Dental Pumice as a Source of Cross Contamination in Laboratories: A Microbiologic Study

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ABSTRACT

Aim: Cross contamination from the patient to dental personnel and again to the patient is a matter of grave concern in dental operatory. In an evaluation of procedures that may be a source of cross contamination, dental laboratory pumice used in the processing of dental prosthetic appliances has been shown to be contaminated with microorganisms. It may result in the inoculation of microorganisms into the patient’s mouths, thereby posing a potential hazard to patients and dental professionals. Therefore, this study was undertaken to assess the presence and extent of contamination in the polishing and finishing procedures of dentures in the dental laboratories.

Methods: Samples of used pumice were collected randomly from dental laboratories in a sterile container. In the microbiology laboratory, 1 g of each sample was weighed and placed in 1ml of sterile saline solution, placed in centrifuged at 3000 rpm for 5 min. 1 ml of the supernatant was then diluted to 10-fold and 0.5 ml of solution was spread in blood and McConkeys agar at 37°C for 24 h. Surface counting method and identification of bacteria was done.

Results and Conclusion: It was found that pumice slurry was contaminated with Acinetobacter, Klebsiella, Pseudomonas, and Staphylococcus; thus, recommending a strong and strict follow-up of the infection control procedures even in the dental laboratories.

Key Words: Cross contamination, dental laboratories, dental pumice, infection control.

Introduction

Certain procedures of dental practice may potentially contribute to the transmission of infections in the dental office. Considering that dentists see a large number of patients and operatories are used repeatedly during a typical practice day with dental personnel moving from one patient to another during various stages of treatment, certain office equipment, instruments, or work surfaces may not be sterilized or disinfected. This results in a cycle of cross contamination from the patient to dental personnel and again to the patient. With a renewed awareness brought about by the recognition of the most devastating disease, acquired immunodeficiency syndrome, there is a greater outcry from the general public who are more concerned about the consequences that may occur if guidelines of infection control are not followed.

Dental health care personnel are also aware of transmissible diseases such as hepatitis B, herpes simplex II, mononucleosis, and influenza. With the large-volume workload of patients, exposure to oral cavity by dental personnel has increased the probability of exposure to pathogenic organisms. Survey shows that 15.9% of general dentists, 17.2% of prosthodontists and 14.2% of dental technicians have previous exposure to hepatitis B; their serums remain positive for the antigen or antibody. When compared to the frequency of 2-5% in general population, it is apparent that dentists are at higher risk of acquiring hepatitis B. The frequency of other, apparently practice related infectious diseases among dentists are not as clearly defined as it is for hepatitis B. Infection control in commercial laboratories has attracted increasing interest as evidence by new laboratory control programs that have been initiated. The National Association of Dental Laboratories in United States has mandated inclusion of the formal infection control program as a requirement for certification of its members in Certified Dental Laboratories. Furthermore, a group of concerned laboratories established the Dental Laboratory Infection Control Council, which requires the member
laboratories complete comprehensive infection control training. It is evident that some infectious diseases can be transmitted to individuals not in direct patient contact, and persons can contract infectious diseases by handling contaminated materials.¹

Verran et al.² investigated the microbiological status of certain high-risk areas in the dental technology laboratory namely pumice slurry, impression agar, and curing water baths. They concluded that pumice slurry freshly made using disinfectant was free from contamination, but colony counts increased after 3 days use. Verran and Winder compared the microbiologic status of pumice slurry in clinical and non-clinical dental laboratories and concluded that non-clinical laboratories are not immune from the presence of potentially pathogenic microbes in pumice slurry.³

In an evaluation of procedures that may be a source of cross contamination, dental laboratory pumice used in the processing of dental prosthetic appliances has been shown by several investigators to become contaminated with microorganisms unless the appliance, pumice is treated with a disinfectant or sterilizing agent. Appliances may result in the direct inoculation of microorganisms into the mouths of patients. Further, the processing of polishing dental appliances with contaminated pumice produces aerosols and splatter, which contain high concentrations of contaminating microorganisms. These microorganisms are spread not only within the dental laboratory that affects the dental personnel, but also throughout the dental suite posing a potential hazard to patients and dental professionals.

Thus, focusing on the potentiality of cross contamination during dental procedures, this study was done to assess the presence and amount of contamination during the finishing and polishing procedures of dentures using pumice slurry.

**Aims and objectives**

1. To assess the presence and extent of bacterial contamination in the laboratory pumice in dental laboratories.

**Methods**

Dental laboratory pumice in the dental laboratory was collected. Samples of used pumice along with unused pumice, tap water were taken as control. From the laboratory, the pumice collected from the pan was mixed thoroughly, and a sample of used pumice was collected using a sterile spatula in a sterile container. Unused pumice with tap water was also collected. The samples were reported to the microbiology laboratory for processing.

The microbiologic laboratory, 1 g of pumice from each of the samples of used and unused pumice was weighed aseptically using an electronic balance, placed in 1 ml of sterile saline solution, centrifuged at 3000 rpm for about 5 min, then placed upright on a test tube rack and left undisturbed. 1 ml of the supernatant was removed and was diluted to 10-fold $10^{-1}$ dilution in saline solution. 0.5 ml of a supernatant was placed and spread using glass spreaders in blood and McConkey’s agar. The agar plates were then incubated at $37°C$ for 24 h (Figure 1).

After 24 h, colonies were counted by surface counting method with the colony counter, and the numbers of colonies were multiplied by the dilution factor. The colonies were identified by Gram-stain and the biochemical reaction by the standard method. The Gram-positive and Gram-negative bacteria were identified by biochemical tests such as coagulase test and indole, citrate, oxidase, catalase, urease, and $H_2S$ tests, respectively (Figure 2).

**Results**

The bacterial colonies recovered from pumice were found to be *Acinetobacter*, *Klebsiella*, *Pseudomonas*, *Staphylococcus citreus*, *Staphylococcus aureus*, coagulase-negative staphylococci, and aerobic spore bearers (Table 1).

**Discussion**

Pumice slurry is usually used for polishing both the new and the repaired prosthesis in the laboratories. The used prosthesis worn by

![Figure 1: Bacterial colonies on blood agar.](image1)

![Figure 2: Colonies of Gram-negative bacteria.](image2)
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<table>
<thead>
<tr>
<th>Used pumice</th>
<th>Colony count (cfu/ml)</th>
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<tbody>
<tr>
<td>Acinetobacter</td>
<td>≤10⁵</td>
</tr>
<tr>
<td>Staphylococci citreus</td>
<td>5000-10,000</td>
</tr>
<tr>
<td>Pseudomonas</td>
<td>3000</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>≤10⁵</td>
</tr>
<tr>
<td>Staphylococci aureus</td>
<td>3000</td>
</tr>
<tr>
<td>Aerobic spore bearers</td>
<td>3000</td>
</tr>
</tbody>
</table>

Acinetobacter, Pseudomonas, and Klebsiella were found in the range of 4000 to >10⁵ cfu/ml. These bacteria are widely distributed in nature. Acinetobacter survives on moist surfaces, dry surfaces such as human skin. Part of oropharyngeal flora found in the small number of healthy people can proliferate to large numbers in immunologically compromised patients. These opportunist pathogens cause infections in respiratory tract, wounds, and cause septicemia. Cordes et al.⁴ in 1981 found that chronic exposure in metallic dust may predispose workers to Acinetobacter infections. Williams et al.⁷ in 1983 found Acinetobacter contamination of laboratory pumice of counts more than 10⁵/g. Pseudomonas and Klebsiella are opportunistic pathogens and can cause pneumonia in hospitalized patients. S. aureus and coagulase-negative Staphylococcus epidermis found in the laboratories probably originated from skin of personnel handling the prosthesis as they are normal commensals of skin. Their presence in significant amounts of >10⁵ is important because in case of minor breaks in skin, superficial infections like boils, abscess can occur. Williams et al.⁵ in 1986 recovered from two laboratories fungi such as Aspergillus, Fusarium cephalosporium, which are opportunistic pathogens subjected to predisposing factors. For the immediate denture patients, the possibility of implanting infected material in an open wound is more. Immediate dentures and dentures for debilitated, elderly patients are more susceptible to infections and should be processed with special attention. Van Reenen⁶ reported Gram-positive cocci and Gram-negative bacilli as the causative agent of denture stomatitis. Katberg, Kahn et al.⁹ reported the presence of oral organisms such as streptococci, lactobacillus, and diphtheroids. Such contamination of dentures polished from pumice could be a source of cross contamination to the patients at an unacceptable risk. Denture wearers are older persons who as a group are considered at a higher risk with respect to infections. The process of aging brings with it a reduction in the level of respiratory function. This loss of efficiency is shown in the elderly with limited muscular activity and the increased incidence of respiratory diseases. Transmission of common epidemic diseases such as influenza may cause significant morbidity and mortality in this group. Dental technicians spend a considerable amount of time in pumicing and polishing dentures. Therefore, they are more exposed to aerosol and splatter. Aerosol dissemination of Acinetobacter should be of concern, as the organisms are associated with eyes, ears, and respiratory tract. Infection of the skin may be a hazard for those whose hands are in constant contact with contaminated pumice. Dermatitis has been shown to increase the carriage rate and number of Acinetobacter recovered from skin. Runnells¹⁰ in an overview of infection control in dental practice recommended that the working pumice be discarded after each use or disinfected at least daily after use and can be replaced often preferably daily in busy clinics and laboratories; at least weekly in
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less busy clinics and laboratories. Contaminated pumice should never be left over a weekend to potentially incubate and growing organisms. Lathe attachments such as rag wheels, stones, and burs be removed from the lathe after each use and stored in a disinfectant. Polishing wheels items may be damaged in a liquid chemical sterilizer.

Lathe shields, air infiltration be used to contain contaminated splashes, air borne contamination. Care needs to be taken to clean, disinfect touch and splash surfaces in the laboratory. Clothing worn during the procedures be covered with disposable apron when prosthesis or impressions are handled. Council on Dental Materials; on Dental Therapeutics in 1978 recommended that prosthetic devices be thoroughly cleaned before grinding or polishing procedures that might generate aerosols. Shields, blower evacuation systems be used when prosthetic materials are polished or ground.

In order to reduce the aerosol splatter, in the pumice polishing area: 1. Use of air suction with a velocity of at least 200 ft./min at dental lathe measured in the immediate area of pumice wheel. 2. Use of a plexiglass shield on lathe to intercept splatter particles and keep away from operators head. 3. Placing pumice lathe such that splatter is directed toward wall.

He then suggested specific information of the polishing hood which included a metal enclosure adapted to the front of existing lathe hoods, provision of ports for hands to enter the polishing area and a large viewing window with transparent acetate sheets that can be easily replaced affording a good vision. Council on Prosthetic Devices and Dental Laboratory recommended separate pumice pans for new and existing prosthesis as well as separate polishing burs. A liquid disinfectant (5 parts sodium hypochlorite to 100 parts distilled water) is used as a mixing medium in pumice. Addition of 3 parts green soap in disinfectant solution and suspension of pumice and changing of pumice daily was recommended. Setz and Heeg used combinations of pumice and disinfectant comparing with the conventional mixture of pumice and water. The results revealed use of steribim, which is pumice mixed with benzoic acid and use of antiseptic octenidine were effective in reducing the number of bacteria by 99.99% compared to the conventional procedure.

Verran et al. used Virkon 1% solution, a disinfectant that is both bactericidal and viricidal. Pumice slurry made with Virkon solution was initially unable to resist the challenge of contaminating organisms. In the absence of Virkon, they found aerobic Gram-positive bacilli; members of the coli-aerogenes predominated with streptococci viridans. The subsequent contamination originating primarily from skin, air appears to indicate decreasing ability of the disinfectant to cope with the microbial load. Therefore, use of higher concentrations of Virkon, increased frequency of cleansing of the polishing equipment, use of safety glasses, masks and gloves by personnel using the lathe were recommended.

Summary and Conclusion

Cross contamination is prevalent at every procedure involving patients and laboratories. The risk of infection from patients to the professional and vice versa cannot be ruled out. This study was done to estimate contamination in the pumice slurry, which can act as a source of cross infection in the laboratories. The pumice slurry was contaminated with Gram-negative bacilli such as Acinetobacter, Klebsiella, Pseudomonas, and Gram-positive staphylococci. The results emphasize the importance of strict infection control during dental polishing procedures.

References