

Adverse Effect of Residual Monomer Used in Denture Base Acrylic Resins

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Abstract

Background: Acrylic-based resins are commonly used in daily dental practice as bases of removable partial or complete dentures and tooth-supported or implant retained over-dentures in order to replace the lost tissue structure and divide masticatory forces from the denture to the underlying residual ridges. Poly-methyl methacrylate (PMMA) based acrylic resins are most commonly used. Polymerization leads to conversion of MMA to PMMA during the polymerization reaction not all the monomers are converted into polymers, thus some unreacted monomers which is called as residual monomers are left. The residual monomer is left which might leach into saliva which causes various degrees of cytotoxicity and allergic responses. The present study was conducted with the aim to determine the adverse effect of residual monomer. **Aim:** The residual monomer left during polymerization causes various degrees of cytotoxicity and allergic responses. The present study was conducted with the aim to determine the adverse effect of residual monomer. **Subjects and Methods:** This study was conducted in dental department of our college. An informed consent was obtained by each patient prior enrolling in the study. A total of 78 patients were analysed during the 6 months study, with age group of 14 years to 75 years. All the patients were basically divided according to the treatment undergone by them. **Results:** Out of 78 patients enrolled in the study, 43 were females whereas 35 were males. (graph1). Group A comprised of 17 patients in total, group B comprised of 22 and group C comprised of 39 patients respectively (graph2). The severity of the discomfort was then recorded, and was categorised according to the respective groups (table1). Majority patients complained about the orthodontic appliances, secondly about the temporary crowns and least patients complained about the denture bases. **Conclusion:** The methods and conditions of polymerization and their biodegradation in the oral environment needs to be studied well. Cytotoxic effect of denture base acrylic resins can be directly related to the methods and the conditions of polymerization, the powder to liquid ratio, storage time, polymerization method and curing cycle.

Keywords: Acrylic Resin, Discomfort, polymerization, Biodegradation.

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Received: December 2018

Accepted: December 2018

Introduction

Acrylic-based resins are commonly used in dentistry for fabrication of dental prostheses and denture liners, temporary crowns and various orthodontic appliances. Acrylic resin bases of removable partial or complete dentures and tooth-supported or implant retained over-dentures are basically used to replace the lost tissue structure and divide masticatory forces from the denture to the underlying residual ridges. Denture base liners are used to increase the comfort of denture bases, thus re-establishing the retention, support and stability of removable prostheses. Temporary crowns are used during the interval between tooth preparation and placement of the permanent fixed prosthesis, while orthodontic appliances are used for space maintenance, tipping teeth, overbite reduction, block movements, retention, etc.^[1-5] Poly-methyl methacrylate (PMMA)-based acrylic resins are most commonly used acrylic resins. Polymerization of a PMMA-based dental resin is based on chemical reaction that requires the activation of an initiator, known as benzoyl peroxide, which is decomposed by heat or microwave polymerization.^[6,7] Polymerization can even occur by

addition of a chemical activator, such as dimethyl-toluidine, at moderate temperatures generally known as auto-polymerization or even by light polymerization.^[8,9] Polymerization leads to conversion of MMA to PMMA occurs which is known as curing process. During the polymerization reaction of acrylic resins, not all the monomers are converted into polymers, thus some unreacted monomers which is called as residual monomers are left. Its concentration depends on the methods and the conditions of polymerization. The residual monomer left might leach into water as well as human or artificial saliva.^[10-12] Leached residual monomer leads to various degrees of cytotoxicity and allergic reactions.^[13-15] The present study was conducted with the aim to determine the adverse effect of residual monomer.

Subjects and Methods

Study was conducted in our dental department of our college. Written consent was obtained by each patient prior to enrolling in the study. A total of 78 patients were analysed during the 6 months study, with age group of 14 years to 75 years. All the patients were basically divided

into three groups according to the treatment undergone by them.

Group A: comprised of patients undergoing orthodontic treatment and were advised bite blocks and various appliances having base of acrylic.

Group B: comprised of patients who had temporary acrylic crowns post crown preparation.

Group C: comprised of patients who had received acrylic based dentures (irrespective of partial, complete or implant supported dentures).

All the patients were asked a series of questions regarding the duration of the prosthesis/appliance and the level of discomfort felt during its use. All patients were then clinically examined for visible signs and symptoms. The discomfort was recorded on a chart with reads as; score 1: mild discomfort, score 2: moderate discomfort, score 3: severe discomfort, score 4: wanted immediate correction for it. All the response from the patients were physically accounted and electronically managed later on. All the data was arranged in a tabulated form and analysed statistically

Results

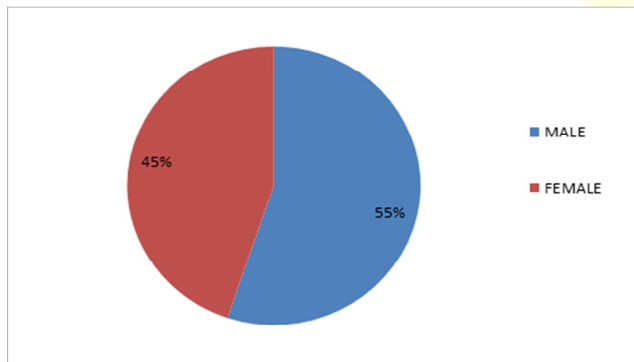


Figure 1: Gender Variation

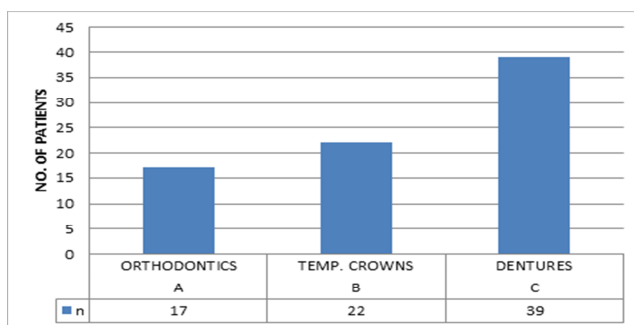


Figure 2: Treatment Offered

Out of 78 patients enrolled in the study, 43 were females whereas 35 were males [Figure 1]. Group A comprised of 17 patients in total, group B comprised of 22 and group C comprised of 39 patients respectively [Figure 2]. The severity of the discomfort was then recorded, and was categorised according to the respective groups [Table 1]. The degree of discomfort faced was maximum in patients wearing orthodontic appliances, followed by patients with

temporary crowns and least discomfort was found in the case of patients wearing dentures with acrylic bases.

Table 1: Type of allergic reaction amongst the subjects.

Group	Mild	Moderate	Severe	Extreme
A	9	4	2	2
B	10	6	3	3
C	11	18	5	5

Discussion

The degree of discomfort including redness and erosion of the oral mucosa, burning sensation and burning mucosa and tongue reported by the patients involved in present study is due to the effects of released, potentially cytotoxic, residual monomers. There are many factors involved in causal of adverse reaction if monomer added to the mixture is more the amount of residual monomer increase which leads to chances for cytotoxicity. Storage time is another factor responsible which plays an important role in cytotoxicity of acrylic denture base materials. In a report it is observed that the cytotoxic effect of acrylic resins was greater in the first 24 hours after polymerization, which decreased with time for all the resins evaluated.^[16] In another study it was observed that the longer the prosthesis is soaked in water, the less cytotoxic effect it is likely to have. The adverse effect may occur during several days after the polymerization, but it can further be minimized if the prostheses are stored in water over 24 hours. It is also proposed that the toxic substances released into the medium within the first 24 hours might react with other chemicals in the medium or broken down over time that may alter their cytotoxic potential. The decrease of the amount of residual monomer after this procedure might occur due to further polymerization in the presence of free radicals. Even though by immersing the prosthesis in heated water, monomer molecules diffuse at higher rate thus, attaining the remaining free radicals and leading to a complementary polymerization reaction. Same results have been observed who have worked on the effect of post-polymerization heat-treatments on the degree of conversion, residual methyl methacrylate concentration and in vitro cytotoxicity of auto-polymerizing acrylic repair resin (self-cure resin). It was also observed that post-polymerization heat-treatment of auto-polymerizing acrylic repair resin by immersion in water at 60°C for approximately 30 min is clinically recommended to enhance the degree of conversion while decreasing the leaching residual MMA. On the basis of polymerization temperature and time, various quantities of residual monomer are left in the polymer resulting in various degrees of cytotoxicity. Also, interactions between oral microbes and the polymer dental materials might occur, which showed some surface degradation effect observed due to bacterial colonization due to increase in the roughness.

Conclusion

There is a high concern regarding the safe clinical application of these materials so the methods and conditions of polymerization and their biodegradation in the oral environment needs to be studied well. Cytotoxic effect of denture base acrylic resins can be directly related to the methods and the conditions of polymerization, the powder to liquid ratio, storage time, polymerization method and curing cycle.

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How to cite this article: Thakur MK. Adverse Effect of Residual Monomer Used in Denture Base Acrylic Resins. *Asian J. Med. Res.* 2018;7(4):DE01-DE03.

DOI: [dx.doi.org/10.21276/ajmr.2018.7.4.DE1](https://doi.org/10.21276/ajmr.2018.7.4.DE1)

Source of Support: Nil, **Conflict of Interest:** None declared.