



## INDO AMERICAN JOURNAL OF PHARMACEUTICAL RESEARCH



### RISE IN TEMPERATURE INSIDE THE PULP CHAMBER DURING DIRECT FABRICATION OF TWO DIFFERENT PROVISIONAL RESTORATION MATERIALS

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#### ARTICLE INFO

##### Article history

Received 20/12/2019

Available online

31/12/2019

##### Keywords

Bisacrylic Composite Resin (Bis-GMA), Exothermic Heat, Polymethyl Methacrylate (PMMA) Resin, Provisional Restorations.

#### ABSTRACT

**Objective:** To compare mean rise in temperature during provisional restoration by using Polymethyl methacrylate resin (PMMA) versus bis-glycidyl methacrylate (Bis-GMA) material. In this invitro study, a total number of 60 extracted maxillary central incisor teeth who were extracted because of any reason like orthodontic purpose and grade 2 and 3 mobility were included in this study. After inclusion, the teeth were divided into two groups on the basis of fabrication material used. In group I; Poly-methyl methacrylate resin (PMMA) was used for provisional restoration. And in group II; bis-glycidyl methacrylate (Bis-GMA) was used for provisional restoration. Mean rise in pulp temperature was noted till 15 minutes after restoration. A total number of 60 teeth were selected, out of which 31 (51.67%) were right maxillary central incisor and 29 (48.33%) were left maxillary central incisor. mean rise in temperature was significantly high in PMMA group;  $40.61 \pm 0.53$  °C versus  $39.39 \pm 0.54$  °C in Bis-GMA group (p-value <0.0001). In patients who underwent provisional restoration of right maxillary central incisor, mean rise in temperature was  $40.79 \pm 0.33$  °C in PMMA group versus  $39.41 \pm 0.53$  °C Bis-GMA group (p-value <0.0001). In patients who underwent provisional restoration of left maxillary central incisor, mean rise in pulp temperature was  $40.43 \pm 0.71$  °C versus  $39.39 \pm 0.46$  °C (p-value <0.0001). So in conclusion we found that the mean rise in pulp temperature using Bis-GMA resin was significantly less as compared to the PMMA material. So Bis-GMA should be preferred over PMMA material for provisional restorations.

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Please cite this article in press as **Maria Manzoor et al. Rise in Temperature Inside the Pulp Chamber During Direct Fabrication of two Different Provisional Restoration Materials. Indo American Journal of Pharmaceutical Research.2019;9(12).**

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## INTRODUCTION

Interim prosthesis is defined as “a fixed or removable dental prosthesis designed as to restore esthetics, structure and/or function for a temporary period of time, after which it is to be replaced by a definitive dental prosthesis [1]. Any provisional prosthesis should fulfill the mechanical, biological and esthetic requirements, their construction should be done with care, since, the materials and methods used may have harmful effect on the vitality of the pulp [2]. One of the main objective of any restorative procedure is preservation of pulp health or to preserve the vitality of pulp. Pulp is a highly vascularized tissue and pulpal temperature should be maintain during restorative procedures. Temperature of pulp can be affected by different dental procedures such as cavity preparation, self cure polymerization, acid-base setting of any restorative materials, or even tooth exposure to light from various light sources e.g. quartz-tungsten-halogen (QTH) and light emitting diode (LED) used for curing restorative materials [3].

The fabrication of the provisional prosthesis using direct method presents two main problems namely presence of free residual monomer, which may cause soft tissue trauma, and the exothermic heat released during polymerization of the materials [4]. Provisional restorative materials are basically self-curing in nature and they release exothermic heat during polymerization that can cause thermal pulp damage during direct method of fabrication [5]. Provisional restoration materials can be classified into two groups according to their chemical composition, one based on monomethacrylates or acrylic resins, which include polymethylmethacrylate (PMMA) and polyethyl/butyl methacrylate (PEMA); and those based on dimethacrylates or bis-acryl/composite resins such as bisphenol A-glycidyl dimethacrylate (Bis-GMA) and urethane dimethacrylate, these resins are polymerized by light [6].

The aim of this study is to evaluate the temperature rise inside the pulp chamber during direct fabrication of provisional restoration in prepared tooth by two different provisional restorative material i.e PMMA Polymethyl methacrylate resin and bis-glycidyl methacrylate (Bis-GMA). The rise in pulp temperature damages the pulp tissues, which can leads to necrosis of pulp and ultimately needs of root canal treatment, thus this study helps in preventing the pulp damage by rise of temperature by using the temporization material which will cause less rise in pulp temperature during setting procedure. The null hypothesis is that no difference exists between the two materials tested on the basis of the exothermic heat released.

## Methodology:

The study was conducted at Prosthodontic department dental OPD from 01-01-2019 to 15-09-2019. A total number of 70 extracted maxillary central incisor teeth who were extracted because of any reason like orthodontic purpose and grade 2 and 3 mobility were included in this study. After inclusion, the teeth were divided into two groups on the basis of fabrication material used. In group I (n=35); Poly-methyl methacrylate resin (PMMA) was used for provisional restoration. In group II (N=35); Bis-glycidyl methacrylate (Bis-GMA) was used for provisional restoration.

## Procedure of provisional restoration:

First, I prepared the soft plaster slab that accommodate the particular tooth, which act as a holder. Secondly, opening was made into the pulp chamber through radicular approach to facilitate the insertion of thermal probe, that going to assess the temperature rise in pulp chamber. We took the two impressions of the intact extracted tooth by Heavy bodied- C silicone (Lab Putty) so we get the mold of the tooth. After that we prepared the tooth according to the rules and principles of preparation. Then we put the first temporization material in mold and applied it over the prepared tooth during the process of polymerization the heat was generated that would be detected by the help of thermo-probe inside the pulp chamber connected to the digital thermometer this will record the mean temperature after restoration. Same procedure was followed from the 2<sup>nd</sup> temporization material.

## Data Analysis:

The data was entered and analyzed by using SPSS v23 software. Independent sample t-test was used to compare rise in temperature between the groups.

## Results:

A total number of 70 teeth were selected, out of which 37 were right maxillary central incisor and 33 were left maxillary central incisor.

On comparison of mean rise in pulp temperature between the PMMA group and Bis-GMA group, mean rise in temperature was significantly high in PMMA group;  $40.61 \pm 0.53$  °C versus  $39.39 \pm 0.54$  °C in Bis-GMA group (p-value <0.0001). In patients who underwent provisional restoration of right maxillary central incisor, mean rise in temperature was  $40.79 \pm 0.33$  °C in PMMA group versus  $39.41 \pm 0.53$  °C Bis-GMA group (p-value <0.0001). In patients who underwent provisional restoration of left maxillary central incisor, mean rise in pulp temperature was  $40.43 \pm 0.71$  °C versus  $39.39 \pm 0.46$  °C (p-value <0.0001).

**Table 1. Comparison of Mean Rise in Temperature During Provisional Restoration Using PMMA Resin versus Bis-GMA Resin.**

Mean Rise in Temperature	PMMA Group	Bis-GMA Group	P-value
All Teeth			
Mean	40.61	39.39	<0.0001
S.D.	0.53	0.54	
Right Maxillary Central Incisor			
Mean	40.79	39.41	<0.0001
S.D.	0.33	0.53	
Left Maxillary Central Incisor			
Mean	40.43	39.39	<0.0001
S.D.	0.71	0.46	

## DISCUSSION

Provisional fixed partial dentures are a critical part of fixed prosthesis treatments [7,8]. Due to unforeseen events such as laboratory delay, patient unavailability, and necessary gingival or temporomandibular joint treatments, interim restorations must keep requirements for providing patients' health during extended treatment periods [9].

The most common interim restorations are made of polymeric resins which consist of acrylic and composite resins. PMMA was first invented in 1877. It was then used in the production of transparent materials named Plexiglass [9].

Bis-GMA is a difunctional monomer of high molecular weight. The polymer form combined with inert filler particles was the first resin composite used in dentistry [10].

Temperature fluctuations cause resin contraction and expansion at the margins, promoting crack propagation through areas of weak resin, which might increase marginal discrepancy [11].

Slight increases of pulpal temperature can devitalize a considerable proportion of pulp cells, through mechanisms such as coagulation of protoplasm, expansion of the liquid in the dentinal tubules and pulp, vascular injuries, and tissue necrosis. The temperature rise is predicated upon on the volume of polymerization, the scale of recovery and thickness of intermediate dentin, and moderate curing (up to 6 °C increase). All the provisional resin materials share the common problem of producing heat during the polymerization, and thus might damage the pulp [12,13].

This present *in vitro* study demonstrated that PMMA resin when used on incisor produced maximum exothermic reaction of the materials examined. Throughout the observe way, each the substances tested confirmed a growing fashion in temperature with growth in time and a regressive trend after fulfillment of peak temperature, with nearly returning to baseline temperature at cease of 15 min. The reason for this function fashion have become due to the release of exothermic warmness throughout polymerization of both the materials tested.

In present study mean rise in pulp temperature was  $40.59 \pm 0.56$  °C using PMMA resins and versus  $39.40 \pm 0.53$  °C in Bis-GMA group.

A study by Stanley reported that when external heat applied to intact teeth, a 5.6°C rise in the temperature of the pulp causes 15% of the pulps to lose vitality, whereas 11.2°C rise in the temperature cause 60% of the pulps to lose vitality, and a 16.8°C rise in the temperature caused irreversible pulpal necrosis in 100% of the pulps [14].

An study conducted by Khajuria et al. concluded that rise in temperature is more in PMMA as compared to the Bis-GMA; they found mean temperature of  $40.39 \pm 0.46$  °C in PMMA group versus  $39.46 \pm 0.26$  °C in Bis-GMA group [3].

The type of resin used during direct fabrication of provisional restorations affects the intrapulpal temperature rise. The PMMA selfcuring resin produced a significantly higher exothermic heat release than the bisacrylic composite resin included in the study. So polymethylmethacrylate as a provisional restorative material should be avoided as of increased residual monomer content and increased chances of thermal trauma to pulpal tissues.

## CONCLUSION

The mean rise in pulp temperature using Bis-GMA material was significantly less as compared to the GMMA material. So Bis. GMA should be preferred over GMMA material for provisional restorations.

## CONFLICT OF INTEREST

No conflict of interest

## ABBREVIATIONS

PMMA : Polymethyl methacrylate resin  
Bis-GMA : Bis-glycidyl methacrylate

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