

Investigation of Contact Allergies to Component and Auxiliary Prosthetic Materials

Ketij Mehulić¹
Muharem Mehulić²
Patricija Kos³
Dragutin Komar¹
Katica Prskalo⁴

¹Department of Dental
Prosthetics
School of Dental Medicine
University of Zagreb
²University Hospital for Lung
Diseases "Jordanovac",
Zagreb
³Private practice, Poreč
⁴Department of Dental
Pathology
School of Dental Medicine
University of Zagreb

Summary

Contact allergy is a delayed reaction to sensitivity in which a localised lesion of the skin or mucous membrane occurs as a result of contact with an allergen. The fitting of a fixed, or placement of a mobile, prosthetic appliance in the oral cavity causes corrosive processes to occur on the surface of the restoration and the release of ions which, as haptens, can induce allergic reaction.

The aim of this investigation was to examine the occurrence of allergies to component and auxiliary prosthetic materials by patch test in patients with lichen ruber planus, stomatitis and stomatopyrosis. Thirty-two patients with fixed and/or mobile restorations and seven patients with one of the above diagnoses without a restoration, participated in the investigation. Testing was carried out by standard technique (patch test) with 13 allergens. The results of the investigation indicate the greater probability of a positive patch test in subjects with the aforementioned diseases and with a restoration, in relation to subjects without a restoration ($P = 0.62$). The probability of symptoms worsening increased with the insertion/fitting of a fixed or placement of a mobile restoration ($P = 0.019$). This was particularly so in the case of restorations made of Co-Cr-Mo alloy. With the increase in the number of units of fixed restorations, or the presence of mobile restorations in both jaws, the probability of a positive patch test to cobalt chloride also increased ($P = 0.05$). Lichen ruber planus increased the probability of a positive patch test in the majority of cases ($P = 0.05$). The greatest number of positive results were for the allergens nickel, cobalt and chrome (each 17.95%) and a negative finding was obtained for dibutylphthalate and HH mix. Stomatopyrosis increased the probability that the subject would have a positive result for chrome ($P = 0.019$). The occurrence of a positive patch test was greater in women for all allergens ($P = 0.05$), apart from epoxy resin, where it was less than in the male subjects ($P=0.036$). Because of the greater incidence of contact allergies in the population a more detailed investigation of prosthetic materials is needed prior to their introduction into clinical practice. In the case of patients with atopic history allergological testing and immunological tests should be performed prior to prosthetic treatment.

Key words: allergy, component and auxiliary prosthetic materials, patch test.

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Address for correspondence:

Ketij Mehulić
Department of Dental
Prosthetics
School of Dental Medicine
Gundulićeva 5, 10000 Zagreb
Croatia

Introduction

Today's understanding of allergy to component and auxiliary materials in dental prosthetics is based on more recent knowledge, which ranges from numerous case presentations to many years of clinical studies on large samples (1-4). In dermatology the occurrence of allergy to metal has been known significantly longer, and to nickel as early as 1889 (5), and as a disease since 1933 (6). In 1940 the occurrence of contact dermatitis induced by methylmethacrylate was reported (7). The first attempts at allergological testing to alloys were performed by Morgan in 1949 (lit?), and later thanks to Spector they acquired clinical importance (8). In 1980 Doms-Goosens performed patch testing of prosthetic patients with extracts of nickel, chrome, cobalt, potassium-dichromate, nickel-sulphate and cobalt-chloride and demonstrated the greater incidence of a positive test in relation to non-prosthetic subjects (9). This confirmed many case presentations of a withdrawal of lesions of the oral mucous membrane after removal or substitution of the restoration with another material (10-12). In 1995 Suzuki identified and quantified metal ions released from fixed prosthetic devices in saliva and gingival solution, such as haptens, using a fluorescent radiographic spectroscope (13). Ten of the most frequent metal ions: ions of silver, copper, zinc, gold, palladium, cossiter, mercury indium, nickel and chrome. Of these five elements with stronger allergogenic potential: mercury, nickel, cossiter, chrome and cobalt. The same author concluded that as a means of precaution the use of several metals with strong allergogenic potential should be avoided, and care is essential during use of such inert materials for patients whose history shows the occurrence of contact allergy (13). The use of the same or similar types of alloy is recommended in specific clinical situations, in order to prevent their mutual interaction (14). Patients with stomatitis, stomatopyrosis, lichen and lichenoid reactions are a particular problem because of the suspicion that the occurrence may be linked with the release of components from the materials used for fabrication of the prosthetic device (15-19). Evaluation of the bio-tolerance of prosthetic materials is decisive for their application in dental prosthetics (20).

Aim of the investigation

The aim of this investigation was to examine by means of patch test the occurrence of allergies to component and auxiliary prosthetic materials in prosthetic patients with a diagnosis of lichen ruber planus, stomatitis and stomatopyrosis.

Subjects and methods of work

Thirty-nine patients, aged 18-79 years participated in the investigation, of which 31 women (79.5%) and 8 men (20.5%), with diagnoses of lichen ruber planus, stomatitis and stomatopyrosis. Thirty-two subjects had prosthetics and seven subjects were without restorations. In accordance with the rules of ethics all subjects were acquainted in detail with the object of the investigation, method of testing and possible risks, and their acceptance was confirmed by signature. Allergen extracts from the Immunological Institute d.d. Zagreb were used for the patch test (standard set). The investigation was performed in the Allergology Clinic of the University Hospital for Lung Diseases "Jordanovac", Zagreb. Subjects were tested with 13 contact allergens: potassium dichromate, cobalt chloride, nickel sulphate, HH mix (hydrocine and hexamethylenetetramine), dibutylphthalate, benzoil peroxide, anestezin, Balsam of Peru, colophony, paraben mix, thimerosal, epoxy resin and formaldehyde in water solution (Table 1). Individual allergens, apart from formaldehyde, were dispersed in vaseline with mass share of 0.5 to 20% (depending on the allergen) and filled into plastic syringes of 5 mL. Formaldehyde was prepared as 1-% water solution. 100% vaseline was used as a negative control. A detailed general medical history was taken by an allergologist and dental history by a dentist, with special attention to the type of prosthetic appliance (fixed, mobile, combined), the materials of which the restorations were fabricated, gold-platinum alloy (18/8), (composition: Au 75%, Pt 8%, Ag 9.5%, Cu 5.1%, other), Co-Cr-Mo alloys, clay ceramic on Ni-Cr alloys, (composition of alloys: Ni 65%, Cr 22%, Mo 9.5%), poli methyl meta acrylate (PMMA), or a combination of the same, the occurrence of symptoms in relation to the insertion of the restoration (patient's statement: after insertion of the restora-

tion the symptoms were the same as earlier, or the symptoms intensified), and gingival index (GI) according to Löe and Silness (grades 0-3). Testing was carried out by standard technique according to the recommendations of the International Contact Dermatitis Research Group (ICDRG) (21). Thirteen allergens and vaseline as a negative control were applied to clean skin on the back. Test material was occluded with sterile gauze and plaster, which are usually used during patch testing. The allergens were applied during one visit in order to reduce the risk of different immunological responses in different time intervals. The test was performed and read by the same person, an allergologist, in order to reduce the possibility of work error. Reading was performed after 24, 48 and 72 hours, according to the following criteria: 0 negative response: no skin changes, + weak positive response: insignificant erythema, possible tiny macules/papules without vesicles, ++ strong positive response: erythema, infiltration papules and vesicles, +++ very strong positive response: significant erythema, papules, vesicles and bulla.

Statistical analysis was performed in the statistical programme packet Statistics for Windows, Kernel release 5.5 A (StatSoft, Inc. Tulsa, OK) (StatSoft, Inc. (2000). STATISTICS for Windows (Computer program manual). Basic Statistics and Tables and Non-linear Estimation models were used. The level of significance $p < 0.05$ was considered statistically significant.

Results

In this investigation allergological testing was performed on component and auxiliary materials used in dental prosthetics on a sample of 39 subjects, of which 32 patients had prosthetics (10 subjects with fixed prostheses, 17 mobile and 5 with combined, fixed-mobile restorations fabricated from different materials) (Table 2), and 7 subjects without prosthetic devices. All the subjects ($n = 39$) had one out of three diseases of the oral cavity mucous membrane, which was confirmed in the case history taken by a specialist in oral medicine and by a medical examination immediately prior to testing. Sixteen subjects (41%) had lichen ruber planus, 14 (36%)

stomatopyrosis and 9 (23%) stomatitis. In the history twenty-two of the patients (56%) reported earlier manifest allergies and allergic diseases and 17 subjects (43.6%) had a negative history of any form of allergy.

Gingival index was evaluated grade 1 in 18 patients (46.1%), grade 2 in 15 patients (38.5%) and grade 3 in 6 patients (15.4%).

Subjective statements by the subjects with prosthetics ($n = 32$) on the occurrence of symptoms with regard to the insertion of the restoration, showed that 13 (40.6%) did not consider that their condition had deteriorated and 19 (59.3%) felt that symptoms of disease had intensified after the cementing of a fixed, or placement of a mobile, restoration. During the medical examination of the same subjects by a dental practitioner no correlation was determined between the lesion and the restoration in 18 subjects (56.25%) (in terms of mechanical irritation of the restoration, poor surface treatment, asymmetric occlusion etc.), while in 14 subjects (43.75%) the clinical finding confirmed the possible negative effect of the restoration on the mucous membrane.

A positive patch test was determined for 20 subjects (51.2%), (17 from the group with prosthetics and 3 from the group without prosthetics) to one of four allergens. (Classification of the subjects according to the number of allergens to which they showed a positive test is presented in Fig. 1). Nineteen subjects (15 from the group with prosthetics and 4 from the group without prosthetics) (48.7%) did not show any signs of over-sensitisation to the 13 tested allergens. (Classification of the positive findings to the tested allergens is presented in Table 3). No positive reaction was determined only for dibutylphthalate and HH mixtures (Table 3). Somewhat higher probability for a positive patch test ($P = 0.62$) was determined for subjects with a prosthetic device compared to those without one. The probability of a positive patch test to cobalt chloride ($P = 0.05$) increased with increase in the number of prosthetic appliances in the oral cavity. The results show statistically significant correlation between symptoms of disease and wearing of mobile restorations. The probability of symptoms worsening ($P = 0.019$) increased with the insertion of a fixed, and particularly placement of mobile, restorations in the oral cavity, particularly when fabricated from Co-Cr-Mo

alloy ($P = 0.04$). The occurrence of a positive patch test in the female subjects was greater for all allergens ($P = 0.05$) compared to the male subjects, apart from epoxy resin where it was less ($P = 0.036$). Statistically significant correlation was determined between the age of subjects and the total number of prosthetic devices ($P = 0.009$), and the age of subjects and number of prostheses ($P = 0.001$). Statistically significant correlation was determined between stomatitis and a positive patch test, regardless of the type of tested allergen ($P = 0.034$). Stomatopyrosis is a condition in which the probability that the subject will have a positive result to testing for chrome ($P = 0.019$) is greatly increased. Lichen ruber planus increases the probability of a positive patch test to some allergens ($P = 0.05$). Significant correlation was determined between the occurrence of lichen ruber planus and poor oral cavity hygiene ($P = 0.015$).

Discussion

A review of the recent literature reveals many data on the frequent occurrence of allergic reactions of prosthetically treated patients with diseases of the oral mucous membrane (22). In his study Scalf put forward the concept of the possibility that allergy is the basis of lichen and lichenoid reactions (23). Other authors were of the same opinion (24, 25). Alanko used patch test to test patients with lichen, stomatopyrosis, stomatitis, leukoplakia and glosso-dynia and he also obtained greater occurrence of a positive test in these patients compared to healthy patients (26). Mizoguchi investigated the occurrence of lichen planus on the cheek along the mandibular nerve and unusual sensation in the mouth in patients with restorations of platinum-silver-gold and nickel-chrome alloys (27). Biopsy showed lichenoid tissue reaction and tests were positive for palladium and platinum, and contact dermatitis occurred on the site of testing with palladium. The changes healed after the restorations had been removed. Almost as a rule there was a higher percentage of women in the studies, particularly in those studies in which the subjects were chosen according to the type of oral disease, which was confirmed in this investigation (28). Marcusson studied the incidence of contact

allergy and exposure to allergens and postulated that if people were exposed to other transitional metals, such as gold and palladium, to the same extent as exposure to nickel, they would probably be sensitised in the same way to them and develop contact allergic reaction (29). Thus, he suggests that nickel should be a marker for reactivity to other metals (29). It should also be taken into account the fact that the organism can become tolerant to an allergen to which it was earlier sensitised, and no longer reacts to its presence, e.g. old age, immunodeficiency, during application of drugs which diminish allergic reaction, or for other inexplicable reasons (21).

In contrast to the above studies in which patients were tested, Schaffran performed patch test in healthy subjects for gold, nickel and palladium, with and without restorations fabricated from gold alloys and claimed that half the patch tests positive to gold were also patch positive to nickel, half of those allergic to nickel were also allergic to palladium and that all those positive to palladium were also positive to nickel (30).

In this investigation the occurrence of a positive patch test in the group of subjects without prosthetic devices can be explained by the patients' amalgam fillings (14, 31). Two patients were patch positive to thimerosal, mercury derivate thiosalicyclic acid. In 1993 Pirker warned of the great likelihood of false positive results for this extract, and in the majority of cases allergy caused by mercury (31). Schafer demonstrated the frequency of allergy to a mixture of aromatic additives and thimerosal (32). In 2001 Suneja linked allergy to thimerosal and the increased incidence of allergies to neomycin, bacitracin and tixocortol pivalat (33). One subject in this study showed a positive finding to paraben, and as their use is widespread in cosmetics, the home and medicine, allergy testing to them is more frequent outside the field of dentistry (34,35). The occurrence of a positive patch test to formaldehyde, which was similar to that in this investigation was determined by Zimerson (36), to balsam of Peru Hausen (37) and Wohrl (38), to colophony Smith (39) and to benzoi peroxide Dejobert (40). The choice of the allergen extracts used in this investigation was inevitable because of the extremely high cost of other extracts and impossibility of otherwise realising the investigation. Furthermore, *in vivo* investigations require

special conditions which are frequently very difficult to accomplish, and consequently the sample had to be limited to a relatively small number of subjects.

According to De Rossi contact allergies in patients with prosthetics are much more frequent than previously thought (41), and therefore they should be considered in cases of burning, redness, swelling, pains and similar symptoms around the prosthetic device, particularly in the case of a patient with atopic history. Emphasis should also be placed on the importance of correct method of casting and cooling of the object in the dental-technical laboratory, resulting in a good quality cast. Several factors will also have an effect on the corrosive stability of the restoration, such as surface treatment of the restoration, presence of several different types of alloys in the mouth, pH changes, occasionally up to exceptionally high values, poor oral hygiene habits and also local and systemic response of the organism should not be overlooked (42).

Conclusion

Prosthetic materials are in long-term direct contact with oral tissues, during which they are susceptible to corrosive processes, which results in the release of metal ions, which as haptens form antigens, i.e. allergens, leading to sensitisation of the organism and later to allergic diseases. In this investigation most of the positive reactions to the patch test were obtained for nickel, cobalt and chrome. However, the possibility of undesired reactions to other, auxiliary materials, should not be ignored, which are often forgotten in dental practice. Particularly in the case of sensitive patients with diseases of the oral cavity mucous membrane, in whom the probability of an allergic reactions is greater, both to the component and auxiliary prosthetic materials. Accordingly, before prosthetic work is performed for patients with lichen ruber planus, a detailed history should be taken and testing to allergic extracts which will without doubt contribute to better choice of material and prevent worsening of the disease.