Risk factors and preventive measures for occupational diseases in dental technicians

Faktori rizika i mere sprečavanja profesionalnih bolesti kod zubnih tehničara

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Introduction

The construction procedure of fixed and mobile dentures is based on principles of dental doctrine and in the way widely used worldwide. The process of constructing prosthetic restorations and mobile orthodontic appliances is the result of team cooperation between dentists and dental technicians. The work of dental technicians is highly specific and implies construction of mobile and fixed dentures and mobile orthodontic appliances on plaster models obtained by casting individual dental impressions and patients’ jaws. According to the data of the Serbian Institute of Occupational Medicine and Radiological Prevention there are about 3,800 dental technicians, of whom 70% are women. The working time in state sector is 40 hours per week, while it is much longer in private sector.

The work in dental laboratory requires ultimate precision and manual dexterity, good vision and ability of recognizing slight differences among variety of hues. All dental restorations are the result of correctly established indication and personal creative expression of dental technician, whereby the final piece placed in a patient’s oral cavity can be considered a tiny work of art.

On the other hand, the work of dental technicians represents a great risk of occurrence of occupational diseases not only due to numerous harmful substances used and released during the process of constructing dentures and orthodontic appliances but also due to inadequate working conditions in dental laboratories and improper protection of the staff. Dental technicians are constantly exposed to harmful effect of different solvents, non-organic acids, evaporations and gases obtained during material exploitation, dust during finishing and grinding, metal alloys, ceramic and acrylics. The group of potentially toxic substances includes methacrylates, silicium dioxide, butylene glycol, hexane solutions, ethyl acetate, nitrocellulose, glutaraldehyde, benzoyl peroxide, hydroquinone, bisphenol A, kaolin and oxides of different metals. Concentration values of these substances in the air are very often considerably higher than values of maximum allowable concentrations (MAC), particularly if dental laboratory is without automatic device for measuring air pollution. Particular attention should be focused on methacrylic monomer that is known to have a wide spectrum of detrimental effects such as irritation of skin, eyes and submucose, allergic dermatitis, asthma, and symptoms of central and peripheral nervous system (headache, back pain, nausea, loss of appetite, reduction of gastric motoric activity, tiredness, sleep disturbance, neuropathy, loss of memory). The toxicity of methyl methacrylate was demonstrated in vitro.

Metal alloys such as vitalium, visil, duralium and viro-nite are used in construction of crowns, bridges and skeletal partial dentures. Major ingredients of these alloys include cobalt (35–65%), chrome (20–30%) and nickel (0–30%) and small amounts of molybden, silicium dioxide, beryllium, boron and tantalum, the harmful effects of which have already been laboratory and clinically well documented. Gold and palladium alloys are rarely used nowadays. Although considered to be relatively bioinert, conjoined allergic reactions to palladium and nickel have been reported.

Contact dermatitis

Dermatological occupational diseases occur as a result of irritation or immunological reaction of skin, most often fingers and hands, and rarely face and eyelids (Table 1). Contact dermatitis is mostly occupational disease in industrially developed countries. The results of the study conducted by Ruste-
meyer and Frosch show that 16% of dental technicians in Germany have symptoms of contact dermatitis. The prevalence of contact dermatitis is 22% and 43% in Australian and Danish dental staff, respectively. In the last few years increase of affected persons has been observed. Contact dermatitis of hands is clinically manifested by skin dryness of fingers and hands, redness, broken and peeling skin, itching and pain (Figure 1). The disease improves at weekends and holidays. Mechanical friction (abrasion, attrition), work with plaster, constant changes of temperature and hand washing further contribute to the development of skin changes. When symptoms of dermatitis are present among dental staff the standard Patch test is used for detecting hypersensitivity to a specific group of allergens: methyl methacrylate, potassium dichromate, cobalt nitrate, nickel-sulfate, formaldehyde, hexamethylenetetramine, epoxy resin, phthalic anhydride, mercury precipitate, colophonium, benzoyl peroxide, benzoic acid, hydroquinone.

Dental staff is at increased risk of developing contact dermatitis caused by methacrylates molecules which pass through thin latex gloves. Methacrylates represent ingredients of acrylic resins used in construction of plate and skeletal dentures. According to the laboratory investigations carried out by Marks et al. and Werrer et al. immunological reaction to methyl metacrylates was present in 1% of examined subjects. In addition, local contact reactions to butyl methacrylate, urethane dimethacrylate and cross-linking agents (dimethacrylate, ethylene glycol dimethacrylate, 2-hydroxylethyl methacrylate, etc.) were clinically described. Cockayne et al. have described the case of a dental technician allergic to colophonium, the ingredient of numerous waxes used in dentures construction.

Allergic diseases

Systemic allergic reactions to chemical substances that dental technicians come in contact with during their everyday work are, fortunately, very rare. They include type I hypersensitivity reactions manifested as generalized urticaria, bronchial asthma, and very rarely as anaphylactic shock or edema of larynx. Jaakkola et al. in their epidemiological study indicate that medical staff is more often affected by...
bronchial asthma if exposed to chemical toxic substances for a long period of time.

Literature data point to link between systemic autoimmune diseases including rheumatoid arthritis, systemic sclerosis and systemic lupus erythematosus and extra work with potentially toxic substances in dental laboratory. According to findings of Fabrizio et al. 14 out of 27 dental technicians who underwent neurological examination showed some disorders including postural tremor, and Parkinson’s disease was diagnosed in one dental technician. The results of a clinical study conducted by Gorell et al. 29 indicate that long-lasting work with metal alloys increases the risk of developing Parkinson’s disease. Sadoh et al. 3 reported the case of a dental technician affected by Sjögren’s syndrome after long-lasting exposure to silicium dioxide.

Neurological diseases

During their work dental technicians are in contact with chemical solvents containing hexane and metals (mercury, iron, chrome, cobalt and nickel) that were proven to have detrimental effect on central nervous system 3. According to findings of Fabrizio et al. 31 out of 27 dental technicians who underwent neurological examination showed some disorders including postural tremor, and Parkinson’s disease was diagnosed in one dental technician. The results of a clinical study conducted by Gorell et al. 29 indicate that long-lasting work with metal alloys increases the risk of developing Parkinson’s disease. Sadoh et al. 3 reported the case of a dental technician affected by Sjögren’s syndrome after long-lasting exposure to silicium dioxide.

Respiratory diseases

Vaporization of methyl methacrylates and dust which is the result of finishing dentures and metal alloys may lead to damage of nasal cells with subsequent higher susceptibility to respiratory infections. Clinical manifestations of respiratory diseases of dental technicians are cough, enhanced mucous secretion, and decreased respiratory capacity 31.

A meticulous finishing of dentures implies extra strain of the eye muscles, which along with increased probability of olfactory infections and mechanical injuries represents risk for damaging sight among staff in dental laboratories. Benzoyl peroxide, the initiator of polymerization of methacrylates under in vitro conditions damages fibroblasts of the eye.

Other risks for health damage

Finishing minor dentures requires high precision and extra strength, so that cramps and painful tension of muscular and skeletal system are possible. Although slight, loading of back and neck should not be neglected taking into account time duration of fixed body position. Work with material taken from patient’s oral cavity is accompanied by risk of developing infection if adequate disinfection is not carried out.

Clinical study on increased risk of developing carcino-genic diseases among dental technicians has not been conducted yet, but there is some evidence suggesting mutagenic effect of particular components of metal alloys such as chrome, cobalt, nickel and beryllium, as well as crystals of silicium dioxide. Choudat 25 suggests link between bronchial cancer, mesotheliomas and dental technicians’ work.

Preventive measures for dental technicians in workplace

In order to improve life and work efficacy of dental technicians it is necessary to provide them with standardized and optimal working conditions. Dental laboratories, both state and private, should be spacious, clean and well lit. Air pollution is prevented by adequate local and general ventilation system. Dental technician’s workplace should have adequate ventilation system. It should also have separate worktable equipped with kit for grinding, cutting and polishing of dentures, spirituous lamp and hand instruments. In order to avoid damages of musculoskeletal system brought about by strain, adequate adjustable chair should be chosen. Eating,
drinking and smoking are forbidden at workplace. In addition, it is preferable to have regular shorter breaks spent in a clear air area.

Dental staff should adopt standard procedures for handling with different substances and objects. Manufacture of dentures and orthodontic appliances implies utilization of wide spectrum of different materials that could damage health of the employees. Whenever it is possible, all substances and chemical agents that could be potentially harmful should be replaced with those that are more efficient and less toxic, irritable and sensible. This particularly refers to the use of hypoallergenic acrylates and alloys without nickel and beryllium.

It is imperative that dental technicians use adequate personal protection. Protective uniform includes work uniform, protective gloves, glasses and masks. Nitrile and rubber gloves made of synthetic materials are recommended regarding the fact that latex and vinyl gloves do not provide adequate protection from penetrating molecules of methacrylate monomer and other potentially toxic substances and that allergic reaction to their ingredients is rather common. However, these gloves reduce precision and efficacy of work, so that some additional effort is needed for carrying out any delicate work on dentures. In order to protect periphery nervous system from deleterious effect of vibrations, the use of specialized anti-vibration gloves is recommended. Asbestos gloves are used for handling hot molds. Protective glasses should have lateral shield so as to avoid eye injuries. Wearing protective masks represents the first line of defense against damage of respiratory organs and nervous system. Protection of hearing is needed while finishing metal caps of skeletal dentures and caps of fixed dentures and is imperative when noise is higher than 80 dB. Disinfection of impressions and corrected dentures is necessary for protection of dental laboratory from microbial contamination.

While manipulating acrylates a direct contact with non-polymerized mass (no-touch technique) should be avoided. Personal hygiene is important factor in prevention from contact dermatitis. The use of low base soap and lotions is recommended. It is contraindicated to use creams and lotions under latex gloves because they could deteriorate stimulating potential toxicity. This particularly refers to the use of hypoallergenic acrylates and alloys without nickel and beryllium.

Dental technicians run the risk of developing local and systemic occupational diseases. Therefore, preventive measures should include adequate workplace, proper equipment handling, selection of biocompatible materials, wearing protective uniform, health-education work and early detection of disease symptoms. The goal of prevention is optimization of working conditions with individual physical and mental capabilities in order to preserve health of dental technicians and thus maintain appropriate level of their working and life skills.

**Conclusion**

Dental technicians should regularly undergo specific medical examinations with primary emphasis on lung function, skin diseases, diseases of ear, throat and nose, disorder of hearing and periphery circulation. Preventive measures also imply health-education work so that the staff could get acquainted with potential risks of their work, early symptoms of diseases, as well as using adequate protection.

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