ORIGINAL ARTICLE

Prevalence of microbial colonization in the mouth mask used by the dental professionals

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Abstract

Background: Potential transmission of disease to personnel during dental procedures has become a source of increasing concern to the dental profession. Certain dental procedures may potentially contribute to the transmission of infections in the dental operatory. Hence, it would be worthwhile to analyze the microbiology of the mouth mask used by dental personnel to minimize cross infection and to improve patient and clinician safety.

Aims and Objectives: The aim of the study was to identify, evaluate, and categorize the microorganisms colonizing the mouth mask used by general dental practitioners.

Materials and Methods: The swabs for the study were taken from the triple layered mouth masks used by general dental practitioners after 30 min of routine dental procedure. The microbial contamination was studied by observing and recording the colony morphology on the culture plates, Gram’s-staining with light microscopic screening of the slides, and the biochemical characterization of the isolates using standard microbiology protocols.

Results: Microbiological analysis of swabs taken from the mouth mask of general dental practitioners showed that all the mouth masks had bacterial contamination of which Gram-positive Streptococci species and Gram-negative Pseudomonas species are predominant.

Conclusion: Our study revealed that there is increased concentration of both Gram-positive (especially Streptococci, Staphylococci species) and Gram-negative organisms (Pseudomonas, Klebsiella species) on the surgical masks used by dentists which are potentially pathogenic. To reduce a load of bacterial contamination in the clinical environment, measures to improve air quality in the dental operatory should be undertaken.

Keywords
Dental operatory, micro flora, mouth mask, nosocomial infection

Introduction

With over 6 billion microbes/ml of saliva colonizing every individual’s oral cavity, the dental operatory is a hub of microbial activity. In keeping with international guidelines and universal precautions for infection control, several protective measures have been taken to control the contamination of the operatory and to protect the patient and the health care personnel. An important part of infection control is the clinician’s mouth mask which sees an assault of microorganisms from the touch of possibly contaminated hands to the contaminated aerosols due to routine ultrasonic scaling, high speed handpieces and other dental procedures.¹ In the dental operatory, the clinician’s mouth mask, one of the health care personnel’s protective equipment comes in close proximity to the patient and is an area of significant concentration of the aerosol. Hence, it would be worthwhile to analyze the microbiology of the mouth mask to minimize cross infection and to increase patient safety by the reduction of risk of nosocomial infection and improve clinician’s safety.

Materials and Methods

Ethical clearance was obtained from the Institutional Ethical Committee with reference number - SMIMS/IHEC/2015/A/32.
The study was carried out to determine the prevalence of microbial colonization in the mouth mask used by dental professionals. Microorganism was procured from the sampling site, transferred via an inert vector, and then subjected to subsequent microbial analysis. Medical grade sterile cotton swabs with plastic casing and sterile peptone water were found ideal for the study. The swabs for the study were taken from 100 mouth masks (triple layered non-woven polypropylene mouth mask) of general dental practitioners used for a period of 30 min, during miscellaneous dental procedures. A sterile swab dipped in sterile peptone water is streaked over the outer surface of the mouth mask, and the collected sample is transported in peptone media to the microbiology laboratory where they were subjected to microbial analysis. Swabs were incubated for 2 h at 37°C and then the sub-cultures were transferred to the MacConkey and blood agar plates, which were then incubated at 37°C for 24 h. After the incubation, the colony morphology was analyzed on the culture plates. Gram’s-staining with light microscopic screening and biochemical characterization such as testing for catalase, coagulase, bile, oxidase, triple sugar iron, indole, and citrate were performed using standard microbiology protocols.

### Results

Out of 100 samples collected, *Streptococcus* species were found to predominant, seen in about 64 samples, *Pseudomonas* species in 44 samples, *Klebsiella* species in 40 samples, *Staphylococci* species in 34 samples, *Escherichia coli* in 30 samples, *Acinetobacter* in 18 samples, and *Citrobacter ferundii* in 6 samples. The identification of these organisms was based on morphologic characteristics and biochemical reactions as shown in Table 1.

### Statistical analysis

Statistical Package for Social Sciences (SPSS 16.0) version was used for the analysis. A regression model (generalized linear model with logit link function) was used to estimate the prevalence of antimicrobial agents [Table 2 and Graph 1].

### Discussion

In general, it is been hypothesized that blood borne 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 potential access via the micro abrasion in the mucosa of the airway. Similarly, aerosols also has a capacity to produce numerous health risks, among which tuberculosis and severe acute respiratory syndrome are considered fatal.

Micik proposed the term “aerosol” and “splatter” in the dental environment in their pioneering work on aerobiology. The production of aerosols and splatter with the usage of ultrasonic scaler tips and burs of high speed handpieces is considered to be very exhaustive or intensive. They may come in contact with the mucosa of the nostrils, oral cavity, eyes and skin as well as on the hair and garments. They have adequate mass and kinetic energy to move and settle on object due to gravity but limited penetration into the respiratory system.

Ultrasonic scaler generates aerosol with bacteria peaking over 300 colony forming units/cubic feet of a dental clinic.

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### Table 1: Morphological characterization of microorganisms and the number of samples identified

<table>
<thead>
<tr>
<th>Organisms identified</th>
<th>Characterization</th>
<th>Number of samples identified</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pseudomonas</em></td>
<td>Rod shaped and motile, non-spore forming, Gram-negative bacilli, indole-negative, citrate-positive</td>
<td>44</td>
</tr>
<tr>
<td><em>Klebsiella</em></td>
<td>Non-motile, encapsulated Mac-Conkey agar - Lactose fermenting colonies, Gram-negative bacilli, indole-negative, citrate-positive</td>
<td>40</td>
</tr>
<tr>
<td><em>Acinetobacter</em></td>
<td>Heterogenous collection of non-motile Gram-negative oxidase negative saprophyte distinguished from other bacteria by lack of pigmentation</td>
<td>18</td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td>Non-sporulating colonies, MacConkey agar - Lactose fermenting colonies, Gram-negative bacilli, triple sugar iron - pink brown appearance</td>
<td>30</td>
</tr>
<tr>
<td><em>C. ferundii</em></td>
<td>Motile Gram-negative non-sporing rods which ferment glucose and other carbohydrates, oxidase negative</td>
<td>6</td>
</tr>
<tr>
<td>Beta-hemolytic <em>Streptococci</em></td>
<td>Blood agar plate – Beta hemolytic colonies, Gram-positive cocci in tetrads</td>
<td>64</td>
</tr>
<tr>
<td><em>Staphylococci</em></td>
<td>Blood agar plate – Opaque, round colonies, Gram-positive cocci</td>
<td>34</td>
</tr>
</tbody>
</table>

* C. ferundiii: *Citrobacter ferundii*, E. coli: *Escherichia coli* 

### Table 2: Number and percentage of prevalence of microorganisms

<table>
<thead>
<tr>
<th>Organism indentified</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pseudomonas</em></td>
<td>44</td>
<td>18.64</td>
</tr>
<tr>
<td><em>Klebsiella</em></td>
<td>40</td>
<td>16.94</td>
</tr>
<tr>
<td><em>Acinetobacter</em></td>
<td>18*</td>
<td>7.62</td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td>30*</td>
<td>12.71</td>
</tr>
<tr>
<td><em>C. ferundii</em></td>
<td>6*</td>
<td>2.54</td>
</tr>
<tr>
<td>Beta-hemolytic <em>Streptococci</em></td>
<td>64*</td>
<td>27.11</td>
</tr>
<tr>
<td><em>Staphylococci</em></td>
<td>34*</td>
<td>14.40</td>
</tr>
<tr>
<td>Total</td>
<td>236</td>
<td>100</td>
</tr>
</tbody>
</table>

*P < 0.05 *Pseudomonas* significant to others, *P < 0.05 *Klebsiella* significant to others, *P < 0.05 *Acinetobacter* significant to others, *P < 0.05 *E. coli* significant to others, *P < 0.05 *C. ferundii* significant to others, *P < 0.05 *Beta-hemolytic streptococci* significant to others. *C. ferundii* *Citrobacter ferundii*, E. coli: *Escherichia coli*
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In this study other than Gram-positive cocci we also isolated Gram-negative bacteria such as Pseudomonas, Klebsiella, E. coli, Acinetobacter, C. ferundii.

Most of the organisms isolated from the mouth mask were potentially pathogenic. Among the bacteria isolated, Gram-positive Staphylococci were found to be more prevalent. The coagulase-negative Staphylococci are common colonizers of skin and have increased risk of cross-contamination to patients with prosthetic devices, intravascular catheters, and immunocompromised hosts.[8]

Among the Gram-negative bacilli isolated, E. coli have a half-life of 21.2 min at 21-23°C, this cause opportunistic infection of the urinary tract and septicemia in extreme cases. Klebsiella pneumoniae capable of affecting lower respiratory tract, surgical wound sites, and urinary tract found to be one of the most common causes of nosocomial infection.[6] Pseudomonas aeruginosa, an opportunistic pathogen capable of traveling 4 m and persists 45 min in the air infects the respiratory tract, burn wounds, also implicated for surgical site infections.[6,10] Acinetobacter increasingly plays a role in nosocomial pneumonia in intensive care unit patients especially ventilator-associated pneumonia and also causes bacteremia and secondary meningitis. C. ferundii are associated with acute necrotising pancreatitis.[6]

Conclusion

Our study showed that there is an increase in the concentration of various types of pathogenic microorganism, on the surgical masks used by the dentist. Complete elimination of the risk posed 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 clinical work, performing periodic chemical treatment of dental unit water lines as suggested by the manufacturers, using new disposable masks with 95% filtration efficiency for particles of 3.0-5.0 µm in diameter for each and every patient, and changing it at an interval of 20 min in aerosol or 60 min in a non-aerosol environment.[11]

Thus, this study was carried out to analyze the microbial contamination of the personnel protective equipment used by dental practitioners and to create awareness among the dental fraternity regarding the microbial colonization of the air in the dental operatory, thereby reinforcing the norm that stringent measures to control microbial contamination of not just the operative equipment but also the accessory paraphernalia pertaining to health care is of vital importance and strict protocol to maintain the quality of the same is important to maintain a healthy practice.

Acknowledgment

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