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All is not well with acrylic

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Abstract

The introduction of Veronite in 1937 by Dr. Walter Wright gave dentistry its most useful resin. It was polymethyl methacrylate material which proved to be the most satisfactory material tested upto that time. It was so well received by the dental profession that by 1946, 98% of all denture bases were constructed from methyl methacrylate polymers or copolymers. In recent years the emphasis has turned to the possible toxic or adverse effects that the material might present to the host. This article reviews the reported adverse effects of acrylic and implies caution while handling and using it.

Key Words

Acrylic; denture base; dental acrylic

INTRODUCTION

Prior to the introduction of acrylic resin, materials like vulcanite, cellulose nitrate, phenol formaldehyde, polystyrene, nylons and terylene were used for making denture bases. These materials had various short comings like poor esthetic property, low impact strength, low flexural strength, lack of colour stability and poor patient acceptance due to bad odour and taste and the difficulty encountered in relining and rebasing.[1,2] Acrylic resins proved to be superior to all the materials available then. Though acrylic resin was introduced to the dental profession primarily as a denture base material,[3] it was gradually put to a wide variety of uses in dentistry as well as in various specialties of surgery. Therefore besides being used for the fabrication, relining and repair of compete and removable partial dentures, interim and transitional prosthesis, it has also been utilized for making impression trays, artificial teeth, temporary crowns, splints, speech aids, space maintainers, occlusal splints, infant feeding devices, correction of facial deformities, orbital repairs and temperomandibular joint interpositional arthroplasty.

LIMITATIONS

Nonetheless, this material is far from being ideal. Woelfel[4] in 1971 listed the disadvantages as follows: 1) poor thermal conductor; 2) non wettable surface; 3) non radio opaque; 4) relatively low modulus of elasticity' 5) high coefficient of thermal expansion. In the early development of prosthetic devices emphasis was placed on the physical, chemical and mechanical properties of dental materials. In the years since its introduction there have been a large number of reports concerning the complications and untoward side effects associated with its use. The tissue compatibility and allergic sensitization of the skin to the components of denture plastics has been a subject of considerable contention. Chemical irritation could occur from either the polymer, residual monomer. Benzol peroxide, hydroquinone, the pigments used or a reaction product between some component of the denture base and its environment. The usual component singled out as an irritant is residual monomer.[5] Though the concentration of residual monomer may be as low as 0.2-0.5 percent in heat cured dentures cured by long curing cycles in the cases reported by Mc Cabe and Basker in 1976 the residual monomer content of the offending dentures were 5-6 times higher than the normal value. Fisher[6] stated that monomeric methyl methacrylate is a sensitizing agent and can cause an allergic contact type eczematous reaction on the skin and oral mucosa. Hence care should be taken while using this material as they are usually placed in intimate contact with large areas of oral mucosa that may be infected, inflamed or lacerated. The mucosa may be further compromised by xerostomia producing a dry, fragile epithelium. Also there is a risk in patients with previous allergic diseases and burning mouth syndrome. In these cases a high incidence of sensitivity reaction to denture allergens

has been observed usually to methyl methacrylate.[7] Osteomyelitis, mobility gingival recession and epithelial downgrowth around the resin implant, increased pocket depth and bone loss have accompanied use of this material and have caused 50-75% 5 year failure rate. Also bone resorption under chin implants, bone reaction and possible methyl methacrylate emboli have been reported following implantation of methyl methacrylate.[8] Acute toxic non dermatological reactions were experienced by some prosthodontists following activities such as working with methyl methacrylate or other synthetic resin materials. The reactions were expressed as eyes, respiratory or general symptoms in connection with exposure to volatile liquids and grinding dust. Such reactions were of transient nature while permanent sequelae were reported in dental technicians. Dentist and technician should therefore refrain from handling the acrylic resin dough with bare hands. The high concentration of monomer in the dough may produce local irritation and even serious sensitization of the fingers.[9]

Adverse reactions of monomer on other organs and systems in the human body

Several studies have investigated and identified the cytotoxicity and genotoxicity of methacrylates.[10] In an in-vitro study it was shown that methyl methacrylate exerts its toxic effects by interacting with the cell membrane and formation of micronuclei indicative of chromosomal damage was noted. As a consequence of DNA damage the mammalian cell cycle was delayed in g1 and g2 phases. The monomers used in resins are volatile and nasal olfactoty epithelium can be affected. Mucosal degeneration and necrosis have been reported. Repeated inhalation can result in lung irritation. In an animal study Sokomen and Oktemer showed that rats exposed to low concentration of monomer showed significant pathologic changes in cilia of trachea and bronchial respiratory epithelium. This study emphasized the need for well ventilated working places.[10]

DISCUSSION

With the implication of methyl methacrylate as the culprit behind the various adverse reactions to acrylic resin it becomes imperative to conduct studies to evaluate the cytotoxic potential of the same. It is well known that prolonged contact with large quantities of monomer can elicit some sort of adverse reactions in the host. But as far as its dental and surgical applications are concerned it is of utmost importance to know if small quantities of monomer equivalent to the residual monomer content of heat cured resins used for dental appliances or that minute quantity that is inhaled or came in skin contact while kneading acrylic dough could cause significant toxicity. Austin and Basker observed that specimens produced by a short curing cycle contained upto 7 times the residual monomer content than that cured by a long curing cycle.[10] It was also found that the residual monomer content in heat cured resins is resistant to removal by immersion in water. Tsuchiya et al.,[11] claimed that under oral and artificial conditions significant amounts of formaldehyde and methyl methacrylate were leachable from acrylic resin denture base materials. It was found that preleaching in water reduced the subsequent leaching of both formaldehyde and methyl methacrylate. They also stated that acrylic dentures should be immersed in hot water at 50 degree centigrade before insertion to decrease their cytotoxic potential.

CONCLUSION

Methyl methacrylate a widely used monomer in dentistry and medicine has been reported to cause abnormalities or lesions in several organs. Experimental and clinical studies have documented that monomers may cause a wide range of adverse health effects such as irritation to skin, eyes, and mucous membrane, allergic dermatitis, stomatitis, asthma and even neuropathy. Not only patients but the dental staff is also at higher risk of adverse reactions of monomer. Particular care should be taken to keep residual monomer content in dentures to the minimum possible and care should be taken while handling acrylic in the lab by dentists and technicians.

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