Original Article

Is safeguard compromised? Surgical mouth mask harboring hazardous microorganisms in dental practice

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Abstract

Context: Dental personals are more prone to acquire infections through saliva and aerosols. Surgical masks (SMs) are used by dental professionals to reduce microorganism shedding from the mouth, nose, and face of the patient. **Aims:** This aim of the study is to assess the bacterial and fungal presence and their prevalence over the contaminated surgical mask in dental practice. **Settings and Design:** This study was conducted with sample size 240 used surgical masks collected from 130 dental personnel. **Subjects and Methods:** A cross-sectional questionnaire survey was conducted with analysis involved inoculation of external and internal surfaces in an enrichment media for isolation of bacteria and fungi. Group of isolated bacteria and fungi were preliminarily identified by morphology and using Gram's stain and lacto-phenol cotton blue mediums. Data were analyzed using paired *t*-test; the significant level of $P < 0.050$. **Results:** Microbiological analysis of samples revealed bacteria *Staphylococci* 26.35% as a predominant species followed by *Pseudomonas* 17.82% and *Streptococci* 15.50%. *Aspergillus* fungal species was also present in 6.97%. Mean ± SD of bacterial and fungal contamination on inside/outside area of the used masks was 48 ± 26 and 180 ± 110 cfu/ml/piece and 14 ± 6 and 32 ± 13 cfu/ml/piece, respectively, $P < 0.001$. The used surgical masks from dental department personnel working outpatient dental department had relatively higher bacterial and fungal contamination than the other dental departments. **Conclusions:** To reduce a load of microorganism contamination in the clinical environment, more awareness campaigns should be implemented in daily routine and air quality of dental departments should be improved with necessary protective measures.

Keywords: Dental department, dental personal, microbial contamination, surgical mask

Introduction

In hospitals and dental clinics, the major risk of infection for healthcare workers and dental professionals is the transmission from patients, through contaminated instruments or pieces of equipment and the hospital surroundings.[1,2] In hospital-acquired infections, surgical site infections (SSIs) and dental clinics play a role in more than 20% of infections.[3,4] It is by the Centre for Disease Control and Prevention that 2.7% of surgical procedures are complicated by patient working areas because of the presence of various infections.[5] With over 6 billion microbes/ml of saliva colonizing in every individual's oral cavity, the dental clinic is an axis of microbial pursuit. To maintain international guidelines and precautions for infection control, various protective measures have been taken to control the contamination of the dental clinics and to protect the patient and the dental personal. The significant part of infection control is the clinician's mouth mask which acts as a strike to microorganisms from the touch of possibly contaminated hands to the contaminated aerosols due to routine ultrasonic scaling and high-speed handpieces.[6,7]

Spooner JL in 1967 in his review mentioned that Weaver and Capps were the first who described in 1915 that face masks are effective against contagious disease as well as cross infections.[8] In the dental clinics, the dentist mouth mask, major protective

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equipment comes in direct closeness to the patient and is an area of significant concentration of the aerosol but the literature available showed that the surgical mouth mask might not be sufficient to protect the person from air-borne pathogens and might also be the origin of various air-borne and droplet infection.[9,10] Hence, the present study was conducted to assess the bacterial and fungal presence and their prevalence over the contaminated surgical mask in dental practice.

Subjects and Methods

This study was conducted to assess the bacterial and fungal contamination and their prevalence on 240 used surgical face masks (face mask earloop triple-layered non-woven polypropylene) from 130 dental personnel during the 2 months period from September to November 2019. The participants of the study were of both genders aged 20 to 40 years, and have voluntarily participated and gave the signed consent form. The study was conducted with the ethical approval of the ethical committee. A cross-sectional survey was conducted using a self-administered questionnaire, consisting of seven questions used to assess the knowledge and practice of participants regarding the use of mouth mask.

The 130 dental clinic participants were working from different departments such as: Department of oral medicine and radiology, department of oral and maxillofacial surgery, department of pedodontics, department of endodontics, department of periodontics, and dental emergency room of the college. Their used surgical masks maximum of 30 min duration, which were 240 in total, were collected in sterile zip lock pouches to culture and analysis of the bacterial and fungal counts on the inside and outside surface of the mouth masks. Inside and outside surface of the mouth masks were separated by sterile technique and put in a sterile container consisting of trypticase soy broth for 25 min. A spread plate method was used for determining total bacterial and fungal counts. General bacteria of the specimen are cultivated in a plate count agar (PCA) and general fungi of the specimen are cultivated in a Sabouraud 4% dextrose agar (SDA). The plates were incubated at 37°C for 48 h to get the bacterial counts, and incubated at room temperature for 7 days for fungal counts. The observation was done daily for 10 days. With the method given by Larone 1995, preliminarily identification of microorganism's species present was done by Gram's stain and microscopic morphology (lactophenol cotton blue) of the isolated bacteria and fungi was performed.[11] After incubation, the bacterial and fungal colonies were counted and calculated to express as colony-forming unit/m3 (cfu/m3) by a formula as follows:

Total counts (colony-forming unit/m3 or cfu/m3) = [Total colonies × 1000]/250

Collected data of the study were analyzed using Statistical Package for Social Sciences (SPSS) software version 17 using descriptive frequency method. Results are represented as frequency and percentage to estimate the prevalence of antimicrobial agents present in the samples as well the responses of participants. Mean and standard deviation (SD) for describing bacterial and fungal counts were analyzed using the paired *t*-test and to compare between the mean of microbial contamination on the outside and inside areas of used masks.

Results

A total of 240 used surgical masks were collected in the present study from 130 dental professionals from various departments to assess the bacterial and fungal contamination. Out of 130 participants, 73 were males and 57 were females. Questionnaire variables analysis revealed that 66.9% of participants wear their mouth-masks while working at chair-side and about 33% wear them all the time. 67.6% of the study participants keep their mouth

Table 1: Participants response based on questionnaire

Variables		Results *n* (%)
Gender (*n*-130)	Male	73 (56.1)
	Female	57 (43.8)
Time period of wearing mouth mask	Only Chairside	87 (66.9)
	Whole working time in clinics	43 (33)
Frequency of changing mouth mask	For every patient	89 (68.4)
	Once daily	41 (31.5)
Practice of exchanging mouth mask with friends	Yes	35 (26.9)
	No	95 (73)
Storage of mouth mask	Working apron pockets	25 (19.2)
	Books	17 (13)
	Instrument tray	88 (67.6)
Working on the case without mouth mask	Yes	55 (42.3)
	No	75 (57.6)
Awareness regarding used mouth mask causing cross-contamination if touched once	Yes	111 (85.3)
	No	19 (14.6)
Disposal of mouth mask with household waste	Yes	21 (16.1)
	No	109 (83.8)

masks in the instrument trays, while 19.2% in their clinic working apron pockets. 85.3% participant responded that mouth-mask can cause cross-contamination when touched. In the present study, 42.3% participant attempted cases without a mouth mask and about 26.9% stated that they have exchanged their mouth-masks with others. 16.1% of participants stated that a mouth-mask can be disposed along with the normal household waste [Table 1].

All bacterial and fungal species were identified in samples by their morphological appearance and biochemical reaction characteristics. Table 2 results revealed that out of 240 samples collected, bacterial species was predominated by *Staphylococci* species 26.35% followed by *Pseudomonas* 17.82% and *Streptococci* 15.50%. *Aspergillus* fungal species was also present in 6.97%.

In the present study, results stated that the mean ± SD of bacterial contamination on the inside area of the used masks was 48 ± 26 cfu/ml/piece and 180 ± 110 cfu/ml/piece from the outside area. It was significantly different, $P < 0.001$. The used surgical masks from dental department personnel working outpatient dental department had relatively higher bacterial contamination than the other dental departments. [Table 3] For fungal contamination, mean ± SD on the outside area of the used masks was significantly higher than the inside area 14 ± 6 and 32 ± 13 cfu/ml/piece, $P < 0.001$. The used surgical masks from dental personnel working in the outpatient dental department had relatively higher fungal contamination than the other dental departments [Table 4].

Table 2: Number and percentage of prevalence of microorganisms

Organism indentified	Number	%
Pseudomonas	46	17.82
Klebsiella	28	10.85
Acinetobacter	22	8.52
E. coli	36	13.95
Staphylococci	68	26.35
Betahemolytic *Streptococci*	40	15.50
Aspergillus species	18	6.97
Total	258	100

Table 3: Bacterial contamination on used surgical masks by studied dental depts.: Inside and outside areas of the used masks (*n*=240)

Studied Dept to collect sample	Mean±SD of bacterial contamination (cfu/ml/piece)	
	Inside mask	Outside mask
Outpatient department (*n*=40)	93±62	232±137
Oral and maxillofacial surgery (*n*=40)	39±13	231±134
Dept of pedodontics (*n*=15)	30±13	149±87
Dept of endodontics (*n*=45)	39±20	146±95
Dept of periodontics (*n*=65)	39±21	161±112
Dental emergency room (*n*=35)	49±25	162±94
Total (*n*=240)	48±26*	180±110*

*Statistically significant difference by paired *t* test, *P*<0.001

Table 4: Fungal contamination on used surgical masks by studied dental depts.: Inside and outside areas of the used masks (*n*=240)

Studied Dept to collect sample	Mean±SD of fungal contamination (cfu/ml/piece)	
	Inside mask	Outside mask
Outpatient department (*n*=40)	16±7	37±13
Oral and maxillofacial surgery (*n*=40)	11±6	34±13
Dept of pedodontics (*n*=15)	15±9	25±16
Dept of endodontics (*n*=45)	14±5	32±13
Dept of periodontics (*n*=65)	15±5	25±7
Dental emergency room (*n*=35)	15±3	35±13
Total (*n*=240)	14±6*	32±13*

*Statistically significant difference by paired *t* test, *P*<0.001

Discussion

In dental clinics, it has been assumed that bloodborne pathogens such as hepatitis B virus and hepatitis C virus can be transmitted through the inhalation of blood products in the aerosol, which obtain their main entry inside the body via the microabrasion in the mucosa of the airway.[12] In 1969 Micik, proposed the term "aerosol" and "splatter" in the dental clinics, which has a capacity to produce numerous health risks, among which tuberculosis and severe acute respiratory syndrome are considered fatal.[13,14]

In the present study, a cross-sectional questionnaire revealed that the study participants were not properly aware of the proper usage of mouth mask in clinical practice. Most of the participants have claimed to change mouth mask after every case but storage habit was not adequate and keeping mouth mask in instrument trays and working apron pockets causes external contamination, the main reason for a microbial load on the outer surface of a mouth mask. Studies done by Banu *et al.* and Vargese *et al.* stated that white coat pockets harbor various bacteria which can lead to infections in the clinical working area.[15,16] Monalisa *et al.* in their study found that 47% of participants reported keeping their mouth mask in instrument trays while 44% store mouth mask in apron pockets, which was consistent with the present study.[17]

In dental clinics, the usage of ultrasonic scaler tips which produces 300 colony forming units/cubic feet of bacteria and burs of high-speed handpieces is considered as the main source of aerosol production.[15,18] Mareeswari *et al.* stated that microorganisms which are commonly present in the dental clinic working contaminated surfaces may include Gram-positive *Streptococcus* spp., *Staphylococcus* spp., and Gram-negative *Pseudomonas* spp., *E. coli,* and *Aspergillous* spp.[7] Most of the micro-organisms isolated from the used surgical mouth mask were potentially pathogenic and Gram-positive bacteria were isolated in majority of number from the present study which remains consistent with the study done by Pospero *et al.* where total bacteria from the dental professional face mask and from the contaminated surfaces in the dental clinics had 42% of *Streptococcus* species, 41% of *Staphylococcus*, and 17% of Gram-negative bacteria.[19]

The present study was performed for the assessment of bacterial and fungal contamination on the used surgical masks among dental professionals. The disposable surgical mouth masks were at first developed to strain aerosols containing microorganisms discharged from the mouth and nose, and probably to shield the human respiratory system from fine airborne particles that are known to be linked with various respiratory disorders.[2] Normally surgical mouth mask is developed to prevent microorganisms from the nose and oral cavity of the dental operator from spreading to others. However, surgical mouth mask is not well designed to filter particles of some infectious agents, especially *M. tuberculosis*.[9] In the present study, bacteria and fungi were significantly more in number on the outer surface of contaminated used surgical mask which was found similar to study done by Luksamijarulkul *et al.* with the presence of bacteria and fungi on outer surface of mask 166 ± 199 cfu/ml/piece and 34 ± 18 cfu/ml/piece, $P < 0.001$ respectively.[2] In 1998 Kretzer and Larson stated that some used mask behaviors probably increased the microbial contamination on the masks.[20] Therefore, it is suggested that surgical masks could filter most of microorganism from the environment of dental clinics. Luksamijarulkul *et al.* in their study found that the majority of isolates are *Staphylococcus aureus* (41%) and *Pseudomonas* species (38%) similar to the present study, and the most isolated fungi were *Aspergillus* species (44%) and *Penicillum* species (25%) from the isolated incubated colonies, while in our study, only *Aspergillus* spp. was present as fungal colony.[2]

Gram-positive *Streptococci,* coagulase-negative *Staphylococci,* and *Aspergillous* fungi that are common microorganism in dental clinics have increased risk of cross-infection to patients with prosthetic devices, intravascular catheters, and immune-compromised patients.[20] The American Conference of Governmental Industrial Hygienists (ACGIH) suggested that the optimal level of bacterial counts or fungal counts in the indoor air of any patient working areas should be less than 500 cfu/m3.[21] However, World Health Organization proposed that the microbial counts in the medical and dental patient operating places should be less than 300 cfu/m3 and for individuals or patients with immune-suppression, it should be less than 100 cfu/m3.[22-25]

Conclusion

Dental clinics are places with a high concentration of various infectious microorganisms, present on the surgical mouth masks used by dental professionals. Moreover, as the saying goes: "Do not think any virtue trivial, and so neglect it; do not think any vice trivial, and so practice it." Complete elimination of the risk raised by the aerosol is difficult but it can be minimized by using sterile water or sterile saline in dental water lines, draining and flushing water for a sufficient period of time before beginning the dental clinical work, performing periodic chemical treatment of dental chair water lines, and good housekeeping should be implemented. Moreover, dental professionals should change the mask after each dental operatory procedures, especially those beyond 2 h. Double-layered surgical mask or 95% efficiency for aerosol particles of 3.0 to 5.0 μm in diameter should be provided to patients as well to prevent cross-contamination.

Declaration of patient consent

The authors certify that they have obtained all appropriate participant consent forms. In the form, the participants have given their consent for their images and other clinical information to be reported in the journal. The participants understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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