EVALUATION OF THE AIR QUALITY IN DENTAL LABORATORY

Diana Diaconu-Popa, Monica Tatarciuc, AncaViţalariu

Department Implantology, Removable Dentures, Technology
Faculty of Dental Medicine, University of Medicine and Pharmacy "Grigore T. Popa" – Iaşi

Corresponding author: Monica Tatarciuc Faculty of Dental Medicine University of Medicine and Pharmacy "Grigore T. Popa" - Iasi, Romania 16, Universitatii Street, 700115
E-mail: tatarciucm@yahoo.com

ABSTRACT

During the technological steps of dental prostheses realization, the technician is exposed to various noxes that may affect his health. The aim of our study was a quantitative analysis of a dust released into the dental laboratory during the dental prostheses processing and finishing and to determine the microbial charge of these powders.

The air samples were taken fromthe laboratory for 7 days, 8 hours a day and the powders' concentration was performed with HPC 601 Airborne Particle Counter. To determine the microbiological contamination of the air it was used the collection by sedimentation method. The data were recorded before, during and after the prostheses were processed.

The results obtained show a high degree of air pollution and contamination in the dental laboratory, which, although below the maximum allowed, may affect the health of the dental technician who is permanently exposed to these noxes by their cumulative effect.

Keywords: air pollution, microbiological contamination, dental laboratory, occupational exposure

INTRODUCTION

Dental technicians, during their activities, are exposed to a series of noxious factors, which might affect their health. The Occupational Information Network, a US Department of Labor database, conducted a study to rank the 'Most Unhealthy Jobs' in America. They analyzed the health risks in each of the 974 occupations in the database using criteria such as exposure to radiation, contaminants, infections, and time spent sitting, with scores of these factors on a scale from 0-100, with a higher score indicating an increased health risk. Dental profession ranked number 1 as the unhealthiest job of all 974 occupations in this study [1].

Dental laboratory technicians are exposed to numerous pollutants that could cause occupational diseases in the medium or long term, such as bronchitis, asthma, silicosis and other respiratory complaints. Exposure occurs during handling the refractory investments, sandblasting of metallic parts and finishing operations. Dusts of non-precious alloys (very often used dental technology) are extremely toxic and can cause allergic symptoms, respiratory complaints, dermatological problems and neurotoxicity among dental technicians. Each stage of the technological algorithm can involve the inhalation of a number of harmful substances [2].

. Several cases of respiratory problems have been reported among dental laboratory stuff and epidemiological studies have shown a high prevalence of pneumoconiosis related to combined exposure to several contaminants and their period of action.

Metals, waxes, resins and silica can cause irritation or allergic reactions, affecting the skin and the respiratory system, as well. The risks of benign pneumoconiosis induced by hard metals are well documented, a prevalence of 15.4% after 20 or more years of exposure being reported, whereas the prevalence in the general population is less than 1%. Malignant pneumoconiosis is caused by dust from crystalline silica, asbestos or beryllium [3, 4, 5].

Silicosis is the most common occupational disease among dental technicians, and isolated cases of systemic autoimmune diseases have been observed.

Contaminated invisible aerosol particles remain in the air for a long time after using lathes for the polishing of prostheses [6,7].

The rotation speeds of engines are usually high, thus generating very fine powders, whose pathogenicity depends on the particles size, concentration, composition, and duration of exposure.

The smoke released during the wax burnout stage, contains mainly colophony, known as an allergic substance that may cause asthma. In most cases, the processed pieces are also microbial contaminated, so that their pathogenic potential is even higher. [8,9] Therefore all these chemical agents (gases, vapors, powders), have an irritating or carcinogenic action. Because it is not possible to eliminate all sources of contamination in the laboratory, a series of prevention measures should be taken in order to avoid the professional diseases [10,11] .

The aim of the present study was to evaluate the amount of accumulated dust during daily activities and to realize a quantitative determination of air-borne germs in dental laboratory.

MATERIALS AND METHODS

The first step of this study was a quantitative analysisof the dust resulted during divesting and finishing processof dental prostheses. The second step consisted in a quantitative determination of microbial concentrationof the air-borne microorganisme after the same technological stages (fig.1)

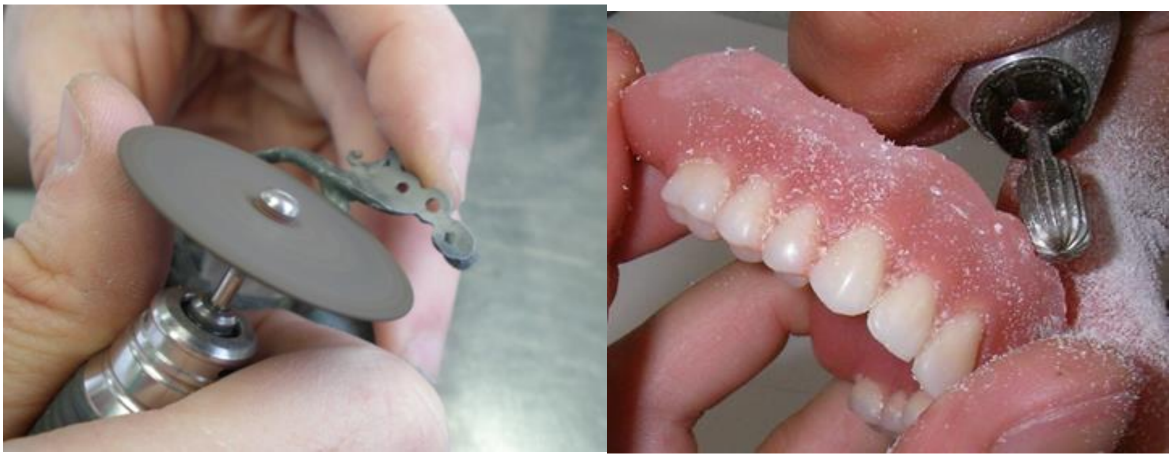

Fig 1. Finishing of dental prostheses

Air samples have been taken during7 days, 8 hours daily. The quantitative analysis of the respiratory powders from the dental laboratory, was performed with HPC601 laser particle counter, placed in the working space, at ambiental temperature of 24°C.

For the microbial evaluation we used the Koch method. Their inoculation was done on preformed solid culture medium, based on agar-agar, in opened and exposed Petri dishes with a diameter of 90 mm. Five samples were placed in various working areas of dental laboratory; first samples were left uncovered for 15 minutes at the first hour in the morning. Next group, also consisted in five samples, was obtained during specific working steps. The last five samples were recorded at the end of working day.

After exposure, the Petri dishes were sealed and sent to the microbiology laboratory. Samples were incubated for 24 hours at 37ºC, and then were allowed for additional 24 hours at room temperature and light exposure. Colonies were counted starting from the premise that each colony has grown from a microorganism, and by counting all colonies, we obtained the total number of bacteria. The method used is simple and allows simultaneous multiple determinations, thus achieving very accurate characterization of air contamination.

To express the microbial load per unit air volume, Omeliansky formula was used, which calculate the germs from 10 litters of air deposed on a surface of100 cm^2 in 5 minutes:

Number germs/ air m^3n X 10000: S T/ 5, where **n** is the number of colonies developed on culture medium surface, **S** is the Petri dish surface in cm^2, and **T** is time of exposure in minutes.

RESULTS AND DISCUSSIONS

The dust concentrations values in the dental lab were statistically analyzed with IBM SPSS Statistics 25 program, and the average values per day are presented in table 1

Table. 1. Dust concentrations in the dental lab

Day	**1**	**2**	**3**	**4**	**5**	**6**	**7**
μg/m³	**1,2**	**1,7**	**2,8**	**3,7**	**2,2**	**2,9**	**3,1**

The average value of the dust concentration recorded in the dental lab was 2,51μg/m³, while the maximum admissible limit is 10 μg/m³ (fig.2). Although all recorded values are below the maximum allowed, the high degree of toxicity and long exposure to these pollutants may cause a change in the health of practitioners. Fine and ultra-fine particulate matter, which includes harmful bio-aerosol particles, are capable of reaching the deepest part of our lungs, being absorbed into the blood stream and having systemic effects to our health. [12,13]

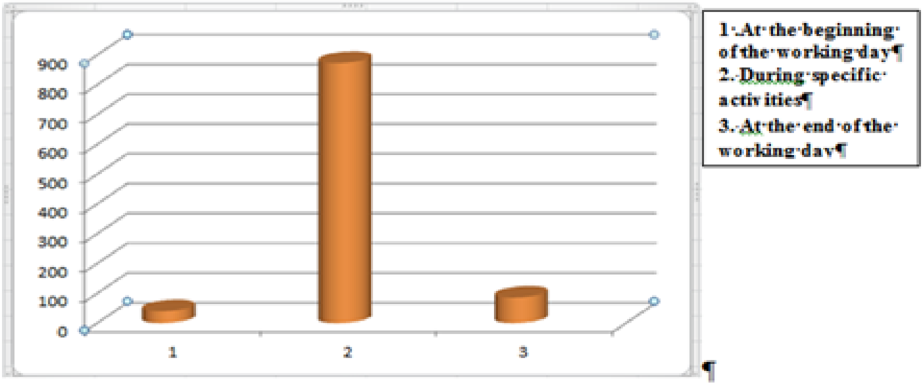

Fig 2 The average value of the dust concentration

Determination of units number that forming colony per cubic meter in air, allowed to assess the microbial load in the dental laboratory at different moments of the working day (fig.3)

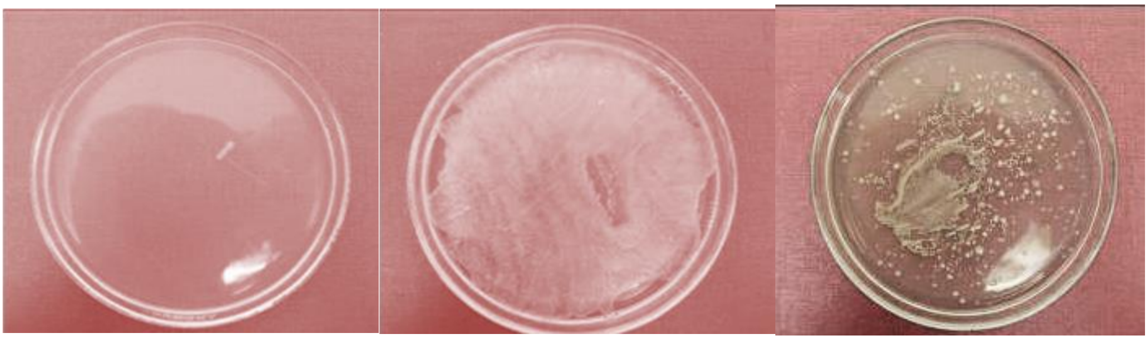

Fig.3 The Petri dishes with microbial colonies

Data obtained were statistically processed and results are expressed as mean values recorded (Table 2).

Table 2. The microbial load in the dental laboratory

At the beginning of the working day	During specific manoeuvres	At the end of the working day
40	**873**	**86**

The highest values corresponded to intense working moments when specific technological steps are performed. Values recorded at the end of the working day, after decontamination, were lower than those obtained during the work stages, but higher than those recorded at the beginning of the day (fig.4).

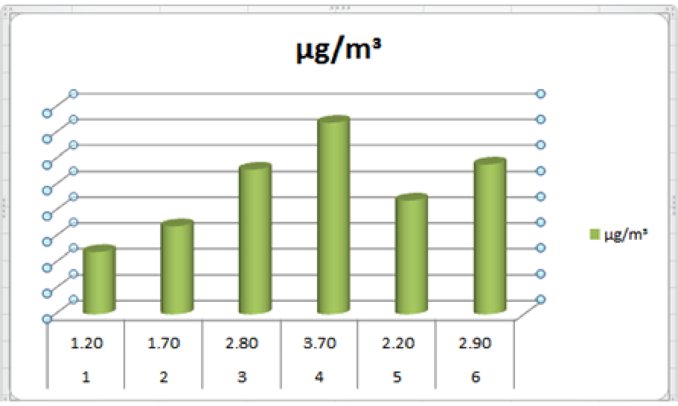

Fig.4 Microbial load in the dental laboratory

This underlines the need for daily air decontamination in workspaces and use of specific measures in order to protect the medical stuff.

The resulting powders are contaminated with bacteria as a result of an inappropriate decontamination of used prostheses or instrumentation [14,15,16]. Microbial aerosols are generated during dental treatments and may represent an important source of infection. The level of air born bacterial pollution generated during routine activity showed that a very high level was recorded during prostheses divesting and finishing stages . Aerosols resulted from polishing procedures may cause different infection and can damage the general health status [17,18].

CONCLUSIONS

The dental laboratory has responsibility for producing high-quality work but also for fulfilling the requirements for documented, quality assurance routines with respect to hygiene and infection protection and providing the dentist with information about relevant routines, working methods, and equipment at the laboratory. It should be noted, however, that in the working relationship between dental laboratory technician and dentist, the dentist is more highly trained in respect to microbiology, infection protection, and hygiene.

Apart from improved security for the patient, well-conducted quality procedures can give the laboratory competitive commercial advantages through promotion of its particular hygiene standards to current and prospective dentist clients.

It has been shown that bacteria can survive in dental pumice for extended periods of time. In a dental laboratory where the polishing lathe is constantly used, it is important that the items to be polished are free of bacteria when brought to the area. It is therefore important to change the pumice on a regular basis and disinfect the pan holding the pumice before putting fresh pumice into it. It is strongly advised that the same pumice is not used for new work and repair work. When working on repairs, it is recommended that a small fresh amount of pumice is dispensed and used. As pumice always produces a contaminated splatter and aerosol, a liquid disinfectant (5 parts sodium hypochlorite to 100 parts distilled water) should be used as the mixing medium in pumice.

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