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REVIEW ARTICLE

Contact Allergy to Denture Resins and Its Alternative Options

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ABSTRACT

Intolerance to dentures as a result of allergy is very rare. In such cases, the allergy is triggered not by the acrylic but mostly due to the unpolymerized precursors. Epicutaneous test reveals the allergy is due to the presence of benzoyl peroxide initiator and hydroquinone inhibitor. In contrast, the monomers methyl methacrylate (MMA) and triethylene glycol dimethacrylate are allergens that are primarily responsible and relevant for dental clinicians and technicians in their jobs. Latex and vinyl gloves are not adequate barriers for monomer and are generally unknown as clinicians still work with doughy acrylic mixtures without adequate precautions. Research papers were reviewed—many papers were studies for their cytotoxicity effects of Methyl Methacrylate. Various reports mentioned in the literature make the monomer as the main felon. Allergen-free dentures as an alternative to denture base resins and precautionary measures for dental professionals and technicians have also been mentioned.

Keywords: Allergen-free denture, Allergy, Monomer.

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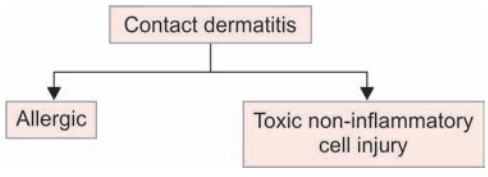
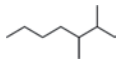
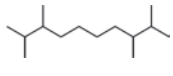
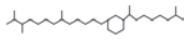
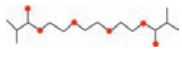
INTRODUCTION

This study reviews the possible hazards of dental patients and clinicians who are exposed when receiving and rendering treatment with resin-based materials. Polymethylmethacrylate resins are frequently used in daily dental practice as they are able to provide the essential properties and have necessary characteristics. They are mainly used in the fabrication of temporary crowns, liners, various dental prosthesis, and orthodontic appliances. In the oral cavity, properties and functional values of acrylic resins-based products depend on the endogenous factors caused by polymerization, i.e., degree of conversion of the monomers, method of manipulation and condition of polymerization, and exogenous factors like saliva, bacteria, and mastication.[1] Allergy is a hypersensitivity reaction to an allergen, which is enhanced by repeated exposure. Immediate allergic reactions to various foods and drugs are well known; such responses to acrylic are less common and are usually of delayed or contact allergy.[2] Contact dermatitis can be allergic (type IV) and toxic noninflammatory cell injury.



Allergy to dental resin-based materials is due to reaction in the resin matrix like monomer. Some of the monomers with the allergic potentials are described in the table as follows[3]:

Compound	*Use*	*Molecular structure*	*Possible adverse effect*
MMA Methyl Methacrylate	Acrylate monomer, common in orthodontic bansplates and dentures		Allergy Toxic
HEMA 2-hydroxyethyl-methacrylate	Common in bonding materials and resin-enforced glassiononer cements		Allergy
EGDMA Ethyleneglycol dimethacrylate	Common monomer in composite and bonding		Allergy Cytotoxic
UDMA Urethane dimethacrylate	Monomer used in composites		Allergy Genotoxicity
TEGDMA Triethylene-glycol dimetha-crylate	Common monomer in composites and fissure sealants		Allergy Genotoxicity

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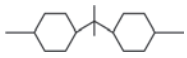
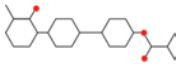
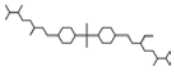
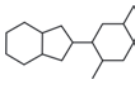
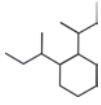
Compound	Use	Molecular structure	Possible adverse effect
Bisphenol A	Present as a pollution in some materials		Xenoestrogen
Bis-DMA	Monomer used in some fissure sealants and composites		Xenoestrogen
Bis-GMA	Common monomer in composite fillings and fissure sealants		Allergy Genotoxicity
Tinuvin P	UV-light absorber		Allergy
Phthalates	Softener in dentures and denture lining materials	Dimethyl Phthalate 	Xenoestrogen
Formaldehyde	"Waste product" from polymerization		Genotoxicity Allergy

CHEMICAL CHARACTERISTICS OF DENTAL RESIN MATERIALS

It is very crucial to have knowledge of the chemical background of the monomers to understand the biological effects of resin materials used by dental clinicians and technicians. Monomers are small molecules that during polymerization reaction are able to form long polymeric chains. Monomer used in dentistry can be mono, di, or multifunctional due to the number of reactive methacrylic groups. They can be aromatic or aliphatic origin. Monomers of low molecular weight are added to increase the degree of conversion, as well as to lower the viscosity of the material.[4] The polymerization is an addition reaction where the monomers are joined together to long and "stable chain polymers." The reaction is started when the initiator is cleaved into free radicals. Activators can be light, chemical, or heat. The activator gives the energy to the initiator, then splits the initiator into free radicals. By activating the monomers, they will be linked together, creating a three-dimensional network of chains by continuous splitting of double bonds and addition of more monomer to the free electron end.[5]

The polymerization ends by coupling of two growing chains together in creating a covalent bond. Termination of the process also occurs when there is not sufficient monomer left to react or the distance between the reacting molecules becomes long.[4]

BIOCOMPATIBILITY

The Williams Dictionary of biomaterials defines biocompatibility as "the ability of a material to perform with an appropriate host response in a specific application." When a material does not interfere, neither toxic, injurious nor immunological with living tissue, then the material is said to be "BIOCOMPATIBLE." A material with a low degree of conversion will have more unreacted double bonds and will have a greater ability to cause a reaction in living tissue.[4]

GENOTOXICITY

Toxicity refers to chemical breakdown of biological tissue. Genotoxicity is the ability of the material to mutate or break down a deoxyribonucleic acid. It is considered a carcinogen.[6]

ESTROGENIC EFFECT

Few materials bind to estrogen receptors and cause similar effects of a sex hormone. They are called xenoestrogen.[7] Bisphenol A has been found to be a xenoestrogen.[8]

CLINICAL SIGNS OF ADVERSE REACTIONS

The polymer to monomer ratio is one of the variables that influence cytotoxicity of denture base acrylic resins. Jorge et al[9] investigated the effect of polymer to monomer ratio on residual monomer levels and observed that resin prepared with a high proportion of polymer (5:3) resulted in significantly lesser residual monomer. Kedjarune et al[17] found that more monomer added to the mixture, greater the amount of residual monomer, and therefore, more potential for cytotoxicity.[1]

CONTACT TYPE DERMATITIS

Monomer acts as haptens in a delayed hypersensitivity mechanism, which is observed in several dentists and lab technicians. Stevensons and Moody[10,11] have reported allergic, eczematous, contact dermatitis of the hands and face of dentists, which makes monomer the culprit.

BURNING

A frequently occurring symptom reported by denture wearers, which is similar to an allergic reaction, is that of a burning sensation in the mouth or in the tongue. The symptoms are similar to those of "burning mouth syndrome," which can make wearing of denture virtually impossible. Burning mouth syndrome patients suffer from taste disorder, also known as dysgeusia, and complain of bitter or metallic taste in the mouth. The first case of hypersensitivity was reported in 1941. This is also called stomatitis venenata.[10-12]

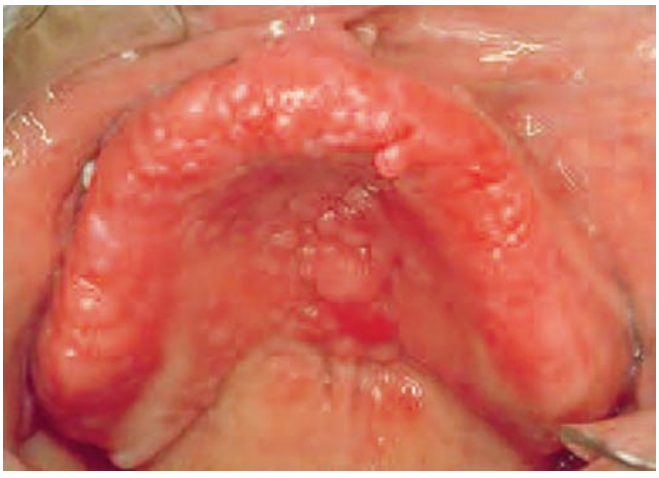


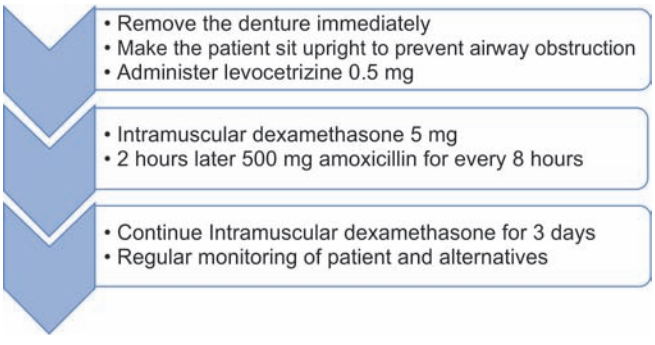
Fig. 1: Edematous mucosa due to monomer allergy

Skin allergies to acrylates are confined by patch testing where multiple suspected allergens are specially prepared and applied to the back of the patients with suspected acrylate allergy for 48 hours. The result of the patch test is determined by a dermatologist, who will look for redness and elevation of the skin at the individual test site (Fig. 1).

PRECAUTIONS AND TREATMENTS

Treatment Protocol

Most commonly, in case of adverse reaction of the oral cavity, there can be edematous tongue which can obstruct the airway.



METHODS OF DECREASING THE RESIDUAL MONOMER

- A method was suggested by Jorge et al,[9] which evaluated the effect of two postpolymerization treatment and different cycles of polymerization on cytotoxicity of two denture base resins, Lucitone 550 and QC 50. They mentioned that after polymerization, water bath at 55°C for 1 hour reduced the cytotoxicity of Lucitone 550.
- Another method suggested by Sheridan et al[13] reported that cytotoxic effect of acrylic resins was greater in the first 24 hours after polymerization. The authors concluded that longer the resins were soaked, lesser its cytotoxic effect.[14]
- Patients having allergic reactions to temporary restorations made with autopolymerizing resins should be provided with prefabricated temporary crowns, which eliminate the potential of residual monomer allergy

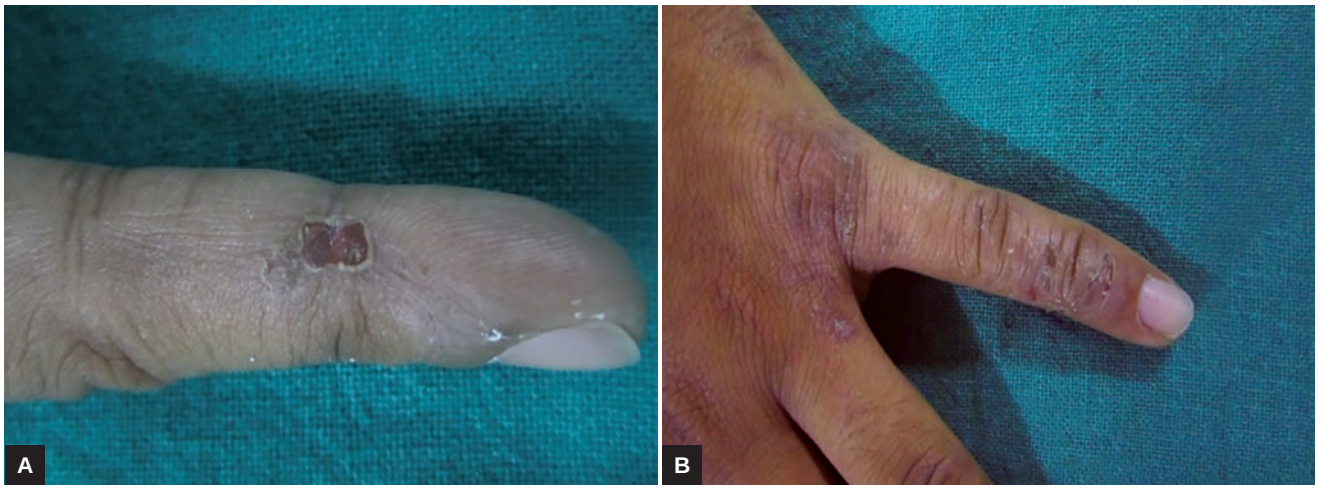
ALLERGY-FREE DENTURE

- *High-impact polystyrene*: Elastomer graft polymer with styrene. Similar to polystyrene and injection molded.
- *Polycarbonates*: Includes glass fiber-reinforced materials, which have advantages over methylmethacrylate (MMA) because of their high impact strength. They do not contain MMA monomer, so can be used in allergic patients.
- *Polyvinyl chloride-based acrylic*: In this group of mixed polymers consisting of vinyl chloride, vinyl acetate and MMA acid ester are used as denture materials. This denture acrylic group includes luxene, virlene which show good dimensional consistency, low water absorption, and high breaking strength. They require a complex special apparatus for processing using the melt-press process, which means these materials are less used.
- *Eclipse prosthetic resin system*: Light cure fabricate denture (Dentsply), indirect buildup method for fabricating dentures, i.e., monomer free and flask free; does not contain any ethyl, methyl, butyl, or propyl methacrylates; and can be used for allergic patients.
- *Valplast*: Flexible denture base material, i.e., ideal for partial denture but very rarely used for complete dentures. It is a nylon thermoplastic material which eliminates the concern about acrylic allergy.
- *Metallic denture base*: Used for cast partial denture as well as completed denture. Metals used are usually base metal alloys, $TiSAl_4V$. The advantages are biocompatibility, hypoallergenicity, dimensional stability, and good proprioception.[11,15,16]

In addition, dentists and hygienists who may develop contact allergy by handling resin materials, use of vinyl gloves or latex gloves provide protection as long as it takes the resin monomer to penetrate the gloves. It also advices to adequately apply Vaseline, which may act as a barrier in penetration of monomer in the palms. Medical treatments include topical steroid application and oral steroids for secondary infections, e.g., azathioprine, cyclosporine (Figs 2 and 3).

DISCUSSION

A contact allergy in dentistry is a type of delayed hypersensitivity reaction in which a lesion of the skin or mucosa



Figs 2A and B: Dermal erosions, raw ulcer

Figs 3A and B: Ulceration and peeling of skin

occurs at a localized site after repeated contact or exposure. There may be burning sensation of tongue, inflamed and edematous mucosa accompanied by severe burning. Hands, to start with transient vesicles, rupture to form erosions and ulcerations which are extremely painful. Erythema, papules, and edema are characteristics of allergic manifestations and in severe cases weeping blisters may appear. These allergic reactions are mainly due to the presence of monomer in conventional heat cure acrylic resins. The antigens come in contact with the epithelial cells to form haptens that bind to Langerhans cells to the regional lymph nodes and present to the antigen to T-lymphocytes and thereby inflammation process proceeds. It is better to soak the postpolymerized denture in 55°C water bath for 1 hour to reduce the residual monomer.

A study conducted by Malmio University Hospital, Sweden, selected 1,632 dental staff and patients who had been patch tested for allergy of dental acrylates; 48 of them had positive results to one or more acrylates. The most common was 2-hydroxyethylmethacrylate followed by ethylene glycol dimethacrylate, triethylene glycol dimethacrylate, and MMA. Anthony Goon[17] also mentioned that as we store it in higher temperatures, the capacity of the allergen is less. Direct application of relining materials should be avoided, which may severely irritate the mucosa. There are various low allergen-free denture materials mentioned earlier, which can be of great help to the patient as well as technician. Stomatitis venenata was associated with wearing of plastic dentures, which was first reported by Rattner in 1936. In 1954, Fischer found that the liquid monomer of methylacrylate can cause an allergic reaction upon contact with skin and mucosa. In 1956, Smith and Bains[18] demonstrated that heat-cure denture bases have 0.2 to 1% residual monomer compared with autopolymerizing resins, which were 5% more.[19]

CONCLUSION

It is always necessary to keep in mind the allergy caused by monomers of various dental materials. Alternatives must be thought to treat a patient with monomer/methacrylate allergy. Acrylic-based resin is intensively used in dentistry as denture base materials. Increasing concerns

arise regarding safety in the use of acrylic to the patients, clinicians, and technicians. Therefore, practical knowledge and awareness is most important when dealing with patients having allergic reactions to denture base resins and to find an alternate material for such patients.

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