

THEORETICAL AND PRACTICAL ASPECTS OF THE ILLNESSES THAT ARE OR ARE NOT CLASSIFIED AS OCCUPATIONAL DISEASES IN THE DENTAL LABORATORY – PRELIMINARY STUDY (PART II – CHEMICAL SUBSTANCES – LIQUIDS, GASES OR VAPOURS)

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Keywords: dental laboratory technician, occupational diseases, chemical substances
Abstract: The activity in the dental laboratory is extremely complex in terms of both outputs (fixed and mobile prosthetic restorations executed by dental technicians) and inputs (wide range of materials used by them). Therefore, in this paper we intend to bring to the readers' attention a number of problems faced by dental technicians in their daily activity, problems related to the illnesses they may develop, which are or are not classified as occupational diseases.

INTRODUCTION

As mentioned in the first part of the paper submitted for publication, there are many occupational diseases to which dental technicians are exposed. Such occupational diseases have been largely discussed. However, little has been done in this respect. Specifically, the present paper, divided into two distinct parts, is intended to highlight the prerequisites for the introduction of a course in occupational medicine (mandatory or optional) in the university curricula for dental technician speciality, which would provide future dental technicians with the appropriate medical notions and make them really aware of labour protection.(1-4)

Specifically, gases are substances found in such state at ordinary temperature and they obey to their own laws. Vapours represent the gaseous phase of liquids at particular temperature.(1-4) Liquids dispersed in the form of mist in work areas belong to the same category.(1-4)

In this regard, we can discuss (1-4): asphyxiating gases (carbon monoxide, hydrogen cyanide); respiratory irritant gases (ammonia, halogens, sulphur oxides, nitrogen oxides, formaldehyde, acrolein etc.); organic solvents; other gases, vapours or spray solutions (e.g. mineral oils); relatively inert gas (nitrogen, methane, carbon dioxide etc.).

Some of the gases and substances mentioned above can be also found in various forms in dentistry, particularly in dental laboratory. Such chemicals, be they liquids, gases or vapours, enter the body mainly by the respiratory route and secondarily, only some of them, by cutaneous or digestive route.(1-4)

The solubility of these substances is of particular importance. In general, most soluble substances can be quickly absorbed at the level of upper respiratory tract, where they show their aggressiveness.(1-4) The cutaneous route is specific to fat-soluble substances. The substances that do not penetrate the skin may block hair follicles and sebaceous glands, thus generating local dermatoses.(1-4) Once inside the body, such toxic substances cause both general effects (often non-specific) and effects localised at the level of target organs, depending on their aggressive particularities.(1-4) Some of these substances may be

harmful as such or by their metabolites. The toxicity of these substances may be brutal, acute, having effects that sometimes have unpredictable evolution or, most characteristic of the profession, chronic.(1-4)

Among the most toxic substances used in the dental laboratory, we mainly refer to methyl methacrylate (monomer, liquid form). Polymerised acrylic resins in dental laboratory or dental office are actually two-component systems: liquid and powder (liquid is the monomer and powder is the methyl methacrylate polymer). The monomer is methyl methacrylate, a liquid that is transparent, volatile, strong-smelling, flammable, insoluble in water but soluble in organic solvents, being itself a solvent for fats.(1-8)

Methyl methacrylate has a necrotic effect on the odontoblastic extensions and on some nerve endings in dental tissues. It is not chemically stable, tending to spontaneously polymerise under the action of heat and light. That is why it is kept in dark containers and away from heat sources.(1-8)

The polymer or polymethyl methacrylate is solid at room temperature but becomes plastic at a temperature over 125°C. Chemically speaking, polymethylmethacrylate is very stable. It is soluble in organic solvents. Water absorption is reduced.(1-8)

In dentistry, there have been reported two types of contamination with this toxic substance, namely methyl methacrylate monomer:

- inhalation of methyl methacrylate vapours while preparing (mixing) methyl polymethylmethacrylate as well as while processing or polishing parts of acrylic resins; the maximum inhalation of methyl methacrylate vapours should not exceed 100 ppm;
- skin contact occurs while preparing the material with bare hands (no gloves – see the smooth finish of dental prostheses with fingers unprotected by gloves).

Specifically, not only the questionnaire we administered to a batch of dental technicians from Romania but also a number of studies in the literature have confirmed and

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Article received on 23.02.2016 and accepted for publication on 05.04.2016

ACTA MEDICA TRANSILVANICA June 2016;21(2):28-32

reported a very high incidence of allergic dermatitis among dental technicians.

It has been noticed that the symptoms get reduced or disappear during holidays and they recur after starting work. Moreover, both the results of our questionnaire and the literature mention the concomitant incidence of allergic dermatitis and allergic rhinitis or conjunctivitis among dental technicians.

Other noxious chemical substances, be they liquids, gases or vapours, which can be found in dental laboratories and which were mentioned in our questionnaire are as follows:

- disinfectants used for the decontamination or disinfection of impressions, prosthetic parts or other materials and instruments that come or come back from the dental office to the dental laboratory;
- other substances for cleaning or degreasing (e.g. isopropyl alcohol, chloroform, acetone etc.) or liquids in polishing pastes (e.g. ethylene glycol, sulphuric acid);
- toxic vapours that may result from melting the casting wax etc.

All the mentioned substances can be really harmful for the professionals who work in the technical department, i.e. dental laboratory, as they can cause disorders when they come in contact with the skin, they are inhaled, or they are ingested accidentally.

PURPOSE

The purpose of this paper is actually to bring to the attention of those who work in the dental laboratory some extremely important risk factors to which they may be exposed, namely some factors of toxic and biological nature that can cause illnesses that are or are not classified as occupational diseases: toxic substances that are solids (powders), liquids, and gases or vapours.

In the first part of the study that has already been submitted for publication, we focused on powders of toxic nature. For the second part of the paper, we studied chemical substances such as liquids, gases or vapours, which can cause illnesses that are or are not classified as occupational diseases in the dental laboratory. At the beginning, it is necessary to clarify some basic concepts so that overall understanding can be gained.

MATERIALS AND METHODS

In what follows we present a study conducted by us, which clearly and briefly shows how aware experts in the field, namely experienced dental technicians, are of the risk of developing different illnesses in the dental laboratory, which are or are not classified as occupational diseases, disorders mainly caused by the exposure to noxious substances, liquids, gases or vapours, in the dental laboratory. In the first study we conducted, we addressed the same problem, but we focused on toxic powders in the dental laboratory.

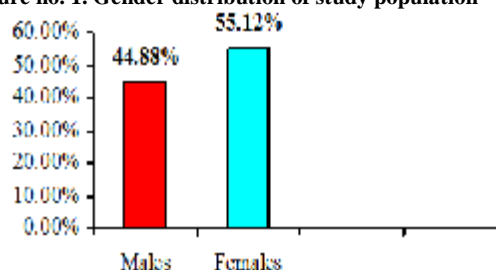
The method of investigation used in the second study was the questionnaire too. For the current study, the questionnaire comprised 9 questions (items). It was administered to a batch of 127 subjects, dental technicians who work not only in Bucharest but also in other randomly chosen 17 counties in Romania: Ilfov, Giurgiu, Prahova, Galați, Teleorman, Argeș, Dâmbovița, Brăila, Ialomița, Constanța, Bihor, Gorj, Dolj, Mehedinți, Vâlcea, Hunedoara and Alba.

The selected dental technicians were both males and females, aged between 40 and 70, working for minimum 10 years and maximum 40 years.

The statistical analysis resulting from the present preliminary study is very brief, being suggestively represented through graphs.

Of the 127 investigated dental technicians, 57 subjects, representing 44.88% were males, and 70 subjects, representing 55.12%, were females (figure no. 1).

Figure no. 1. Gender distribution of study population



The questionnaire administered to the 127 dental technicians is presented below:

Questionnaire

1. Have you been informed about the diseases that are or are not classified as occupational you are exposed to while performing prosthetic restorations made of acrylic resins, by being exposed to methyl methacrylate monomer (through the product leaflets, specialised articles or other scientific materials: respiratory, cutaneous or digestive route)?

2. Do you use protective equipment such as mask, gloves, goggles, when you prepare or process acrylic masses?

3. Are you aware of the main infectious diseases you are exposed to while manipulating the materials that come from the dental department to the dental laboratory:

- Hepatitis B virus (HBV);
- Hepatitis C virus (HCV);
- Human immunodeficiency virus (HIV);
- Mycobacterium tuberculosis;
- Cytomegalovirus;

4. Have you been informed about the occupational risks of infectious nature you are exposed to when you do not perform the decontamination and disinfection of the materials that come from the clinical department (impressions, intermediary or final prosthetic parts etc.) by immersion or spray using disinfectants?

5. Have you been informed about the illnesses that are or are not classified as occupational diseases you are exposed to while using disinfectants (glutaraldehyde-based substances, halogen compounds, quaternary ammonium salts, alcohols or peracetic acid) to decontaminate and disinfect the materials that come from the clinical department (impressions, intermediary or final prosthetic parts) without wearing appropriate protective equipment (overall, filter mask, gloves, goggles) (through the product leaflets, specialised articles or other scientific materials: respiratory, cutaneous or digestive route)?

6. Have you been informed about the illnesses that are or are not classified as occupational diseases you are exposed to while using cleaning or degreasing agents (e.g. isopropyl alcohol, chloroform, acetone etc.) as well as liquids in polishing pastes (e.g. ethylene glycol, sulphuric acid) (through the product leaflets, specialised articles or other scientific materials: respiratory, cutaneous or digestive route)?

7. Have you been informed about the illnesses that are or are not classified as occupational diseases you are exposed to while in contact with the toxic vapours resulting from melting the casting wax (through the product leaflets, specialised articles or other scientific materials: respiratory, cutaneous or digestive route)?

8. Do you consider the "dental technician" profession is a high risk one in terms of developing illnesses that are or are not classified as occupational diseases? Variants such as low,

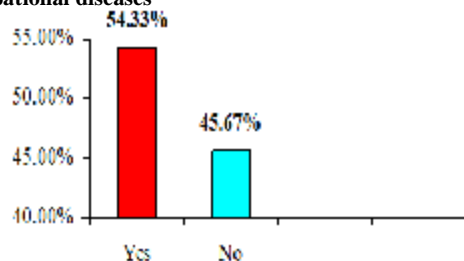
medium and high risk are provided.

9. Have you experienced allergic reactions such as allergic dermatitis, rhinitis or conjunctivitis while using the substances described above. If yes, did they cease to develop during holidays?

RESULTS

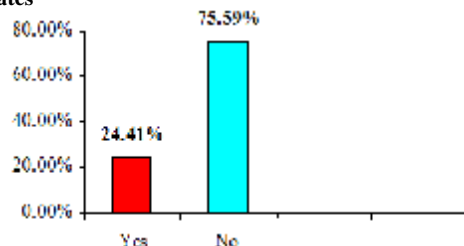
To the first question in the questionnaire, 69 subjects, representing 54.33%, responded affirmatively, while 58 subjects, representing 45.67% responded negatively (figure no. 2).

Figure no. 2. Knowledge of diseases classified or not as occupational diseases



To the second item, 96 subjects, representing 75.59%, responded negatively, while 31 subjects, representing 24.41%, responded affirmatively (figure no. 3).

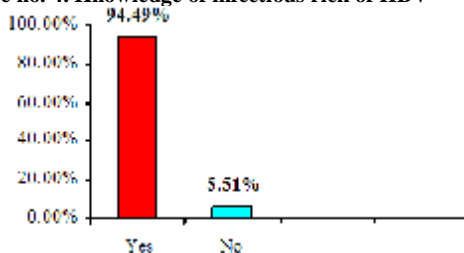
Figure no. 3. The use of protective equipment in processing acrylates



To the third question, which we consider extremely important, related to the fact that dental technicians are aware of the main infectious disorders they are exposed to while manipulating the materials that come from the clinical department in the dental laboratory, the answers were as follows:

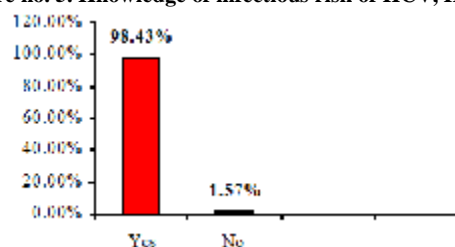
- a. Hepatitis B virus (HBV): 120 subjects, representing 94.49%, responded affirmatively, while 7 subjects, representing 5.51%, responded negatively (figure no. 4);

Figure no. 4. Knowledge of infectious risk of HBV



- b. Hepatitis C virus (HCV): 125 subjects, representing 98.43%, responded affirmatively, while 2 subjects, representing 1.57%, responded negatively (figure no. 5);

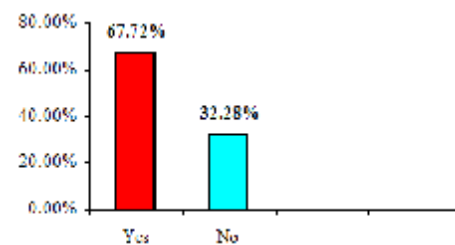
Figure no. 5. Knowledge of infectious risk of HCV, HIV



- c. Human immunodeficiency virus (HIV): 125 subjects, representing 98.43%, responded affirmatively, while 2 subjects, representing 1.57%, responded negatively (figure no. 5);

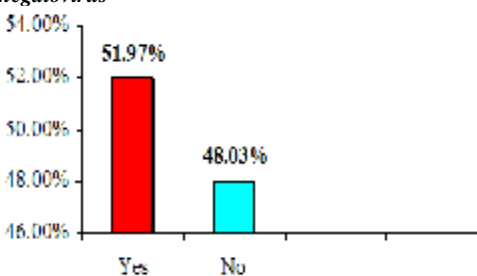
- d. *Mycobacterium tuberculosis*: 86 subjects, representing 67.72%, responded affirmatively, while 41 subjects, representing 32.28%, responded negatively (figure no. 6);

Figure no. 6. Knowledge of infectious risk of *Mycobacterium tuberculosis*



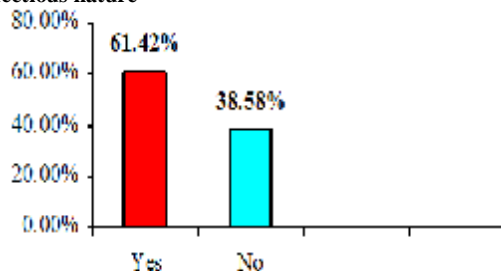
- e. *Cytomegalovirus*: 66 subjects, representing 51.97%, responded affirmatively, while 61 subjects, representing 48.03%, responded negatively (figure no. 7).

Figure no. 7. Knowledge of infectious risk of *Cytomegalovirus*



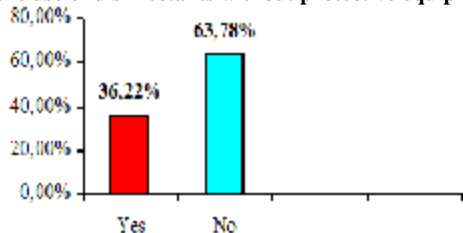
To item number 4, 78 subjects (61.42%) responded affirmatively, while 49 subjects (38.58%) responded negatively (figure no. 8).

Figure no. 8. Awareness on the occupational hazards of infectious nature



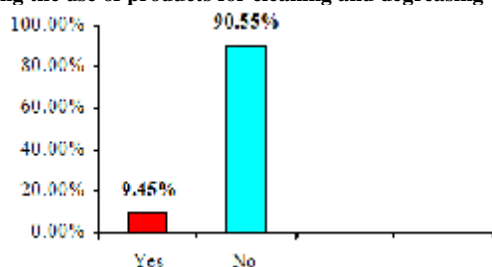
To the fifth question, 46 subjects (36.22%) responded affirmatively, while 81 subjects (63.78%) responded negatively (figure no. 9).

Figure no. 9. Information about occupational risks arising from the use of disinfectants without protective equipment



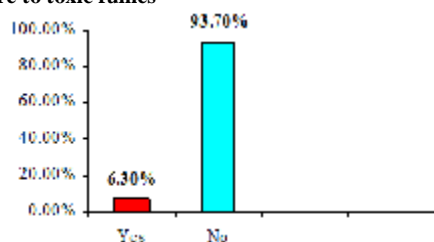
To item number 6, 12 subjects (9.45%) responded affirmatively, while 115 subjects (90.55%) responded negatively (figure no. 10).

Figure no. 10. The knowledge of occupational hazards during the use of products for cleaning and degreasing



To question number 7, 8 subjects, representing 6.30%, responded affirmatively, while 119 subjects, representing 93.70%, responded negatively (figure no. 11).

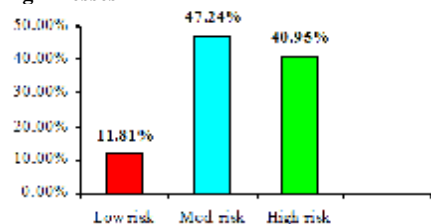
Figure no. 11. The knowledge of occupational hazards by exposure to toxic fumes



To question number 8, the answers were as follows (figure no. 12):

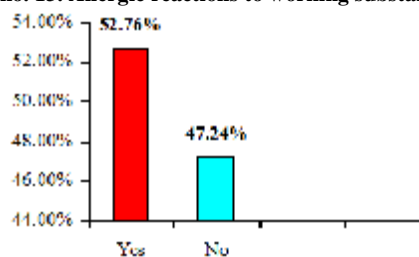
- low risk: 15 subjects, representing 11.81%;
- medium risk: 60 subjects, representing 47.24%;
- high risk: 52 subjects, representing 40.95%.

Figure no. 12. Dental technician profession as a risk of developing illnesses



To question number 9 in the questionnaire, 67 subjects (52.76%) responded affirmatively, while 60 subjects (47.24%) responded negatively (figure no. 13).

Figure no. 13. Allergic reactions to working substances



DISCUSSIONS

Following the study of the answers to the 9 questions in the questionnaire, some interesting aspects arise:

- in terms of dental technicians information on the diseases that are or are not classified as occupational to which they are exposed when performing prosthetic restorations made of acrylic resins, by exposure to monomer methyl methacrylate, (through leaflets, specialised articles or other scientific materials: respiratory, cutaneous or digestive route), more than half of the interviewed subjects were aware of the risks to which they can be exposed;
- unfortunately, a far lower percentage of the interviewed subjects, i.e. only 24.41% of the interviewed dental technicians used protective equipment (overall, mask, goggles, gloves) when they prepared or processed acrylic masses;
- following the responses to the first 2 items, we can draw the conclusion that a percentage between 54% and 76% of the dental technicians had a slight idea of the toxicity and aggressiveness of methyl methacrylate monomer;
- as for the occupational exposure to infectious risks in the dental laboratory, only 61.42% of the interviewed dental technicians were aware of them, and if we consider the knowledge about contamination with HBV, HCV, HIV, about 95% of respondents were aware of such infectious agents, and with regard to the contamination with *Mycobacterium tuberculosis* and *Cytomegalovirus*, over 50% of respondents were aware of the diseases caused by such micro-organisms (67.72% in the case of *Mycobacterium tuberculosis* and 51.97% in the case of *Cytomegalovirus*);
- only a percentage of 36.22% of the interviewed subjects had real knowledge about the possibility of developing diseases that are or are not classified as occupational ones, caused by the toxicity of disinfectants used for the decontamination and disinfection of the materials that come from the clinical department (impressions, intermediate or final prosthetic parts) and wore protective equipment when working with them;
- following the answers to items no. 3, 4, 5, we can conclude that there were serious knowledge gaps as far as microbiology and virology related to the dental technician profession were concerned; moreover, the small percentage of dental technicians who used chemical substances to decontaminate and disinfect the materials coming from the clinical department (impressions, intermediary or final prosthetic parts) were not aware of the aggressive potential of such chemical compounds for the human body;
- only a percentage below 10% of the interviewed subjects were informed on the occupational diseases that are or are not classified as occupational ones to which dental

technicians are exposed while using cleaning or degreasing substances (e.g. isopropyl alcohol, chloroform, acetone etc.) or liquids in polishing pastes (e.g. ethylene glycol, sulphuric acid) (only 9.45%) or because of the harmful action of the toxic vapours that may result from melting the casting wax (only 6.30 %) (through leaflets, specialised articles or other scientific materials: respiratory, cutaneous or digestive route). In conclusion, the answers to questions number 6 and 7 showed that dental technicians had little knowledge about the toxicity of the substances used in the technical department, be they liquids, gases or vapours;

- related to the fact that the interviewed subjects considered the “dental technician” profession as a high-risk one in terms of potential occupational diseases, the answers were as follows: 11.81% considered it a low-risk one; most of them, i.e. 47.24%, appreciated the “dental technician” profession as a medium-risk one; a quite large percentage, i.e. 40.95%, considered the particular profession a high-risk one. In our opinion, the “dental technician” profession is a high-risk one in terms of occupational diseases, as practitioners are exposed to a wide range of noxious substances, some of them very harmful to the human body;
- as for the last item in the questionnaire, namely number nine, over 50% of the interviewed dental technicians (i.e. 52.76%) answered they had allergic reactions over time, such as allergic dermatitis, rhinitis and conjunctivitis, which ceased to develop during holidays.

CONCLUSIONS

The following conclusions can be drawn from the conducted study:

- dental technicians should be better educated and trained, since they are students, related to diseases that are or are not classified as occupational ones;
- all producers of materials that are used in dentistry (those used in the dental laboratory included) have to describe as thoroughly and clearly as possible all the side effects of using such substances by dental technicians and dentists, as service providers, and by patients, as beneficiaries;
- the clinical department (dental office) has to inform the technical department (dental laboratory) on the products (impressions, intermediary or final prosthetic parts etc.) that come from patients suffering from serious infectious diseases (hepatitis B and C, HIV, tuberculosis etc.), so that the practitioners in the dental laboratory (dental technicians) can respect or, if they consider appropriate, supplement the standard infection prevention measures in relation to the products coming from such patients;
- the workers in dental laboratories should be obliged to wear protective equipment, at least filter masks, and dental laboratories should be very well ventilated;
- the medical team (dentist-dental technician) should be obliged to inform the patients in writing about the risks they are exposed to while accepting the prosthetic restoration, in terms of the materials the restorations are made of.

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