Inert bioceramics (Al₂O₃, ZrO₂) for medical application.

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Abstract

Ceramics is defined as the art and science of making and using solid articles having as essential components inorganic non-metallic materials and which are composed largely of them (Kingery et al., 1976). The inherent brittleness of traditional ceramics has limited their ability to compete with ductile metals and polymers for technical applications. However, over the last 100 years innovative techniques in the fabrication of ceramics have led to their use as high-tech materials. Inert bioceramics, such as Al₂O₃ and ZrO₂, have inherently low levels of reactivity compared with other materials such as polymers and metals as well as surface reactive or resorbable ceramics. In a human body, they are expected to be non-toxic, non-allergenic, and non-carcinogenic for a lifetime, which leads to a corresponding range of engineering design philosophies for medical application. Due to their excellent frictional properties technical ceramics are nowadays mainly used in endoprosthetics.

Prosthodontic biomaterials and adverse reactions: a critical review of the clinical and research literature.


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Abstract

Prosthodontic biomaterials include impression materials, luting cements, and restorative materials. They consist of metals and alloys ceramics, and polymer materials and are retained in patients for <60 min or for decades. Oral release of compounds from biomaterials occurs, and adverse reactions may follow dental treatment. Especially in allergically vulnerable patients contact allergy may occur. There are reports from many different countries on contact allergy from gold/palladium alloys, components from polymer-based materials, chromium/cobalt alloys, and nickel. Notifications on adverse reactions in Norway, Sweden, and England are handled by a registry in which patient reactions and occupational exposure are recorded. Data from The Adverse Reaction Unit in Bergen and Umeå have been a most valuable basis in extending knowledge in a field of current interest in dentistry. A review of the clinical and research literature relating to prosthodontic biomaterials and
adverse reactions shows that reliable methods seem necessary to expose the frequency of adverse reactions in general dentistry, including prosthodontic treatment.

Immuno-allergological properties of aluminium oxide (Al2O3) ceramics and nickel sulfate in humans.

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Abstract

For more than 30 years aluminium oxide (Al(2)O(3)) ceramics have been used for implants in maxillofacial and orthopaedic surgery. Up to now, there are no reports and also no investigations on hypersensitivity reactions. In order to evaluate the aspects of immuno-allergological reactivity to aluminium oxide ceramics, skin testing and in vitro lymphocyte activation studies were performed. The patch test reactivity to a standard series of contact allergens and to an aluminium oxide (Al(2)O(3)) disk was examined in a consecutive series of 250 patients frequenting a University Dermatology Clinic. Furthermore, peripheral blood mononuclear cells (PBMC) of 15 nickel-allergic and 15 non-allergic individuals were cultured with medium alone, with the pan T-cell mitogen phytohemagglutinine (PHA) or with nickel sulfate (NiSO(4)). By additional presence/absence of Al(2)O(3) disk its influence on the cytokine secretion pattern and proliferative response was investigated. The results show that in contrast to a high frequency of delayed-type hypersensitivity to standard contact allergens, no allergic skin reactions to Al(2)O(3) ceramics occurred. The IL-4 and IFN-gamma production in vitro remained almost unchanged by the presence of Al(2)O(3) disk as well as the proliferative response of PBMC of non-allergic individuals. Cellular reactivity of nickel allergic and non-allergic donors was partly enhanced upon contact to Al(2)O(3) disks.
Abstract

Patch testing as a part of the diagnostic evaluation of patients suffering from oral mucosal complaints or with symptoms where dental materials are suspected to be the cause is hampered by numerous difficulties. The ingredients of denture materials as well as their liberation in the oral cavity are often unknown. Contact with many of the potential ingredients of denture materials can occur on other occasions, as well, thus making it difficult to find out where the patient has acquired his or her sensitization. The special morphological and immunological situation in the oral mucosa may produce tolerance of substances which evoke a positive patch test reaction on the skin of the back. This paper introduces the possible spectrum of allergens in these patients and discusses the difficulties in the assessment of the relevance of positive patch test reactions. From August 1992 to July 1994, 756 patients with complaints of the oral mucosa and/or suspected contact allergy to denture materials were patch tested in the departments of dermatology joining the Information Network of Departments of Dermatology in Germany (IVDK). Among these patients, women were overrepresented, while individuals with atopic dermatitis were underrepresented. The allergen spectrum included amalgam, mercury compounds, gold salts, palladium chloride and methyl methacrylate. However, the epidemiological value of these data is limited. A second part of this paper will review the various groups of allergens.
Dental materials--problem substances in allergologic diagnosis? II: Patch test diagnosis and relevance evaluation of selected dental material groups

Article in German

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Abstract

The problems in patch testing and relevance evaluation as well as the practical consequences are discussed for the most important groups of dental materials (DM). These include metal alloys: amalgam with a low allergy prevalence; palladium salts showing a high correlation with nickel allergy but a low one with metallic palladium or alloys; the widespread allergen nickel is most relevant when dealing with nickel containing DM-alloys that are not corrosion resistant; gold salts with widely differing test results and limited benefit to detect genuine gold intolerance. Among synthetic resins methylmethacrylate is the most important allergen because of the high frequency of exposition. With composite materials and other methacrylates, both cross reactions and active sensitization should be kept in mind. Relevant reactions due to additives are rare; positive benzoyleperoxide tests should be interpreted very critically. A number of DM may contain allergens of the etheric oils-colophonium - Perubalsam group. DM should be tested with standardized methods only. As the dental consequences may be expensive, interpretation of such test results demands utmost care and special experience.

Do adverse effects of dental materials exist? What are the consequences, and how can they be diagnosed and treated?

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Erratum in:


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Abstract
OBJECTIVES: All dental biomaterials release substances into the oral environment to a varying degree. Various preclinical biocompatibility test systems have been introduced, aiming at an evaluation of the potential risks of dental materials. Potential pathogenic effects of released substances from dental materials have been demonstrated. For the biocompatibility of a biomaterial, it is not only important that minimal diffusible substances are released when it is in body contact--the material must also fulfill the function for which it has been designed. This is also very much dependent on the material properties and its handling properties. The aim of this review was to generate an overview of the present status concerning adverse reactions among patients and personnel.

MATERIALS AND METHODS: A systematic review was performed using a defined search strategy in order to evaluate all MEDLINE-literature published between 1996 and 2006.

RESULTS: The compilation of the literature available has revealed that the majority of studies have been carried out on patients compared with personnel. Adverse reactions towards dental materials do occur, but the prevalence and incidence are difficult to obtain. The results were essentially based on cohort studies. Clinical trials, especially randomized-controlled trials, are in the minority of all studies investigated, with the exception of composite and bonding studies, where clinical trials, but not randomized-controlled trials, represent the majority of studies. Patients and personnel were treated separately in the manuscript. Amalgam studies show the lowest degree of verified material-related diagnosis. Even if objective symptoms related to adverse reactions with polymer resin-based materials have been reported, postoperative sensitivity dominates reports concerning composites/bondings. Verified occupational effects among dental personnel show a low frequency of allergy/toxic reactions. Irritative hand eczema seemed to be more common than in the general population.

CONCLUSIONS: Patient- and personnel-related studies are of variable quality and can be improved. There is a need for a better description of the content of materials. A registry for adverse effects of dental materials would be useful to detect the occurrence of low-incidence events.