

Original Article

The Protective Role of Front-Closed and Front-Open Gowns Against *Staphylococcus Aureus* Contamination of Dental Students before and after Restorative Treatments

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KEY WORDS

Dental Health Services;
Conservative Treatment;
Staphylococcus;

ABSTRACT

Statement of the Problem: Due to the close contact with patients during dental treatments, dentists and those affiliated to the dental profession are at higher risk for various infections. Infection prevention in dentistry is an important topic that has gained more interest in recent years.

Purpose: We aimed to evaluate the protective role of front-closed and front-open gowns against *staphylococcus aureus* contamination of dental students before and after restorative treatments.

Materials and Method: Sixty male dental students performed the restorative treatments on the teeth of the patients in the front-closed and front-open gowns groups. Before and after the treatment, the wet sterile swab samples were collected from the students' neck and anterior part of the chest. The samples simultaneously cultured on the blood agar and the Staphylococcus-specific medium using spread plate method. Finally, the colonies were counted within 24-48 hours.

Results: The mean of the total colony count increased in both groups of front-open (787.8 ± 88.91) and front-closed gowns (630 ± 122.7), but the changes were significant only in the front-open gown group ($p \leq 0.001$). Compared to the front-closed gown group (430 ± 71.08), the total colony count of *staphylococcus aureus* in the front-open gown group (490.3 ± 62.5) was increased significantly ($p \leq 0.001$).

Conclusion: We confirmed that dental students occupationally exposed to the bacterial agents and even simple minor changes in gown could considerably decrease the contamination. Education about bacterial transmission, as well as infection prevention and control measures is necessary for dental students, especially when they participate in clinical practice.

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Received October 2017;
Received in Revised form January 2018;
Accepted February 2018;

Cite this article as: Afroozi B., Mardani M., Motaghi A., Tahmorespour A. The Protective Role of Front-Closed and Front-Open Gowns Against *Staphylococcus Aureus* Contamination of Dental Students before and after Restorative Treatments. J Dent Shiraz Univ Med Sci., 2018 December; 19(4): 305-310.

Introduction

During dental procedures, the surrounding air is contaminated with the saliva, blood, and droplets, which can transmit the pathogenic agents such as bacterial infections to the practitioner, personnel, and other pa-

tients. [1-4] These particles can be airborne for a long time. Moreover, there are less than $50\mu\text{m}$ in diameter and spread much more at the 60-cm distance from the source of contamination; therefore, the smaller particles make their way to the deep parts of the respiratory sys-

tem. [5-9] The ventilation rate, humidity, and size of the particles affect the persistence of the clinic air contamination. [10-11] However, little is known about the real risks of cross-transmission in the dental healthcare setting. Due to the frequent exposure of dental personnel to the blood and saliva, an occurrence of the special infectious diseases was increased among this group compared to what happens in the whole society. [12] The blood residue was found particularly under the nails of the thumb and index finger in 80% of dentists, in which 40% of the blood residues remained for a week. [13] The respiratory infections are more prevalent in dentistry in comparison to other medical fields. [3-4, 14] *Staphylococcus aureus* is a major human pathogen associated with high mortality that is easily isolated from the dental clinical surfaces, dental patients, and dental healthcare professionals. *Staphylococcus* is also favorable due to its proliferation ability in normal environments, which minimizes the technical problems of isolation. Furthermore, it is easily identified through the simple bacteriological tests. [15-16] *staphylococcus aureus* is a frequent isolate in the oral cavity and perioral region. [17-20] Previous reports show the higher frequency of *staphylococcus aureus* among dental students compared to non-dental students especially methicillin-resistant *staphylococcus aureus*, which are very important for their resistance to many commonly used antibiotics. [21-22] A study examined the congestion and count of the *staphylococcus aureus* in samples taken from the nose, hands, and tongue of the dental students and their patients, as well as the clinic environment before and after the work shift. The results revealed the presence of *staphylococcus aureus* in 74.3% of patients' samples and 14.4% of the dental students' samples. In addition, *staphylococcus aureus* was found in the samples from clinical environment before it had opened for the patients, which is increased through the visiting time. [23] Therefore, the current study aimed to evaluate the protective role of front-closed and front-open gowns against *staphylococcus aureus* contamination of dental students before and after restorative treatments.

Materials and Method

Sixty male dental students were selected out of the students of Khorasgan University, Isfahan, Iran. They were

all supposed to do restorative treatments on the teeth no. 4, 5, 6 and 7 of patients. The ethical issues were considered regarding the guidelines of Shiraz University of Medical Sciences. The students were divided into two equal groups (n=30); one wearing front-closed and the other wearing front-open gowns. An operator, wearing mask and gloves, took samples from the students' neck and the frontal part of the chest before and after performing the restorative treatments in each working shift. A wet sterile swab used for the sampling. The swabs were stored in phosphate buffer solution or 0.9% sterile sodium chloride solution and the full separation was performed for the bacteria adhering to the swab.

Then, the bacteria were cultured on the two bacterial culture media using spread plate method, the blood agar that used to grow all organisms and mannitol salt agar that used for isolation and identification of *staphylococcus* colonies, particularly the pathogenic ones (*staphylococcus aureus*). The plates were incubated at 37°C (Memmert, Germany) and the colonies were counted after 24-48 hours. The colony-forming units were used to quantify the microbiological results and analyses were performed using the statistical package for the social sciences software. The data expressed as the mean ± standard deviation. The independent and paired t-tests used as appropriated and a p-value of less than 0.05 considered as statistically significant.

Results

When comparing two groups of front-closed and front-open gowns before and after restorative treatment (Table 1), data show that mean of bacterial colonies increased in both groups after restorative treatment. However, these changes were significant only in the front-open gowns ($p \leq 0.001$). The mean increase in the colony count was 83.6 and 366 in the front-closed and front-open gowns groups, respectively. The independent t-test proved this difference as statistically significant ($p = 0.03$).

Table 1: The protective role of front-open and front closed gowns against bacterial contamination during restorative treatment

Time	Front-closed gown (mean ± SD)	Front-open gown (mean ± SD)
Before treatment	546.4 ± 82.1	421.8 ± 52.4
After treatment	630 ± 122.7	787.8 ± 88.91
p Value	0.41	<0.001

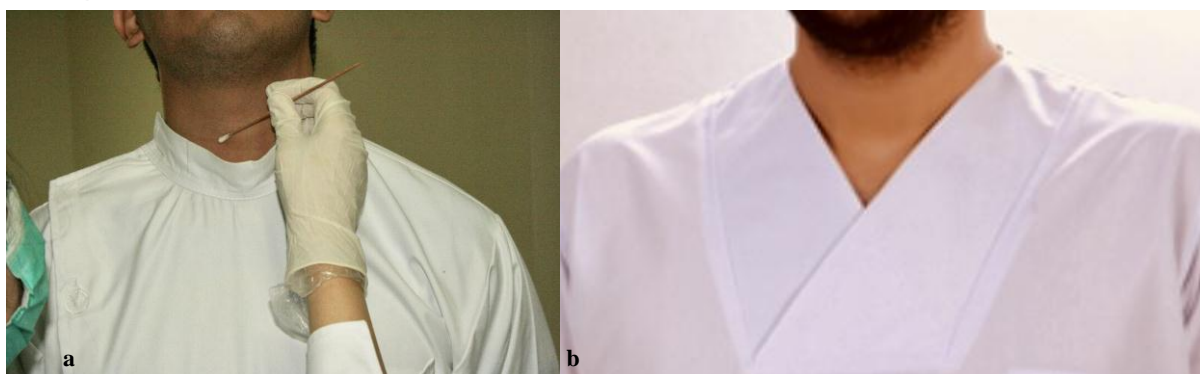


Figure 1a: Close front gown, **b:** open front gown

On the other hand, the mean of staphylococcus are increased in both study groups after restorative treatment (Table 2). Paired t-test revealed that the changes were significant only in the front-open gown group ($p \leq 0.001$). The mean increase of staphylococcus count was 60.2 in front-closed and 218 in front-open gown groups. Independent t-test showed that this difference was statistically significant ($p = 0.02$). (Figure 1)

Table 2: The *staphylococcus aureus* counts in the study groups before and after the treatment

Time	Front-closed gown (mean \pm SD)	Front-open gown (mean \pm SD)
Before treatment	369.8 \pm 47.1	272.3 \pm 38.5
After treatment	430 \pm 71.08	490.3 \pm 62.5
p Value	0.301	<0.001

Discussion

Currently, there is a little information available based on the local research about the efficacy of protective gown against the microbial contaminations. The gown is considered protective during dental procedures. Hence, the present study designed to evaluate not only the efficacy but also the difference between the two types of front-closed and front-open gowns. In addition, we selected the *staphylococcus aureus* as the major human pathogen associated with high mortality rate. The resistance to commonly used antibiotics allows it to stay alive longer. [15-16, 21-22]

Our finding shows when the protective equipment was used, the rate of bacterial colonies considerably decreased. The front-closed gown was strongly protected the dental students during restorative treatments while the front-open gown shows the very highly significant increase in the total counts of bacterial colonies. Similarly, the front-closed gown was better protects the dental students against *staphylococcus aureus*. These differences may reflect the better protective role of the

front-closed gown. The findings of the present study declare the presence of *staphylococcus aureus* as the source of contamination.

This is the first study to identify the efficacy of protective gown against the bacterial contamination among dental students. In the study from Mexico, dental students are more significantly carried methicillin-resistant *staphylococcus aureus* than non-dental students did. [21] Moreover, nasal colonization of methicillin-resistant *staphylococcus aureus* occurs in some dental students, especially those who have clinical experience. [15] Although the filtering efficiency of masks tested varied from 14 to 99%, [24] Muhadi *et al.* [25] investigated the bacterial contamination of white coats in three medical colleges of Malaysia and found that the incidence of *staphylococcus aureus* was 32% on short-sleeved and 54% on long-sleeved white coats. The bacteria are commonly isolated from the pockets and sleeves of white coats since these are the sites of frequent contact. [25-26] In another study, Rautemaa *et al.* [27] showed significant contamination of the room where high-speed rotating instruments were used. In addition to the routine use of masks and gloves, the universal use of pre-procedural rinses and high-volume evacuation is recommended to diminish the contaminating risk in dental clinics. [28-29] As infection prevention in dentistry is an important topic, recent studies focused on the design of new gowns that is protective enough and improved the ergonomic structure of the sleeves and thermal comfort of breathable zones. [30-31]

Concerning the type of bacteria isolated from the gown, some studies reported other bacteria (rather than staphylococcus) that were possibly nonpathogenic. [25, 32] The present study did not investigate other pathogenic factors; nevertheless, dental activities can justify

the source and origin of some diseases that transmitted through blood, saliva, and air particles. Although such transmissions occur only in a clinic, the patients are likely to be the source of contamination and spread of the disease to others.

On the other hand, the rate of bacterial contamination shows that dental jobs can inherently cause the transmission of pathogenic agents. [4] Regarding this fact that a percent of isolated organisms were cultivable on the mannitol salt agar, these agents are inherently pathogenic and could jeopardize the dentist and/or patient's health. Moreover, this indicates the chance of transmission of other pathogenic agents, too. Although it is clear that a part of contamination is the result of direct transmission of bacteria, and another part through the sedimentation of airborne bacteria, the extent of each is still unknown. In addition, the issue has not been directly investigated in the other studies. However, with consideration of the similar studies that reported the higher contamination in special part of the gown, which have a higher contact with contaminated particles and droplets from the patient's mouth, it can be concluded that the most part of contamination of the gown is the result of the close and direct contact. [25-26, 33-35]

The above-mentioned studies showed that the sleeves and pockets of the gown were the most contaminated parts. The center for disease control suggests that wearing gown, mask, protective glasses, and rinsing the patient's mouth with antibacterial agents like chlorhexidine before the dental procedures could control the contamination. [36-37] A study showed that the clinic air was more contaminated during scaling compared to other dental activities. [36] Four hours after the initiation of the dental procedure, the air contamination was increased by 3.3 times. The maximum air contamination and the higher variety of microorganisms were observed at the final hours. [38-39] Hence, increasing the knowledge based on local research about the transmitted microbial contaminations in dental clinics can help prevent such contaminations.

Conclusion

We confirmed that dental students occupationally exposed to bacterial agents and even the minor changes in the protective gown can remarkably decrease the contamination. Education about bacterial transmission, as

well as infection prevention and control measures is necessary for dental students, especially when they participate in clinical practice. This study could be considered as the first step in performing such useful and practical studies and further research must be designed based on the simple but effective practical methods.

Acknowledgement

The author would like to express deep appreciation to Dr. Ahmad Motaghi and Dr. Arezoo Tahmourespour, as well as Dr. Bassiri for their unsparing help with completing this project.

Conflict of Interests

The authors declare that they have no conflict of interests.

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