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Symposium Highlights

Cross-Contamination in
the Dental Laboratory



Cross Contamination in the Dental Laboratory Through the Polishing Procedure of Complete Dentures

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(This article first appeared in the Brazilian Dental Journal.)

Cross contamination is a severe problem that involves health professionals, especially in dentistry. The transmission of diseases during treatment between patients and dentists, auxiliary personnel and dental laboratory technicians can occur if preventive measures are not taken.

The risk of cross contamination in dental clinics as well as transmission of microorganisms in prosthetic laboratories has been reported in various studies¹⁻³. More than 60 percent of the prostheses delivered to clinics from laboratories are contaminated with pathogenic microorganisms, i.e., streptococci, lac tobacilli, diphtheroids originating in the oral cavity of other patients¹⁻³. In prosthetic laboratories, lathes and pumice, usually used for polishing procedures and finishing of prostheses have been described as the greatest sources of contamination with levels of contamination reported of 1.4-8.0 x 10⁵ colony forming units (CFU) in pumice pans⁴.

Kahn et al.¹ reported cross-contamination during polishing in an experiment which simulated routine polishing of

complete dentures without using any disinfection measures before the procedure or with the addition of disinfectant to the pumice. Contaminated invisible aerosol particles remain in the air for long periods of time when using lathes for the polishing of prostheses^{4,5}. In spite of the fact that it is not possible to eliminate all sources of contamination in the laboratory, a series of prevention measures to decrease these levels should be adopted. The use of sterile pumice and rag wheels or the association of disinfectants with pumice for polishing is a viable alternative to significantly reduce cross contamination in the laboratory⁶⁻⁸.

Potentially pathogenic microorganisms, such as Gram-negative bacilli of the genus *Acinetobacter*, as well as *Micrococcus*, *Pseudomonas*, *Moraxella* and *Alcaligenes*, have been detected contaminating pumice in commercial laboratories^{6,9}. These bacteria, which are not part of normal oral flora, can cause serious diseases if passed to patients whose dentures are polished with contaminated material and to the technician by exposure to contaminated aerosol. Williams et al.¹⁰ reported, in 1985, the increase of cases of pneumonia in individuals exposed to lathe aerosol. Sande et al.¹¹ reported 10 cases of infection by *Mycoplasma pneumoniae* involving persons working in dental prosthetic laboratories, suspecting that these infections derived from manipulation of prostheses contaminated by these microorganisms. Therefore, the use of aprons, gloves and protective glasses by the professionals should be a routine¹².

Dental prostheses should be disinfected before they are sent to the laboratory and upon return to the dental clinic¹³ but,

despite rigorous control of sterilization and disinfection of instruments in dental clinics, prosthetic appliances do not receive adequate infection control.

Jagger et al.⁸, in 1995, published a study about attitudes to cross-infection control of dental laboratories in the U.K. They found that only 49 percent of the respondents had a cross-infection policy and of these, 61 percent used no disinfectant in the pumice and 93 percent did not disinfect the polishing instruments. The need of changing this panorama has led to publications on the possibility of transmission of microorganisms between patients and professionals who, directly or indirectly, handle dental material in both the clinic and the laboratory.

The objective of this research is to show, by reproducing the routine conditions of polishing complete dentures, the transmission of potentially pathogenic microorganisms to the operator, polishing cones and new prostheses.

Fourty edentulous patients from the Complete Dentures Clinic of the School of Dentistry at Ribeirão Preto of the University of São Paulo participated of this study. They were of both genders, ranging in age from 35 to 79 years and had complete maxillary dentures made of

thermopolymerized resin and acrylic resin teeth. Patients who fulfilled three requirements were selected: had not taken antibiotics during the previous six months; had used a maxillary denture for at least two months which had not been polished during this time; and used only toothbrushes and tooth paste or soaps for cleaning.

Microbial Processing

To verify the transfer of microorganisms from the polishing of complete dentures, four experiments were conducted (Figure 1).

- Experiment I:** Determination of CFU/mL of complete maxillary dentures demonstrating the contamination level of prostheses. Ten maxillary dentures were placed on sterile Petri plates and transferred to the microbiology laboratory. Under laminar flow, the dentures were washed with 10 mL PBS (phosphate buffered saline) using sterile toothbrushes for removal of microorganisms. The resulting suspensions were serial diluted (100-10⁶) in PBS, pH = 7.2, seeded on Petri plates containing BHI agar, supplemented with 5% defibrinated sheep blood (S-BHIA), and incubated at 37°C for 48 hours under anaerobic conditions

Figure 1

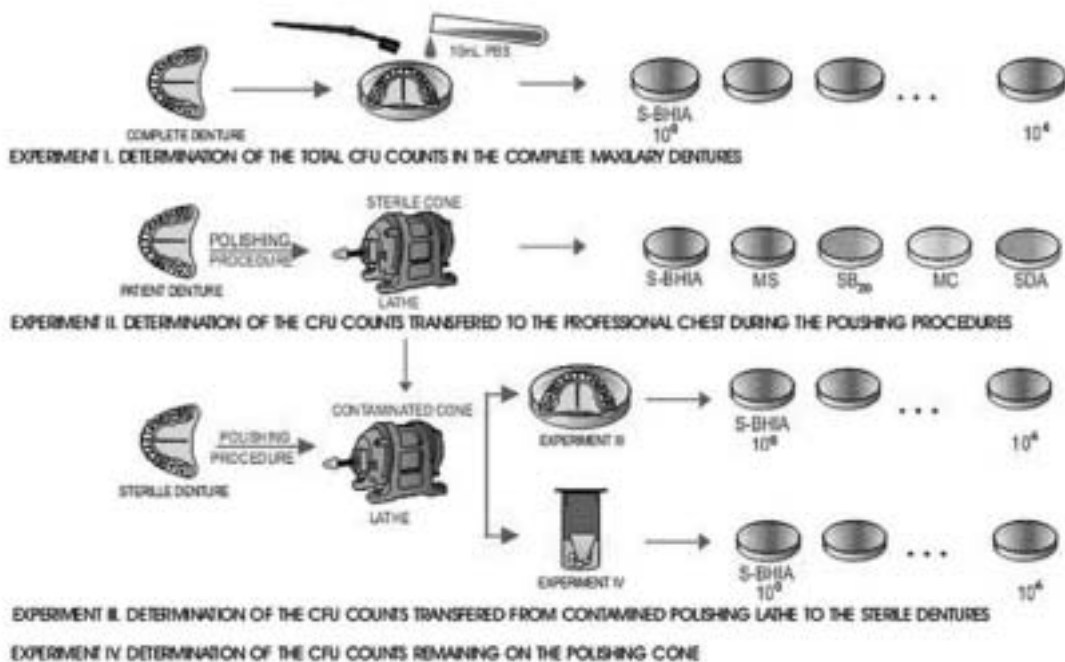


Figure 1. Study design.

(GasPack® Anaerobic System, BBL). The counts of anaerobe colony-forming units per milliliter of sterile PBS used to wash the dentures were determined.

- **Experiment II:** Determination of CFU transferred to the professional during the polishing process of used complete dentures. The complete maxillary dentures of 30 patients were placed on sterile Petri plates and transferred to the prosthetics laboratory for routine polishing with a lathe (style 15.2014, SS White, Dayton, OH, USA), disinfected with 2 percent iodophor and a frontal protection stand (VH Equipments, Araraquara). The polishing cones and pumice were submitted to sterilization in an ethylene oxide gas chamber. Following sterilization, random samples were tested to determine sterility. All tested materials were negative for culture growth. The technician used sterile gloves, mask, protective glasses and apron. Four open Petri plates with the following culture media were attached to the technician: BHI agar, supplemented with 5 percent S-BHIA, Mitis Salivarius agar (MS) selective for Streptococci, MacConkey agar (MC) selective for Gram-negative microorganisms, Sabouraud dextrose agar (SDA) selective for yeast (all media were from Difco, Detroit, MI, USA) and Sucrose-Bacitracine agar (SB20) selective for mutans streptococci (14). Each denture was polished for four minutes at 2,600 rpm, with the culture plates exposed on the thorax and abdomen of the technician for two minutes, respectively. The plates were then closed and incubated at 37°C for 48 hours MC and SDA cultures were maintained under aerobic conditions; SB20, MS and S-BHIA used the anaerobic GasPack® system.
- **Experiment III:** Determination of CFU transferred from contaminated polishing lathe to sterile dentures. Complete maxillary prostheses were made from

a standard model to obtain samples with similar anatomy, size and rugosity to standardize conditions of microorganism transmission. Each denture received individual blister packaging and was submitted to sterilization in an ethylene oxide gas chamber, considered inert for prosthetic materials⁷. A random sample of the dentures was tested for sterility. There was no culture growth. After each polishing procedure of patient's denture in Experiment II, the technician, wearing new sterile gloves, began polishing of the sterile denture using the same cone and pumice used in Experiment II. After polishing, each denture was placed immediately on a sterile Petri plate and taken to the microbiology laboratory for processing with washing with PBS and brushing similar to the method of Experiment I.

- **Experiment IV:** Determination of CFU remaining on the polishing cone after experiments II and III. After polishing the sterile denture in Experiment III, the 30 cones were removed aseptically, placed in a sterile container and taken to the microbiology laboratory for processing. Glass beads and 20 ml PBS were added to the container under laminar flow and were closed and spun for one minute. Ten milliliters of the resulting suspension were diluted and seeded in S-BHIA.

Results

The results are reported in **Table 1** and **Table 2**. Experiment I, determining the CFU in used complete dentures, showed that these dentures were highly colonized (mean 1.4×10^7 CFU per milliliter of fluid used to wash the dentures). In Experiment II, there was a high level of contamination by splatter and aerosols in the different selective culture media used to show the transmission of potentially pathogenic microorganisms to the operator (**Table 2**). Experiment III showed a mean transfer of $1.7 \times$

Table 1

Number of Colony forming units per milliliter founding Experiments I, III and IV.

Experiment	N	CFU/mL (mean)
I	10	1.4×10^7 ff 0.8×10^7
III	30	1.7×10^7 ff 1.5×10^7
IV	30	3.5×10^8 ff 9.0×10^8

CFU/mL = colony-forming units per milliliter of sterile PBS used to wash denture/cone.

Table 2

Mean and frequency of colony forming units (CFU) grown in different culture media transferred to the technician after polishing 30 dentures (Experiment II).

Culture Media	CFU N	>300 %	CFU (mean)
S-BHIA	29	96.7	298ff11
MS	12	40.0	187ff112
SB ₂₀	8	26.7	160ff117
SDA	4	13.3	90ff112
MC	1	3.3	33ff65

S-BHIA: Brian heart infusion agar, supplemented with five percent defibrinated sheep blood

MS: Mitis Salivarius agar

SB20: Sucros-Bacitracine agar

SDA: Sabouraud dextrose agar

MC: MacConkey agar

107 CFU/mL from patient's prostheses to sterile prostheses. The mean number of remaining microorganisms on the cone after experiments II and III was 3.5×10^8 CFU/mL (Experiment IV).

Dental laboratory technicians are particularly vulnerable to microbial cross-contamination from the elastomeric impressions and from the dental prostheses they receive from dental offices^{15,16}. Casts poured from impressions can also harbor infectious microorganisms that can be distributed throughout the laboratory when the casts or dies are trimmed¹⁶.

The results of the four experiments conducted in this investigation revealed massive cross contamination in prosthesis laboratory routines and a strongly contaminating source in complete dentures of patients. The process of polishing using high-speed lathes can transmit disease between the dental clinic and the laboratory technician.

Polishing lathes are considered to be a source of contamination in prostheses laboratories. However, infection control measures are not being effectively applied. This research studied the transmission of microorganisms in the dental laboratory by means of lathes, using a method which reproduced laboratory polishing procedures.

Experiment I determining the CFU in used complete dentures, showed that these dentures were densely

colonized indicating a high level of contamination, especially considering that the patients in this study did not present any debilitating disease. Dentures of patients who are diseased, debilitated and/or immunocompromised have been reported to have even higher levels of contamination¹². In a similar study, Powell et al.³ reported a high level of contamination of complete dentures.

Bacterial contamination of scrub jackets during dental hygiene procedures was studied by Huntley and Campbell¹⁷. They demonstrated that aerosols are produced during examination and scaling when hand instruments alone are used. The number of microorganisms is higher on sleeves than on the chest of scrub jackets, and is higher when ultrasonic or sonic scalers or air polishers are used.

Experiment II verified the transmission of microorganisms to the professional by aerosol contamination produced during the polishing process. Oral microorganisms such as *Streptococcus mutans* and non-oral potentially pathogenic microorganisms such as yeast and Gram-negative bacteria, which can cause eye and respiratory infections, were found in aerosol and splatter. Williams et al.¹⁰ found Gram-negative *Acinetobacter* in cultures of pumice from laboratories. This non-oral bacteria has been associated with infections such as pneumonia, meningitis, septicemia and eye infections⁹.

Experiment III showed a transfer of microorganisms from patient prostheses to sterile prostheses. These results can have serious implications because this experiment reproduced the conduct of most prosthesis laboratories where pumice and polishing cones are not changed or disinfected regularly between procedures on different prostheses. Because the typical users of dentures are the elderly who can have lowered immunological resistance, the transfer of microorganisms confirmed in Experiment III places these patients at risk for the development of infection caused by cross-contamination. In a similar study, Kahn et al.¹ reported a mean transfer of 5.0×10^5 CFU/mL of patient dentures to sterile dentures, noting the presence of pathogenic microorganisms.

In Experiment IV, the remaining microorganisms on the cone after experiments II and III showed that the cone was highly contaminated even after the transfer of a large quantity of microorganisms to the sterile prosthesis, remaining as a source of infection ready to contaminate the environment, professional and future dentures continuing the cycle of cross infection. According to Molinari et al.⁷, the cone should be changed after each polishing and then sterilized.

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The four experiments showed that the handling of dentures between the dentist and the laboratory presents a dangerous source of cross contamination that will continue placing the dentist, technician, patient and auxiliary personnel at risk until efficient measures of infection control are instituted.

The use of aprons, gloves and protective glasses¹² by professionals, the use of lathes with efficient shields⁵, the association of disinfectants with pumice^{7,8}, the sterilization or disposal of the cone after each use⁷ and the disinfection of dentures before sending them to the laboratory and upon return to the dental clinic¹³ are means which can reduce the risk of cross-contamination.

Infection control measures such as the use of barriers during polishing, the disinfection of dentures before being sent to the laboratory and upon return to the dental clinic, the disposal or sterilization of the cone after each use, as well as the addition of disinfectants to pumice, and unit doses of pumice should be adopted with the objective of reducing the risk of cross infection.

In conclusion, complete dentures are massively contaminated with microorganisms and can serve as the primary source in the cycle of cross infection within dental laboratories. The polishing of dentures without previous disinfection leads to a high level of transfer of microorganisms to the professional, the polishing cone and the new dentures. ✨

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1. Streptococci is the only pathogenic microorganism originating in the oral cavity of other patients.
 - a. True
 - b. False
2. In spite of the fact that it is not possible to eliminate all sources of contamination in the laboratory, a series of prevention measures to decrease these levels should be adopted.
 - a. True
 - b. False
3. The use of _____ by professionals should be routine.
 - a. aprons
 - b. protective glasses
 - c. gloves
 - d. all of the above
4. Dental prostheses need to be disinfected only on return to the dental clinic.
 - a. True
 - b. False
5. According to a published study in 1995 about attitudes to cross-infection control only 49% of the respondents _____ .
 - a. Used gloves on a regular basis
 - b. Did not use disinfectant
 - c. Had an infection control policy
 - d. None of the above
6. The objective of this research is to show, by reproducing the routine conditions of polishing complete dentures, the transmission of potentially pathogenic microorganisms to the operator, polishing cones and new prostheses.
 - a. True
 - b. False
7. Patients were selected who:
 - a. Had used antibiotics within the previous six months
 - b. Had used only toothbrushes and toothpastes or soaps for cleaning along with other cleaning devices.
 - c. Had a maxillary denture polished within two months
 - d. None of the above
 - e. All of the above
8. Dental laboratory technicians are particularly vulnerable to microbial cross-contamination from the electrometric impressions and from the dental prostheses they receive from dental offices.
 - a. True
 - b. False
9. The number of microorganisms is higher on
 - a. Sleeves of scrub jackets.
 - b. Chest of scrub jackets.
10. Some of the means which can reduce the risk of cross-contamination are the use of lathes with effective shields, the use of aprons and protective glasses.
 - a. True
 - b. False

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