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OCCUPATIONAL HAZARDS IN DENTISTRY – PART ONE: ALLERGIC REACTIONS TO DENTAL RESTORATIVE MATERIALS AND LATEX SENSITIVITY

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Abstract. *Dentists, as well as dental personnel and their patients are constantly exposed to a number of specific occupational hazards. These cause the appearance of various ailments, specific to the profession, which develop and intensify with years. In many cases they result in diseases and disease complexes, some of which are regarded as occupational illnesses.*
The first part of this paper is a survey of some selected occupational hazards: allergies caused by dental restorative materials and latex hypersensitivity while the second part refers to occupational biohazards, stressful situations, as well as factors leading to the musculoskeletal system diseases and diseases of the peripheral nervous system.

Key Words: *Allergic Reactions, Dental Restorative Materials, Latex Sensitivity*

INTRODUCTION

Carrying out their professional work, dentists are exposed to a number of occupational hazards. These cause the appearance of various ailments, specific to the profession, which develop and intensify with years. In many cases they result in diseases and disease complexes, some of which are regarded as occupational illnesses. Some of dental restorative materials can be potentially harmful to dental personnel and patients and can cause allergic contact dermatitis, asthma, and conjunctival symptoms. At some time in the past, allergic contact dermatitis was generally addressed to reaction to oral hygiene products (e.g. mouthwash, dental floss and toothpaste), metals, disinfectant and glutaraldehide. A vast range of new materials deployed in dental practice in recent years has altered the reported frequencies of reactions and types of allergens that cause allergic contact dermatitis. Because of public concerns regarding the potential toxicity of metals in oral restorations

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(e.g. the toxic effects derived from amalgam fillings) discussed by Pelka [1] as well as greater demand for cosmetic dentistry, the use of acrylics, resins and polymer materials has been widely promoted. This, however, has exposed both dental personnel and patients to a new, highly allergenic group of materials.

The use of latex gloves to provide a physical barrier has resulted in the decrease in allergic reactions caused by traditional allergens in dental personal (allergic reactions to oral hygiene products and metals are, however, still prevalent in patients.) Despite the latex physical barrier, an escalation of allergic reactions to the latex protein itself has been noted in both dental personnel and patients.

The term *"allergy"* (from the Greek *allos* meaning changed or altered state, and *ergon* meaning reaction or reactivity) was used for the first time by a Viennese pediatrician Baron Clemens Von Pirquet in 1906. Von Pircuet used the term to describe an altered reaction he had observed in patients which he described as the influence of external factor, an allergen (such as pollen, stings, drugs or food) on the immune system. An allergic reaction also known as a hypersensitivity reaction is therefore a reaction caused by the immune system in response to a foreign substance (or allergen). Restorative products like acrylics, resins, and polymer materials used in dental practices can potentially cause an allergic reaction. Allergies may develop with the mild sensitivity which increases over time, or they may affect one suddenly. Hypersensitivity to allergens can also be referred to as immune – mediated injury. As types I and IV hypersensitive are associated with allergic reactions, discussion is confined to these two types [2].

Type I or Immediate Hypersensitivity

This type of allergy is referred to as common allergy and is due to excessive productions of the class of antibody known as IgE. Atopy is a term used for the clinical presentations of type I immune reactions. This type of hypersensitivity can result in occupational asthma, angio-oedema and/or urticaria, rhinitis and conjunctivitis. In classic type I hypersensitivity the exogenous agent may be a complete antigen.

Anaphylactic shock is the severest form of a type I reaction. This can sometimes result in fatal systemic reactions in a suspectible individual upon exposure to a specific antigen. Symptoms include respiratory difficulty, fainting, etching, urticaria, swelling of the throat, or other mucous membranes and a sudden decline in blood pressure. Clinical test for type I hypersensitivity include the skin prick test, radio-alergosorbent test (RAST), nasal provocation test, skin-patch test, and nasal smears.

This type of allergic reaction can currently be controlled by avoiding non-allergens, and by hyposensetisation and drug therapy. Some newer approaches include treating with IFN and allergoids.

Type IV Hypersensitivity (Delayed Hypersensitivity)

This type of hypersensitivity is due to allergen contact and results from cell-mediated immunity (cytotoxic T-lymphocytes and cytokines) causing harm to the body. Type IV hypersensitivity reactions are characterized by eczema that peaks 8-72 hours after allergen contact. Inflammation develops in the affected tissues and may even result in chronic inflammatory diseases. Sufferers of this type of hypersensitivity complain of allergic contact dermatitis and irritant contact urticaria. Type IV immune reactions in the

skin manifest as occupational allergic dermatitis. This type of hypersensitivity is diagnosed by means of a skin-patch test.

DENTAL RESTORATIVE MATERIALS AND ALLERGIC REACTIONS

In this review common dental restorative allergens, as well as their allergic reactions, are discussed. The information provided can be used as a guideline to assist the dentist in providing a controlled allergen environment for personnel as well as patients. Scot et al [3] mentioned several manifestations of allergic reactions that have oral and facial involvement. These include angio-oedema of the lips and tongue, urticaria of the face and erythema multiforme of the skin, lips and oral mucous. Allergic contact dermatitis may not only appear on the hands, but is also associated eyelids, as reported by Guin [4] and Fowler [5]. Contact allergy involving the oral mucous, according Scot et al [3], is a poorly understood clinical entity that is infrequently described. Contact allergy is also often mistaken for chronic trauma caused by fractured teeth, fractured restorations, ill-fitting prosthesis or parafunctional oral habits. These lesions have a similar clinical appearance.

Contact allergy appears when a hypersensitivity reaction (type I or IV) develop in the form of the substance of small molecular weight that penetrates the skin of mucous. The substance then combines with the mucosal proteins to form an allergen that can potentially trigger the immune system. Usually the reactions appear to be non-specific both clinically and histologicaly. It is therefore of great importance that the diagnosis of intra-oral contact allergy is based on the temporal relationship between the onset of the symptoms and exposure to a possible allergen. Dental personnel should therefore be aware of the possible allergens that they, as well as their patients, are exposed to, so that they can make informed decisions once faced with contact allergic symptoms. Previous allergic reactions in patients and personnel should always be noted (as type IV hypersensitivity may be triggered as a result of a previous exposure to allergen). Lonnroth and Shahnavaz [6] suggested, on the basis on survey in Sweden among dental personnel, that there is a correlation between hand dermatitis, age eczema in childhood and high fever. They did not find a correlation, however, between asthma, frequent washing of hands and hand dermatitis.

ACRYLATE AND ITS COMPOUNDS

Dental polymer materials based on methacrylate, its polymer, and polyelectrolytes, seem to be a major cause of contact dermatitis in dental personnel. [7,8] Dentistry uses a variety of different polymer materials. The setting of restorative materials and adhesives is initiated chemically by mixing two components or by visible light. In both cases, polymerization is incomplete and monomers, not reacted (also known as free monomers), are released [6]. These free monomers may cause a wide range of adverse health effects such as irritation to skin, eyes or mucous membranes, allergic dermatitis, asthma and paraesthesiae in the fingers. Additionally, disturbances of the central nervous system such as headache, pain in the extremities, nausea, loss of appetite, fatigue, sleep disturbances, irritability, loss of memory, and changes in blood parameters may also be noted.

Protection Against Acrylate Compounds

Unfortunately, the gloves do not protect the hands against the free monomers, as they easily penetrate the gloves. Dental personnel may also inhale these free monomers, as facemasks do not provide enough protection, while eyes are exposed to the monomer vapor. Because permeability of the gloves to monomers, Andersson et al [9], tested the ability of six different types of gloves to prevent the penetration of 2-hydroxyethyl methacrylate (2-HEMA) and triethylene glycol dymethacrylate (TREGDMA) present in Scotchbond1 (a commonly used dental adhesive). The types of gloves were: 1 vinyl glove, 2 latex gloves, 2 nitrile gloves, and a 4H glove. Their results indicated that the 4H glove gave by far the best protection, followed by the 1 nitrile gloves. Latex gloves and the vinyl glove gave very poor protection against the adhesive. It is therefore suggested that when acrylate allergy is suspected, nitrile or 4H gloves should be used.

Acrylate Patch Testing

If acrylate sensitivity is suspected specific acrylate patch testing can be done by the pathologist. However, this test may not give an immediate result, as suggested by Fowler [5]. He reported case of eyelid and hand dermatitis in a dental technician. He had previous evidence of delayed positive test result when a patch test with a sample of an acrylic material from a nail salon showed a positive reaction only after one month. Repeat testing with ethyl acrylate and methyl methacrylate became positive only after five weeks. Kanerva et Estlander [10] also warn that strong concentration of patch test substances may cause a severe allergic reaction, and the patch test sites may remain vitiliginous for a period of time. Dental personnel should therefore be aware that patch testing may have a delayed response and even cause severe discomfort in some people.

Sources of Allergic Reactions

Commercially available dentin primers and dentine bonding agents and cements that contain 2-HEMA (hydroxyethyl methacrylate) are widely used in dental practices [11, 12]. Hamid et al [13], studied dental component released of cements from tooth and mould samples. Analyses of diffusion of the HEMA through dentine showed a relatively sustained movement into the pulp space during the first day, with exponential decline thereafter. The authors concluded that the release of this material may be relevant to the risk of adverse pulp responses in patients and to the risk of allergy in patients and dental personnel.

Sensitivity to monomers that do not react while material is prepared can affect dental personnel as well as patients in the immediate vicinity. Patients are, however, also at risk when they come in to contact with leachables from their fillings. This may occur in any time after the dental procedure. Lygre et al [14] separated and identified leachables from three different polymer-based dental filling materials by using a combined method of gaschromatography and mass spectrometry. The following organic leachables were identified and quantified: DL-camphorquinone, 4-dimethylaminobenzoic acid ethyl ester (DMABEE), drometrizol, 1,7,7 – trimethylbicyclo /2,2,1/ heptane, 2,2-dimethoxy /1,2/ diphenyletanone (DMBZ), ethyleneglycol dimethacrylate (EGDMA), and triethyleneglycol dimethacrylate (TEGDMA). All of these materials may potentially cause allergic reaction.

There are numerous other reports of allergy associated with acrylate and its compounds. Bauer and Wollina [15] reported denture-induced local and systemic reactions to acrylate. Kanerva [16] reported fingertip paraesthesia and occupational allergic contact dermatitis caused by acrylics in a dental nurse; and in another report [17] noted allergic contact dermatitis from eugenol used as a restorative dental material with polymethylmethacrylate

Asthma Due to Acrylate Compounds

Asthma due to dental materials is also an important occupational hazard. Piirila [18] reported occupational asthma, conjuctival symptoms and allergic contact dermatitis among dental technicians exposed to acrylat compounds. Nayebzadeh and Dufresne [19] conducted a study on occupational asthma among dental technicians by determining time-weighted average and peak concentrations of methacrylate vapor and time-weighted average concentration of acrylic dust. They suggested that the use of a local exhaust ventilation system significantly reduced the peak concentration of methyl methacrylate vapor in the breathing zone of dental technicians. However, the local exhaust ventilation was not efficient in reducing the concentration of airborne acrylic dusts.

Cross-sensitivity

Carmichael et al [20] discussed a case study of a patient who presented with recurrent facial dermatitis associated with dental work because of epoxy acrylate BIS- GMA (bisphenol-A0 glycidildimethacrylate). Epoxy acrylate resins have been used in dental fillings since 1962. BIS-GMA is a monomer produced by the reaction of methyl methacrylate and diglycidylether (epoxy resin). BIS-GMA is then cured by the peroxide/amine method or visible light to produce the final non-allergenic polymer in the mouth. BIS-GMA itself rarely causes allergic reactions. Epoxy sensitivity, however, well recognized. Carmichael et al [20] therefore suggested that given the structural homology of BIS-GMA and epoxy the associated sensitivity represents cross-sensitivity to the epoxy moiety within the BIS-GMA

Sensitivity to Dentures

Another commonly utilized dental material is resin in dentures. Barclay [21] noted that hypersensitivity reactions to the commonly used denture base resins are infrequently reported. When they have been reported, most acrylic hypersensitivity reactions have been described as local contact reactions with few reports identifying any significant systemic symptoms. They report a case where the patient suffered extensive systemic symptoms that were strongly linked to denture wear. The authors however, hypothesized that the reactions experienced by this patient to some denture resins was the result of the incorporated coloring agents, as the patient responded positively to patch test of pure dye samples.

Latex Sensitivity

The most frequent allergy complained in dental practices is probably sensitivity to latex [22, 23] Powdered latex gloves were mentioned to cause allergic reaction, although dentists with an allergic profile complained that all latex gloves cause irritation. The powder in latex gloves itself is not the allergen [24]. It only provides binding sites for latex protein, and aids in carrying the protein into the skin [25,26]. It has also been reported that airborne powder particles can cause asthmatic allergic reactions or even anaphylaxis [27]. Dental personnel should also note that latex is present in other personnel protective equipment, e.g. masks, eyewear, and clinical gowns. These items have been linked to adverse skin and mucous membrane reactions.

There are three basic categories of adverse latex gloves associated conditions: irritant, allergic and immediate, or type I hypersensitivity allergy. The first two types (irritant and allergic contact dermatitis are painful and temporarily debilitating, but without potential for serious reactions. The third type (immediate or type I hypersensitivity) is the least common but the worst type of reaction, sometimes leading to anaphylaxis [28]. Sufferers from latex allergy should rather use vinyl or nitril gloves, while it is advisable for severe sufferers to work in latex-free environment.

CONCLUSIONS

Dental products such as acrylics, resins and polymer materials used in restorative dentistry represent a major advance in dentistry. Although these products may act as allergens in part of the population, one should keep in mind that every technology, no matter how beneficial, can exert a negative impact on some members of the population. The reality of public health will always involve balancing maximum benefit and minimum harm to the public health and well-being. Because allergy is a reality dentists have to deal with, the following guidelines are proposed:

- Dental personnel should be familiar with the major signs and symptoms of allergic reactions, including anaphylaxis in the case that an allergic emergency should arise during a consultation. Previous allergic status of patients and personnel should be noted.
- Dental personnel should always keep records of dental materials used. If allergic reaction occurs, backtracking is necessary in order to identify the specific allergen.
- Do not mistake contact allergy for chronic trauma.
- Local exhaust ventilation systems can significantly reduce the peak concentration of acrylate vapor in the breathing zone of dental technicians. (However, the local exhaust ventilation is not efficient in reducing the concentration of airborne acrylic dusts.)
- Nitrile, vinyl, or 4H gloves should be used by the dental practitioner if acrylate or latex sensitivity is suspected
- If sensitivity is suspected in form the patient about possible clinical tests to determine origin of allergy, e.g. acrylate patch testing. Delayed sensitivity may be prevalent in certain cases.
- Be aware of cross-sensitivity towards coloring agents of dentures.
- Create a latex-free environment for personnel and patients with latex sensitivity.

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PROFESIONALNI RIZICI U STOMATOLOGIJI - PRVI DEO: ALERGIJSKE REAKCIJE NA DENTALNE MATERIJALE I OSETLJIVOST NA LATEX

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Stomatološka ordinacija i stomatološke intervencije poseduju specifične profesionalne rizike koji ugrožavaju kako profesionalno osoblje, tako i pacijente. Kontinuirano izlaganje nekim od profesionalnih rizika u stomatologiji može dovesti do pojave različitih oštećenja i oboljenja, od kojih su neka karakteristična kao profesionalna oboljenja dentalnog osoblja (metakarpalni sindrom, poremećaji sluha, oštećenja vida,...).

U prvom delu rada razmatraju se profesionalni rizici (latex i dentalni materijali iz svakodnevne upotrebe) koji uzrokuju različite tipove alergijskih reakcija. Drugi deo se bavi infekcijama i biohazardom stomatološkog okruženja, faktorima koji dovode do poremećaja mišino-skeletnog i perifernog nervnog sistema, kao i problemom stresa kod dentalnog osoblja.

Ključne reči: *alergijske reakcije, dentalni materijali, osetljivost na latex*