

THE INFLUENCE OF VARIOUS MATERIALS ON PATIENT ALLERGIC CONDITIONS TOWARDS DENTAL PROSTHETIC TREATMENT

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ABSTRACT

Introduction: The most common allergens in prosthetic materials are acrylates and metals. Allergy to acrylates and methacrylates is a rare cause of stomatitis, because dentures contain acrylate in polymerized, non-sensitizing form. **Background and Objectives:** This study aims to report the management of the case of a patient allergic to different materials, which requires prosthetic treatment. **Materials and Methods:** A 65-year-old woman requested a complete prosthetic rehabilitation. The difficulty of the treatment was to choose the type of prostheses according to the allergies presented by the patient. **Results:** The removable partial denture, made of Biodentaplast (Bredent, Germany), a combination of classic acrylic and elastic prosthesis, satisfies both aesthetically and functionally. During the evaluation and control at 6 and 12 months, it was found the good preservation of the restorations, the normal appearance of the oral cavity structures and the functionality of the prostheses. **Conclusions:** For the success of the treatment it is important to know the medical and dental history of the patient in establishing the prosthetic treatment plan. The peculiarity of this case lies in the fact that the patient's allergies determine the change of the prosthetic treatment plan, in the sense that a simple fixed prosthesis becomes a mobile prosthesis made of materials chosen in accordance with the patient's condition.

Key words: metals alloys, prosthetic treatment, allergenic effect

INTRODUCTION

Allergic reactions are becoming more common among the population. The oral cavity is permanently confronted with multiple allergens, coming from food, drugs, hygiene products, dental materials and substances, etc. However, allergic manifestations in dentistry

are uncommon. When they do occur, they are either the local materialization of general immune conflicts or allergic contact reactions. This is due to the physiological and immune features of the oral cavity.

The incidence of these allergic reactions is difficult to assess, for several reasons: they are

transient diseases, often non-repetitive and without too annoying symptoms. Even when they occur, they wear a clinical picture that is often nonspecific, which can simulate a number of other conditions, the positive diagnosis remaining uncertain. Sometimes, only the repetitive nature of the episodes and the careful follow-up of the patients make these reactions to be diagnosed with certainty.

The first case of acrylate allergy was documented in 1941 by Stevenson [1,2]. The first reported case of allergy to dental metals was following dental amalgam fillings, which resulted in stomatitis and anal dermatitis [3]. Allergic reactions include swelling, hives, rashes and rhinorrhoea. They can cause health-threatening conditions such as laryngeal edema, anaphylaxis or cardiac arrhythmias [4].

The products used in dentistry contain multiple substances with allergenic potential, including acrylates, metals, alloys, adhesives, compounds from dental work. They can trigger conditions both among patients and among the medical staff who handle them. Materials used for prosthodontic treatment, as they will be in the oral cavity for a long time, must meet biocompatibility specifications [5].

Allergy is a hypersensitivity reaction mediated by both IgE (Immunoglobulin E) antibodies and the cellular response. Patients who develop allergies to dental materials frequently present two types of reactions. Type1, immediate reactions, manifested by sneezing, itching of the nose, hives or local angioedema, symptoms that appear in a few minutes to an hour. Type2, late reactions, which occur 48 hours after contact with the dental material and are manifested by redness, edema and ulceration at the contact site. Dental materials that frequently give allergies, especially type 2, are: methacrylate, metals (nickel, chromium, titanium, etc.), latex, adhesives, materials used to seal channels and fillings (in rare cases).

Acrylates and methacrylates, used in dental prostheses, are obtained by esterification reactions of acrylic and methacrylic acids. The monomers are sensitizers, while the final polymers are inert [6,7]. The sensitizing potential of acrylates depends on the chemical structure. Methacrylates have moderate or weak sensitizing capacity, while diacrylates have strong sensitizing potential [8]. Allergic contact dermatitis caused by acrylates can be occupational in dental personnel during the fabrication and insertion of dentures [9].

Dentures often contain metals, which can raise awareness in some people. Dental metal allergy usually manifests itself in about 48 hours. Oral contact allergy is a T cell-mediated delayed hypersensitivity reaction [4]. At the level of the oral mucosa, after contact with the dental alloys, redness, edema, ulceration, burning and itching appear. Cheilitis, a crack in the corner of the mouth, can often appear [5]. Cases of allergies to some components of metal alloys are frequently reported in dental practice. Nickel is the most common metal sensitizer [10]. Rarely, allergies occur to some components of metal alloys, such as: gold, silver, palladium, platinum, mercury or cobalt.

Goldman reported in 1889 the first case of dermatitis caused by allergy to nickel compounds [11]. Frequency of nickel allergy is 0.1-0.2% [12]. In women, nickel allergy varies between 9-20%. This is among the top three causes of allergic dermatitis, with symptoms such as redness, itching, dryness, scaling, cracking or even blisters. In industrialized countries it ranks first. As symptoms of nickel allergy in the oral cavity we mention: burning sensation, numbness sensation on the sides of the tongue, or gingival hyperplasia. Diagnosis is made with the help of the patch test, 5% nickel sulfate in petroleum jelly [13]. In allergic patients, exposure to nickel leads to systemic contact dermatitis [14]. Nickel allergy is 4-10 times

more common in women than in men [15,16]. Chromium allergy is rarer (10% in males and 3% in females) [17].

Depending on the type of allergic reaction to dental materials, blood tests and prick or patch skin testing are performed. Prick testing determine immediate allergy, especially to latex. Patch testing is used to diagnose late allergy to dental materials. Consists in the application of plasters with dental materials which are removed after 48 hours. The result is read at 48, 72, 96 hours and 7 days in some cases.

PATCH allergy skin testing is performed according to the criteria of the International Contact Dermatitis Research Group (ICDRG). Examination plasters containing the test reagent are placed on the patient's back or arm for 48 hours [18]. One hour after their removal, the stimulation effect disappears, and changes in the skin are evaluated according to the ICDRG criteria [19].

MATERIALS AND METHODS

Clinical case

A 65-year-old female patient addressed our clinic after a recent restoration by fixed metal-acrylic prosthesis in the upper jaw, after which, at an interval of about two weeks, allergic reactions occurred, such as: numbness of the tongue, dysphagia, agitation, daytime bruxism, insomnia. As a result, she discontinued prosthetic treatment on lower jaw (Fig. 1).



Figure 1. Orthopantomography after fixed prosthetic rehabilitation of the upper jaw.

At the time of presentation in our clinic, a

detailed anamnesis was performed. The patient is diabetic, with hypothyroidism, polyallergic to drugs, with a history of four anaphylaxis to: Ampicillin, Augmentin, Motilium and Mercury from amalgam fillings (she is not allergic to silver or gold).

We removed metal-acrylic prosthetic restorations and assessed the patient's dentoperiodontal status. The gums had an edematous, red-purple appearance in areas that were in contact with metal restoration (Fig. 2). Until the completion of prosthetic treatment, temporary acrylic prostheses were performed (Fig. 3).



Figure 2. Intraoral appearance after removal metal-acrylic prosthetic restorations.



Figure 3. Intraoral aspect of the patient with temporary acrylic prostheses.

We delayed the final prosthetic treatment until we performed allergy tests on some dental materials used in prostheses chosen for some therapeutic variants.

The test results on various dental materials showed that the patient has positive reactions for allergies to various types of metal compounds: aluminium, cadmium, cobalt, chromium, nickel (Table 1).

The patient does not have an allergic reaction to dental acrylates, composite materials or other materials used in the bases of mobilizable prostheses (for example Biodentaplast).

Table 1. Materials for which allergy tests have been performed.

Tested material	Allergy test result
Aluminium	Positive
Acrylate	Negative
Thermoplastic resin Biodentaplast	Negative
Wiribond C (chrome + cobalt)	Positive
Cadmium	Positive
Cobalt	Positive
Chromium	Positive
Nickel	Positive
Composite Nexco	Negative

Materials

As a variant of prosthetic treatment, we looked for a therapeutic solution that would fit with the patient's financial possibilities: fixed partial dentures of composite materials and skeletal mobilizable prostheses, all without metal framework.

SR Nexco Paste is a laboratory composite used for both physiognomic and mixed restorations (with metal support), and for prosthetic restoration of the gingiva. SR Nexco Liner and SR Nexco Paste Dentin achieve smooth shade transitions in metal-free restorations. The restorations have a natural appearance, providing colour stability over time. They are also indicated for teeth with dyschromia [20-22]. SR Nexco® light-curing laboratory composite provides restorations with high wear resistance. The composites used in the laboratory contain in their structure 70-80% fillers, 18-30% monomers and 1-3% catalysts, additives and pigments. The proportion of fillers and monomers determines the material. SR Nexco composites are made up of a mixture of dimethacrylates and filler particles (Table 2) [23].

Due to the high content of micro-opal fillers, SR Nexco composite gives restorations a natural appearance. The physical properties of the composite develop during polymerization, giving the restoration a long-

lasting colour and lustre.

Table 2. Monomers and fillers contained in SR Nexco Paste system materials [23].

Monomer	Dentin	Enamel	Liner	Stains	Opaquer
Aromatic aliphatic urethane dimethacrylate	+	+	+	+	+
Decandiol dimethacrylate	+	+	+	+	+
Other dimethacrylates	+	+	+	+	-
Filler	Dentin	Enamel	Liner	Stains	Opaquer
Zirconium oxide	-	-	-	-	+
Barium glass	-	-	+	-	-
Silicon dioxide	+	+	+	+	+
Copolymer	+	+	-	+	-

Biodentaplast prosthesis is one of the most popular, relatively new, in the prosthetic treatment of partial edentulous. It comes with many benefits for the patient [24,25]: light, durable and very faithful; 100% biocompatible with the body; has no wire clasps (has physiognomic clasps); supports sub-sequent modifications; it is well supported by the gingival mucosa, it does not cause wounds; due to its elasticity, it offers resistance over time; high comfort due to low stretch; is made by a special injection technology (Bredent-Germany); it is cheaper than a skeletal prosthesis; adapts immediately to the oral cavity. Biodentaplast is a techno-polymer based on polyoxymethylene. This material combines the advantages of both materials to provide a prosthesis that molds much better to the prosthetic field, trauma is eliminated by elasticity, and when necessary, can be easily adapted, unlike the simple elastic one.

Biodentaplast skeletal prostheses are the most modern form of prosthesis. Clasps are aesthetic (they have the colour of teeth - they are not metallic like metal skeletal prostheses), and they have a dose of elasticity. As long as the optimal thickness of the clasps is obtained, they will not break.

Methods

After allergy tests the temporary prosthetic restorations were removed and the symptomatic treatment of the oral mucosa was performed. After scaling and professional hygiene, the patient was taught to have a meticulous oral hygiene at home (to use a soft toothbrush and mouthwash with chlorhexidine). She was advised to follow a soft diet that does not include salty or acidic foods and to hydrate properly.

To decongest the edematous gingival tissue, we performed a treatment with the Sol diode laser, with a wavelength of 808 nm, with a tip of 400 microns, not activated. As a working protocol, the instrument was positioned perpendicular to the gingival surface, the movement being in the apico-coronal direction. The application time was 2 minutes for each zone and the output power was 2W in continuously mode. Treatment sessions were repeated at 3, 7 and 14 days.

As a prosthetic treatment we opted for unidentary maxillary prostheses, respectively a partial fixed frontal prosthesis to the mandible made of composite material: SR Nexco®. Individual crowns offer to patient the opportunity to effectively maintain oral hygiene.

For edentulous areas, as an alternative to the mobilizable prosthesis with metal skeleton or the acrylic prosthesis, we chose the elastic prosthesis from Biodentaplast (Bredent, Germany), a combination of classic acrylic and elastic prosthesis.

RESULTS

Fixed prosthetic restorations from Nexco have a homogeneous surface, with a natural appearance (Fig. 4).



Figure 4. Nexco composite fixed prosthesis treatment.

Mastication and phonation have been satisfactory since the accommodation period. Obtaining a prosthesis with a good balance that would allow a good masticatory efficiency, comfort and keeping the appearance of the physiognomy brought the smile back on the patient's lips.

The removable partial denture meets the requirements in terms of aesthetics, functionality and comfort.

During the evaluation and control at 6 and 12 months, it was found the good preservation of the restorations, the normal appearance of the oral cavity structures and the functionality of the prostheses (Figures 5,6). The prostheses were sanitized, and supra and subgingival scaling was performed. There were no local or systemic allergic manifestations. The patient is satisfied with the functionality and aesthetics of the fixed and mobile prostheses, doubled by the psychic comfort due to the lack of allergic manifestations.



Figure 5. Intraoral appearance at 6 months after total oral rehabilitation.



Figure 6. Intraoral appearance at 12 months after total oral rehabilitation.

DISCUSSIONS

Khamaysi et al. in a study of contact reactions to allergens in dentistry, using patch tests in 134 patients, showed that cheilitis and perioral dermatitis were the most common manifestations in the oral cavity (25.6%), followed by burning mouth syndrome (15.7%), lichenoid reaction (14%) and orofacial granulomatosis (10.7%). The common contact allergens were: sodium thiosulfate (14%), nickel sulfate (13.2%), mercury (9.9%), palladium chloride (7.4%) and 2-hydroxyethyl methacrylate (5.8%) [26].

Muris et al. showed in a study that 10.2% of allergy patients have symptoms in the oral cavity [27]. Symptoms, represented by dry mouth (xerostomia) and metallic taste, were more common in patients with palladium and nickel allergies. Metallic taste has been observed in the presence of crowns made of metal alloys containing nickel. Symptoms such as: burning and pain in the oral mucosa, oral lichenoid lesions or stomatitis, were not associated with nickel and palladium allergy [27-29]. The sensation of xerostomia occurred in patients with metal crowns who have simultaneous palladium and nickel allergy. The quantitative decrease of saliva can cause corrosion at the level of metal crowns. Salivary flow has a cleansing action as well as an antimicrobial effect through immunoglobulins A (IgA) and lysozyme [30-34].

Researchers at the University of Leipzig, Germany, conducted a study of 86 patients (16.3% men and 83.7% women) who had symptoms of contact allergy at the oral cavity. The most frequent allergies were to metals: 29% to nickel, 23% to cobalt, 13% to palladium, 11% to amalgam, 6% to gold and 3% to titanium. Allergies to methacrylates are on the 5th place [35-38].

Sieber and Olms detected nickel, palladium and mercury as the most frequent ions with allergenic potential in dentistry [39].

Studies have shown the presence of symptoms of burning of the oral mucosa, oral lichen, stomatitis or contact dermatitis in patients with metal allergies [39-41]. All biomaterials, including metals alloys, cause cellular changes with variable intensity, without necessarily manifesting a cytotoxic effect [42-44,45,46,47].

Routine use of patch tests should be avoided as methods in investigating patients with oral or facial symptoms possibly related to dental treatments, as the testing procedure may, in some cases, provoke sensitization of the patient [48,49]. Allergological screening of dental biomaterials is recommended for patients who have had allergic episodes in the past and require expensive prosthetic rehabilitation [50-53].

Different dental materials affect different groups of patients, depending on their exposure to the material. The highest proportion of patient-related adverse reactions was reported due to metals. Biocompatibility tests on dental materials cannot guarantee the absolute safety of adverse reactions [54]. The decrease in salivary pH and the increase in the number of bacteria through the accumulation of plaque on the surface of metal prostheses contribute to the increase in the oxidation process. This causes corrosion and the release of metal ions, which can then lead to allergies to metal alloys in the oral cavity [55,56].

As the number of patients with allergic reactions to dental materials is increasing, dentists need to be aware of possible allergens and the symptoms they cause [57,58]. Studies analyzing dentin bioactivity at the interface with bioceramics have provided valuable insights into the potential interactions between dental materials and oral tissues [59]. Furthermore, patterns in endodontic materials, as observed in Romanian dental practices, indicate a growing interest in safer and more biocompatible alternatives [60-62].

For patients allergic to metal alloys, BioHPP, a high-performance polymer based on polyether-ether-ketone (PEEK) polymer, can be successfully used as an alternative to skeletal partial dentures [63-65].

Mobilizable prostheses that use polymer materials instead of metal skeletons offer good

resistance, elasticity, aesthetics and at the same time are lighter, more comfortable for the patient [66]. Additionally, exploring dentists' preferences in selecting adhesive systems can help improve clinical decision-making and material selection to minimize allergic responses in susceptible patients [40].

CONCLUSIONS

The tissues of the oral cavity often come into contact with potentially allergenic substances. During prosthetic treatment, potentially allergenic materials are used on patients, therefore it is necessary to use them with precaution.

Oral injuries caused by the use of dental metal alloys are mainly due to the release of ions, following the corrosion of these alloys. Nickel, cobalt and chromium, elements present in stainless dental alloys, can present an important allergic effect (in the order mentioned).

According to literature studies, we find that patients have increased risk at metals. Allergic reactions to metals can be caused by amalgam, base metals (Ni, Co, Cr, Al) and precious metals. Symptoms are burning sensations and/or swelling of the oral mucosa or intraoral lichenoid reactions. Dental amalgam is the material that causes the most adverse effects in patients with metal allergies. With rare

exceptions, allergic reactions to dental materials are mild or moderate, not endangering patients' lives.

It is advisable to ask patients questions about previous hypersensitivity to dental materials. As part of the medical questionnaire, each patient should also be asked if a rash has ever developed as a result of wearing earrings or other jewellery.

At present, chromium-cobalt-based metal alloys are frequently used in crown and bridge technology. Therefore, dentists should not rule out sensitization of patients wearing prostheses with CoCrMo alloys.

Because prosthetic treatments use potentially allergenic materials, dentists must pay attention to patients' allergic history and develop appropriate treatment plans. The complete rehabilitation of the oral cavity must be carried out after the elimination of all materials to which the patient is allergic and after ensuring that there are no more recurrences of symptoms.

Conflict of interest: the authors declare no conflict of interest associated with this paper.

Institutional Review Board Statement: the study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Research Ethics Committee of the Faculty of Medicine and Pharmacy, University from Oradea, Romania, Nr. CEFMF/01 from 29.07.2021.

Informed Consent Statement: informed consent was obtained from subject involved in the study.

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