconex (Solarsept).

**Methods** Samples were randomly collected from the tray, light handle and dental chair handles of active dental units in the Periodontics, Prosthodontics and Oral and Maxillofacial Surgery Departments of Dental School of Shahid Beheshti University of Medical Sciences. The samples were collected at two time points before and after daily surface disinfection with Deconex. The collected samples were sent to a microbiology laboratory to determine the type and number of microorganisms. Data were analyzed by Wilcoxon signed rank test ( $\alpha=0.05$ ).

**Results** Based on the culture results and according to microscopic examination and Gram staining, the highest level of bacterial contamination before disinfection with Deconex (Solarsept) was found on dental units of the Oral and Maxillofacial Surgery Department (handles and tray), with Gram-positive *Bacillus* spp. Fixed and removable prosthodontics departments did not have any bacterial contamination. Overall, a reduction in bacterial load was detected after Deconex decontamination ( $P=0.05$ ).

**Conclusion** Spraying and wiping of dental unit components with Deconex at the end of working hours decreased the bacterial growth, and this effect remained until the next working day.

**Keywords** Surface-Active Agents; Equipment Contamination; Bacteria, Aerobic; Dental Equipment

## Introduction

The oral cavity is densely populated with a wide variety of microorganisms which can be transferred to the environment and other individuals via aerosols and during dental procedures.<sup>1</sup> Many dental procedures result in production of aerosols (particles < 50  $\mu\text{m}$  in diameter) and splatters (particles > 50  $\mu\text{m}$  in diameter).<sup>2</sup> Therefore, controlling the transmission of infection in dental office environment is an important priority in dental centers due to high risk of contamination with infected oral fluids and blood.<sup>3</sup>

Dental unit surfaces and components are not in direct contact with patients; however, they may become infected during dental procedures and serve as a reservoir for microbial contamination. Such surfaces can become contaminated directly due to the spread of suspended particles and contact with blood, saliva, and body fluids, or indirectly through contact with contaminated instruments. Evidence shows that inappropriate disinfection of dental instruments can result in transmission of infectious diseases, and is a health hazard for dental personnel and patients. This can be even fatal for immunocompromised patients.<sup>4</sup> Surface contamination can be minimized by proper hand hygiene, cleaning and disinfection.<sup>5</sup> Using a safe and effective disinfectant solution with minimal damage to equipment and personnel is one of the fundamental principles of disinfection. None of the disinfectants are suitable for all purposes; thus, the choice of disinfectant is also important in medical centers.<sup>6</sup> Due to the fact that Deconex (Deconex®53 Plus; Borer Chemie AG, Switzerland) is safe for use on soft tissues and human skin, and does not cause

corrosion of metal instruments, its use is often preferred to other disinfectants in dental clinics. Also, it is useful when short exposure and drying time is required.<sup>7</sup> Thus, the aim of this study was to evaluate microbial contamination of the tray, light handle and dental chair handles before and after disinfection with Deconex.

## Methods and Materials

This descriptive cross-sectional study was carried out to investigate microbial contamination of different dental unit surfaces including the tray, light handle, and dental chair handles in four departments of Dental School of Shahid Beheshti University of Medical Sciences, Tehran, Iran including the Periodontics, Oral and Maxillofacial Surgery, and Fixed and Removable Prosthodontics during 2019-2020. This study was approved by the ethics committee of the university (IR.SBMU.DRC.REC.1399.133).

**Sample size calculation:**

Three parts of 6 dental units from the Oral and Maxillofacial Surgery, Periodontics and Fixed Prosthodontics Departments and 2 dental units from the Removable Prosthodontics Department of Shahid Beheshti Dental School were randomly chosen for sample collection at 2 times, before and after disinfection with Deconex (Deconex®53 Plus; Borer Chemie AG, Switzerland) disinfection. Thus, in this study, a total of 60 samples were collected before and also after disinfecting the surfaces with Deconex.

**Sample collection:**

Sampling was carried out before and after disinfecting the surfaces and waiting for 1 minute for the Deconex to act.

Disinfection was done by the spray-wipe-spray method with Deconex.

For sample collection, a sterilized cotton swab dipped in 0.9% saline near the flame was rubbed on an approximately 5 x 5 cm surface of each of the three parts of each dental unit separately. Then, the swabs were placed in capped tubes containing 5 mL of trypticase soy broth and transferred to the microbiology laboratory. Colony counting was done by the dilution method. Accordingly, 1 mL of each tube content was transferred to a plate containing 15 mL of melted nutrient agar at 45°C and mixed slowly to solidify. The plates were incubated at 37°C for 24 hours. The results were reported in terms of colony-forming units per milliliter (CFUs/mL). To identify the type of bacteria, the swabs were also sub-cultured on nutrient agar, blood agar and MacConkey agar and incubated at 37°C for 24 hours. Then, Gram-staining was performed on the grown colonies and standard biochemical tests were used for bacterial identification. The tubes containing the swabs were incubated at 37°C for 24 hours for use in the next steps.

Statistical analyses were performed by SPSS version 21. The Wilcoxon signed rank test was used to compare contamination frequency before and after disinfection. The significance level was considered at  $\alpha=0.05$ .

## Results

In this study, microbial contamination of different surfaces of 24 dental units including the trays, light handle, and dental

chair handles from the Periodontics, Oral and Maxillofacial Surgery, and Fixed and Removable Prosthodontics Departments of Dental School, Shahid Beheshti University of Medical Sciences were studied at two times before and after disinfection with Deconex. A total of 60 samples were collected before and after disinfection from three surfaces of each unit from the aforementioned departments. Table 1 presents the frequency percentage of contaminated and sterile samples before and after disinfection.

According to Table 1, 54 (90%) and 55 (91.7%) out of 60 samples were sterile before and after disinfection with Deconex, respectively. Also, 6 samples (10%) and 5 samples (8.3%) were contaminated before and after disinfection with Deconex spray, respectively.

According to Table 1, dental chair handles in the Oral and Maxillofacial Surgery Department were the most contaminated part both before and after disinfection. Also, the cleanest sample before and after disinfection with Deconex was obtained from the Fixed Prosthodontics Department.

According to the results of the Wilcoxon signed rank test, there was a statistically significant reduction in the level of bacterial contamination after surface disinfection compared with before ( $P=0.05$ , Table 2).

The highest number of bacteria before and after disinfection was related to dental units in the Oral and Maxillofacial Surgery and Removable Prosthodontics Departments, respectively. The only identified bacterial isolate was *Bacillus* spp. according to the colonial morphology, positive Gram-staining, and positive catalase test.

**Table1-** Frequency percentage of sterile and contaminated samples before and after disinfection

| Table1- Frequency percentage of sterile and contaminated samples before and after disinfection |                      |                     |        |              |        |                    |        |              |        |                   |
|------------------------------------------------------------------------------------------------|----------------------|---------------------|--------|--------------|--------|--------------------|--------|--------------|--------|-------------------|
| Departments                                                                                    | Surface              | Before disinfection |        |              |        | After disinfection |        |              |        | Total<br>I<br>(%) |
|                                                                                                |                      | Sterile             |        | Contaminated |        | Sterile            |        | Contaminated |        |                   |
|                                                                                                |                      | n                   | (%)    | n            | (%)    | n                  | (%)    | n            | (%)    |                   |
| Periodontics                                                                                   | Trays                | 5                   | (83.3) | 1            | (16.7) | 5                  | (83.3) | 1            | (16.7) | (100)             |
|                                                                                                | Light switches       | 6                   | (100)  | 0            | (0)    | 6                  | (100)  | 0            | (0)    | (100)             |
|                                                                                                | Dental chair handles | 5                   | (83.3) | 1            | (16.7) | 6                  | (100)  | 0            | (0)    | (100)             |
| Oral and<br>Maxillofacial<br>Surgery                                                           | Trays                | 5                   | (83.3) | 1            | (16.7) | 4                  | (66.7) | 2            | (33.3) | (100)             |
|                                                                                                | Light switches       | 5                   | (83.3) | 1            | (16.7) | 6                  | (100)  | 0            | (0)    | (100)             |
|                                                                                                | Dental chair handles | 4                   | (66.7) | 2            | (33.3) | 5                  | (83.3) | 1            | (16.7) | (100)             |
| Fixed<br>Prosthodontics                                                                        | Trays                | 6                   | (100)  | 0            | (0)    | 6                  | (100)  | 0            | (0)    | (100)             |
|                                                                                                | Light switches       | 6                   | (100)  | 0            | (0)    | 6                  | (100)  | 0            | (0)    | (100)             |
|                                                                                                | Dental chair handles | 6                   | (100)  | 0            | (0)    | 6                  | (100)  | 0            | (0)    | (100)             |
| Removable<br>Prosthodontics                                                                    | Trays                | 2                   | (100)  | 0            | (0)    | 2                  | (100)  | 0            | (0)    | (100)             |
|                                                                                                | Light switches       | 2                   | (100)  | 0            | (0)    | 2                  | (100)  | 0            | (0)    | (100)             |
|                                                                                                | Dental chair handles | 2                   | (100)  | 0            | (0)    | 1                  | (50)   | 1            | (50)   | (100)             |
| Total                                                                                          |                      | 54                  | (90.0) | 6            | (10)   | 55                 | (91.7) | 5            | (8.3)  | (100)             |

**Table 2-** Colony count (CFUs) of the sampled surfaces before and after disinfection

| Departments                    | Before disinfection                 |             | After disinfection                   |             |
|--------------------------------|-------------------------------------|-------------|--------------------------------------|-------------|
|                                | Log (Number of microorganisms+1)/mL |             | Log (Number of microorganisms+1) /mL |             |
|                                | Median (Q1, Q3)                     | Mean (SD)   | Median (Q1, Q3)                      | Mean (SD)   |
| Periodontics                   | 0 (0, 0)                            | 0.67 (1.94) | 0 (0, 0)                             | 0.24 (1.00) |
| Oral and Maxillofacial Surgery | 0 (0, 1.25)                         | 1.11 (2.14) | 0 (0, 0)                             | 0.69 (1.59) |
| Fixed Prosthodontics           | 0 (0, 0)                            | 0 (0)       | 0 (0, 0)                             | 0 (0)       |
| Removable Prosthodontics       | 0 (0, 0)                            | 0 (0)       | 0 (0, 1.17)                          | 0.78 (1.92) |
| Total*                         | 0 (0, 0)                            | 0.53 (1.62) | 0 (0, 0)                             | 0.36 (1.19) |

\*Exact P value=0.05

Q1 and Q3 stand for the first and third quartile.

## Discussion

Dental clinics can have a high risk of infection transmission such as hepatitis and HIV if infection control measures are not precisely followed.<sup>2</sup> Although the primary source of pathogens is the patient's endogenous flora, an estimated 20% to 40% of healthcare-associated infections involve microorganisms being introduced to patients from the hands of healthcare workers.<sup>8</sup> Contamination of hands of healthcare workers could in turn result from either direct patient contact or indirectly from touching contaminated surfaces. Less commonly, a patient could become colonized with a nosocomial pathogen by direct contact with a contaminated surface.<sup>9</sup> Similar to other dental instruments, different surfaces of dental units are easily contaminated. Therefore, if they are not properly disinfected, they could serve as a source of cross-contamination.

In the present study, we investigated the frequency of microbial contamination of dental unit surfaces in different departments before and after disinfection with Deconex (an available disinfectant suitable for medical surfaces). Furthermore, bacillus species were the only isolated bacteria, which are commonly found in the soil, water, and air, and are not directly pathogenic in healthy individuals. Although they are opportunistic bacteria, they can cause various diseases in patients who are more susceptible to opportunistic pathogens such as pregnant women, elderly patients, cancer patients, AIDS patients, and other immunocompromised patients. Presence of bacillus species on an equipment can be a sign of presence of dust in that place, which was also reported in a previous study similar to the present study.<sup>10</sup>

Khorakiyan et al,<sup>11</sup> in their study declared surface contamination mainly by Gram-positive bacteria. In their study, the Prosthodontics Department of Mashhad Dental School showed the highest rate of contamination on the headrest of dental units and light handles of Endodontics and Prosthodontics Departments by *Bacillus* spp. Also, Khorakiyan et al.<sup>11</sup> reported contamination of light handles and dental chair handles and stated that they were the most infected parts of dental units in the Prosthodontics Department of Mashhad University of Medical Sciences. The most common type of bacteria observed in these areas in their study was *Bacillus* spp., which is quite similar to the current study. Detection of *Bacillus* spp. in Mashhad Dental School, and also in the present study indicates the resistance of these bacteria to disinfection, which can be due to their spore production in hard environmental conditions as in dust. Similarly, Esfahani et al,<sup>12</sup> in Qazvin stated that contamination of dental surfaces was mostly due to Gram-positive *Staphylococcus epidermidis* and Gram-positive *Bacillus* spp., which remained after disinfection of dental surfaces. Similar results were reported by Amin et al,<sup>13</sup> in Ahvaz. In their study, evaluation of the effect of Deconex and sodium hypochlorite on bacteria isolated from dental units showed that *Bacillus* spp. (48%) were the most frequently encountered isolates, followed by *Staphylococcus* spp. (26%). In addition, the results of their study showed that Deconex had promising results for

decontamination of tested microorganisms, and it was recommended for disinfecting dental units and environment.

Saboori et al.<sup>14</sup> examined the effect of Micro10+ and Deconex 53 Plus on dental instruments and showed that Deconex 53 Plus (1%) and Micro10+ (2%) had an acceptable disinfecting effect on dental instruments after 1 hour of exposure (no bacterial growth after contact with Micro10+ and Deconex 53 Plus). In addition, Sharafeddin et al.<sup>7</sup> demonstrated that after disinfecting the high-speed and low-speed hand-pieces with three disinfectant solutions including Deconex, Sidex and Microtone, no bacterial growth was observed. The results of the above-mentioned studies indicated that bacterial growth after disinfection of dental units of Removable Prosthodontics Department in our study may be due to careless disinfection by the personnel. Ghasemi et al.<sup>15</sup> showed that Deconex eradicated all microorganisms after both 5 and 10 minutes. In a study conducted by Bagheri et al,<sup>16</sup> a considerable reduction was seen in the number of bacteria in the pediatric dentistry, restorative dentistry, orthodontics, and oral medicine departments. Similar to the studies by Bagheri et al,<sup>16</sup> and Ghasemi et al,<sup>15</sup> the results of the present study showed a significant reduction in the number of bacteria in the Periodontics, Oral and Maxillofacial Surgery, and Fixed Prosthodontics Departments. However, the duration of disinfection in the above-mentioned studies was different from that in the present study.

Hemmati et al.<sup>17</sup> investigated the antimicrobial effect of SeptiTurbo, Deconex and 0.525% sodium hypochlorite spray on alginate. In their study, 126 alginate impressions were contaminated with *Staphylococcus aureus* and *Pseudomonas aeruginosa* and were then exposed to the three disinfecting agents mentioned above. The samples were then wrapped in paper towels and stored in plastic bags for 1, 3 and 5 minutes. The results showed that the best effect was related to SeptiTurbo, and Deconex had the least effect on these bacteria. In the present study, although we noticed a reduction in the number of bacteria in most examined samples after disinfection with Deconex, statistical analysis showed a significant reduction in microbial count after the use of Deconex only in Fixed Prosthodontics Department.

In the current study, the rate of contamination of trays, light handles, and dental chair handles was evaluated. Different studies have investigated different surfaces. In a study by Anjum et al,<sup>18</sup> contamination of laptop keyboards in different clinical departments of a school of dentistry was evaluated. Although laptop keyboards were not investigated in the present study, existence of Gram-positive *Bacillus* spp. as the most commonly isolated bacteria in the present study indicates contamination with dust, which can contaminate other instruments in the dental clinic as well.

Winter et al.<sup>19</sup> investigated the contamination of dental hand pieces because they may become contaminated during dental procedures and increase the risk of iatrogenic infections. Although infection of hand pieces was not evaluated in the present study, infected hand pieces left on surfaces may increase the risk of surface contamination in dental clinics. In a study conducted by Valian et al,<sup>20</sup> the surfaces studied were

almost similar to the present study. They assessed the contamination rate of headrests, light handles, and tray handles.<sup>20</sup> The results of their study were consistent with our results, showing that light handles had the lowest rate of contamination while headrests and tray handles had the highest rate of contamination.

## Conclusion

According to the results of the present study, it may be concluded that contamination of dental unit surfaces is inevitable, indicating the importance of disinfecting different surfaces of dental units at intervals between patients in order to prevent cross-infection. Deconex spray can partially reduce the load of bacteria on surfaces after wiping for 1 minute. However, microbial contamination was observed at almost all assessed surfaces at one or both sampling times, indicating

that further monitoring is needed to prevent cross-infection. Although only *Bacillus* spp. were isolated in this study, it is important to control them due to the possibility of infecting vulnerable patients through contaminated dust.

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## Conflict of Interest

No Conflict of Interest Declared ■

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