Biohazards risks caused by prosthodontics-related materials

Puja Malhotra,[1*] Nishant Gupta,[2] Chetna Arora,[3] Mayank Singhal,[4] Amit Garg,[5] Shreya Singh[6]

[1]Professor & HOD, Department of Prosthodontics and Crown & Bridge, Santosh Dental College & Hospital, Santosh Deemed to be University, Ghaziabad, Delhi NCR

[2]Professor, Department of Orthodontics and Dentofacial Orthopedics, Santosh Dental College & Hospital, Santosh Deemed to be University, Ghaziabad, Delhi NCR

[3]Professor, Department of Conservative Dentistry and Endodontics, Santosh Dental College & Hospital, Santosh Deemed to be University, Ghaziabad, Delhi NCR

[4]Professor, Department of Oral and Maxillofacial Surgery, Santosh Dental College & Hospital, Santosh Deemed to be University, Ghaziabad, Delhi NCR

[5]Professor, Department of Periodontics & Oral Implantology, Santosh Dental College & Hospital, Santosh Deemed to be University, Ghaziabad, Delhi NCR

[6]Reader, Department of Oral and Maxillofacial Pathology, Santosh Dental College & Hospital, Santosh Deemed to be University, Ghaziabad, Delhi NCR

*Corresponding author: Puja Malhotra

ABSTRACT

Manufactured dental materials for permanent restorations are intended to be stable and insoluble, yet they fall short of this objective. Small amounts of dissolved components necessitate advanced analytical equipment for their detection. Miniscule levels of components that leach from permanent dental restorative materials are extremely unlikely to induce local or systemic toxicity. To elucidate the numerous safety concerns and frequency of adverse reactions in general dentistry, including prosthodontic treatment, it is necessary to conduct dependable study employing sound methods.

Keywords: Adverse effects, biocompatibility, formaldehyde, nanoparticles, polymeric restorative materials

INTRODUCTION

The progression of prosthodontics is marked by a growing number of novel prosthetic materials. There are numerous features of the prosthesis, though. materials, which must be as close to perfect as possible to meet the growing demands of patients, must be compatible on biological, physical, chemical, and aesthetic levels. The practise of prosthodontics necessitates contact with a variety of restorative and auxillary dental materials, including metals, resinbased synthetic polymers, cements, impression materials, and restorative materials such as dental amalgam, composites, and dental ceramics. How secure are these substances? Leakage and transfer of potentially allergenic components pose a danger of hypersensitivity reactions in patients, dental professionals, and laboratory technicians. Indeed, the biocompatibility of dental amalgam has been contested for a very long time, with differing perspectives, and how safe are the substitute materials? Short- and long-term reactions, whether severe or minor, should be extensively documented so that

appropriate measures can be taken. Work in a number of industries, as well as in dentistry clinics with poor mercury management procedures, has been linked to occupational mercury exposure. Biological negative effects from dental materials are uncommon. The incidence of such adverse effects is estimated to be between 1:1000 and 1:10000 for all dental treatments [2], but it depends on the type of practise and the materials utilised.[3] All synthetic materials emit chemicals into the oral environment and have the possibility of undesirable effects and side effects.[4,5] Amalgam has been linked to general health concerns,[6] whereas different restorative materials have been linked to local oral impacts. Biocompatibility of dental restorative materials is being assessed in various test environments. Red blood cells (RBCs) and associated materials have been studied in terms of their impact on cellular and subcellular levels in relation to resin constituents [9,11] and filler particles[12].

Frequent dermatological reactions range from brief redness, irritation, or decreased tactile sensitivity to gravely incapacitating blisters, desquamation, pain, and bleeding. cracks, and discomfort. Frequent causes include acrylic resins, latex gloves, imprint materials, eugenol containing temporary cements. Eye injury is one of the nondermatological reactions caused by UV and visible light utilised in daily life. Vapors from acrylic resin monomers and cyanoacrylates are related to respiratory responses. Cell viability is compromised when elastomeric impression materials remain in inaccessible places, such as subgingival regions. Before excluding patients from our clinics, we must therefore exercise caution.[7,8]

The contribution of functional and cosmetic enhancements of the stomatognathic system with added psychological benefits to the dental, oral, and general health and well-being of the patient should be evaluated. On the one hand, materials and equipment should be handled with caution to avoid occupational dangers, and on the other, oral tissues and the general health of patients should be protected.In the past, impressions for removable and fixed prosthodontics were made using a variety of materials. Primitive substances included rigid and semirigid compounds.

These materials, including as plaster, zinc-oxide eugenol, impression compound, and waxes, have limited applications in dentistry.There are numerous types of prosthodontic restorations and appliances, such as conventional and implant-supported crowns, fixed prostheses (dental bridges), and removable prostheses or dentures. Some are attached with precision attachments and screws, while others are cemented to teeth or implants with minimum gingival and other oral soft tissue contact. Others are either completely supported by the oral mucosa or are removable, resting on both the hard tissues of teeth or their equivalents (implants) and soft tissues. When constructing and fitting prosthodontic equipment for patients, numerous materials, including metals, polymeric materials, ceramics, and various types of cements, are used. In fact, more than 75% of all available dental materials are employed directly or indirectly in the fabrication and placement of prosthodontic restorations in patients' orofacial complexes. Prosthodontic materials are those utilised in the fabrication of indirect restorations for the purposes of this

review. These restorations are fabricated in a dental laboratory using impressions and other chairside records as models. Some of these components, like gypsum, casting waxes, and investment, are only necessary for the laboratory production of prostheses. Typically, these do not make direct contact with the patient's tissues. Consequently, any harmful effects, if any, are primarily confined to dental workers handling them. As a result of their touch with skin, exposure to dust from mixing, grinding, and polishing, and inhalation of fumes and vapours, laboratory processes may result in adversities. Those who are regularly exposed to particles or dust in the dental laboratory and dental clinical area, including personnel and patients during chairside adjustment and finishing of prostheses, should be of special concern.

Biocompatibility tests

There are a variety of preclinical biocompatibility testing available to reduce the likelihood of adverse reactions to dental materials. [15] These tests are classified according to their levels of application. Initial testing include cell culture, hemolysis, systemic toxicity, and estimation of teratogenic and carcinogenic effects and potential. The secondary tests include implantation, skin and mucous membrane irritation, and sensitization. Usage tests take into account how the materials are meant to be utilised in clinical practise. Oral mucosa tests based on reactions to materials in touch with the hamster-cheek pouch are regarded as a short-term usage test for prosthodontic materials and are considered to be less invasive and stressful than suturing the skin to secure the material in contact with the mucosa. If a holding device is utilised, position and pressure exerted by the test specimen are unclear. The reactions will also be affected by the formation of plaque around the test specimen. Due to the intrinsic difficulties of the test or the expense, prosthodontic material testing equipment has not been widely adopted. [16] Therefore, development of usage testing for prosthodontic materials should receive more focus and become a research priority.

Adverse/Side effects of prosthodontic materials

The direct interaction of prosthodontic materials with soft or calcified tissues, or exposure to leachable components arising from corrosion and degradation processes, may result in unanticipated biological adverse effects. [16] The concurrent and combined presence of dental prosthesis restorations produced from multiple alloys with varying compositions tends to exacerbate corrosion induced by galvanic activity. Due to the fact that these components may be ingested, both local and systemic responses are possible. Certain components of prosthodontic materials and their corrosion/degradation products are known to be allergenic, poisonous, and carcinogenic. Local mechanical irritation resulting from an overhanging repair margin or an overextended denture must also be considered unfavourable consequences. Consequently, a variety of possible issues emerge. In the literature, however, few negative effects of prosthodontic materials have been recorded. Similarly, no exhaustive studies have been conducted to estimate the frequency of harmful effects. It is therefore difficult to analyse the biological side effects of prosthodontic materials, and it is essential to distinguish between prospective and actual adverse effects.

Observable side effects Keep in mind that prosthodontic materials are manufactured with inertness and insolubility in mind. Thus, the quantities of leachable components are low, making harmful reactions improbable. To initiate an allergic reaction in a sensitised individual, however, only trace levels of the allergen are required. The most prevalent side effects of prosthodontic materials are contact allergy reactions (type IV reactions) occurrence of undesirable repercussions

In one study, the rate of adverse reactions to dental materials was reported as 1 per 500 patients, or one patient per approximately 3.5 years of practise.[17] During a two-week period, almost 13,000 people were assessed for acute and chronic ill effects. Prosthodontics and orthodontics were somewhat overrepresented in comparison to general dental procedures involving several dental materials. It was not possible to construct an incidence rate for specific materials or groups of materials due to the low incidence rate. The most frequently reported side effects were lichenoid responses in the oral mucosa caused directly by a restorative substance. Many of the signs of the observed reactions were asymptomatic and even went unnoticed by the patients. A questionnaire survey of prosthodontists revealed adverse patient reactions in 1 of 300 patients, or one patient per prosthodontist every 2 years.

Prosthodontic alloys

Some of the metals used in dental alloys, such as nickel, chromium, cobalt, cadmium, and beryllium, are known to be physiologically active or harmful. Approximately one in four adverse responses to prosthodontic materials are caused by metals, particularly chromium, cobalt nickel, and gold alloys used in metal ceramic restorations. According to the literature, allergic reactions to gold-based restorations were more prevalent than those to nickel-containing alloys. [13] Hildebrand et al. investigated 139 published cases of base-metal alloy allergy in detachable partial dentures. [14] Gingivitis and stomatitis were the most prevalent clinical symptoms, however roughly 25% of individuals experienced distant responses. However, mucosal reactions to partial dentures made of metal are uncommon. The most commonly observed gingival signs and symptoms may be attributed to direct pressure contact and the subsequent trauma caused by the same.

Rather than the adverse consequences of alloys or materials utilised in the manufacturing of removable partial dentures. Biological reactions to casting alloys are dependent on the release of components from the alloys, which suggests they should be depending on the level of corrosion. However, there appears to be no association between mucosal reactions to fixed prostheses and corrosion or tarnish. This absence of association may suggest that the observed biological effects are due to sources other than the substance itself. For metal–ceramic restorations, palladium alloys are often better tolerated than base-metal alloys or gold alloys, although they tend to discolour more than other casting alloys. However, technicians who often braze metals above their melting point are at risk, as cadmium will evaporate during the soldering and welding processes.[9-10] This poses an issue for the availability of a sufficient fume extraction technology. In response to

this risk, cadmium-containing solders have likewise been substantially phased out. Alloys are utilised in the production of conventional cast posts and cores. A number of metal combinations, including stainless steel pins, are commonly used. When constructing post-retained crowns, it is especially important not to combine the use of two different alloys for the post and cast core/crown, as galvanic corrosion may result in root fractures.

Implant materials

A range of materials, including polymeric polymers, metals, ceramic, and synthetic hydroxyapatite, have been utilised in dental implants. Cobalt–chromium alloys, vitreous carbon, titanium, and aluminium oxide have been the most often utilised materials. There have been numerous studies assessing the biological properties of dental implants. The bone tissue-implant interface and the ingrowth of bone into the porous implant fixture have received much study. Branemark's demonstration of the idea of osseointegration in relation to titanium implants has provided much of the biological foundation for current implantology.[12-14] Common causes of implant failure include incorrect surgical methods, implant loading issues, and infection. Regarding the inert nature of pure titanium implants, our knowledge is clear at this time.

CEMENTS

Zinc phosphate cement has been and continues to be the most popular luting agent for crowns and bridges. Eugenol is reported to be cytotoxic and allergenic. According to clinical studies, Glass Ionomer cements have a high incidence of post-fusing sensitivity. Pulp investigations generally suggest minor reactivity, albeit significantly more to the luting type of glass ionomer materials than to the restorative kind. In a recent clinical assessment of pulp sensitivity following cementation with zinc phosphate and glass ionomer cements, zinc phosphate was less sensitive than glass ionomer during the first two weeks, but there were no differences after three months. Espelid et al.[18-20] evaluated the clinical behaviour of silver-reinforced glass ionomers and resin-modified glass ionomers and discovered that after 24 months, resin-modified glass ionomers have the best overall performance in terms of retention, marginal integrity, and secondary caries. It was believed that the pressure imposed on the dentine during cementation may have contributed to the observation. Modern luting cements based on resin are also well tolerated by pulp. [16]

CONCLUSION

There are numerous potential hazards, however few adverse reactions have been published. Due to the fact that nickel is a severe allergy, a carcinogen, and can be disseminated to many organs in animal experiments, nickel's presence has received considerable attention. Clinicians and manufacturers are anticipated to be required to report biological side effects certifying bodies or health authorities with regards to the use of the materials. Due to the low incidence of adverse effects caused by the materials now in use, this will meet the needs of patients and those who handle the materials. To elucidate the numerous safety concerns and frequency of adverse reactions in general dentistry, including prosthodontic treatment, it is necessary to conduct dependable study employing sound methods.

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