Original Research Article

COMPARATIVE EVALUATION OF TEMPERATURE RISE INSIDE PULP CHAMBER USING TWO DIFFERENT PROVISIONAL RESTORATIVE MATERIALS

ABSTRACT

Aim: To compare the rise in temperature inside pulp chambers with two different provisional crown prosthesis materials.
Study design: Comparative -in vitro
Place and Duration of Study: Department of Prosthodontics, Liaquat Medical University Hospital from AUGUST 2019 TO DECEMBER 2019.
Methodology: This study was conducted at In-vitro laboratory of Prosthodontic Out Patient department, Liaquat University of Medical and Health, Jamshoro to compare mean rise in temperature during provisional restoration by using Polymethyl methacrylate resin (PMMA) versus bis-glycidyl methacrylate (Bis-GMA). A total number of 60 extracted maxillary central incisor teeth were selected using non probability consecutive sampling technique. 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. Tooth preparations were performed following all the principles. Mean temperature rise was recorded and compared for both material over each tooth using radicular approach after placing the provisional restorations in impression mould.

Results: 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. 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; 40.59±0.56 °C versus 39.40±0.53 °C in Bis-GMA group (p-value <0.0001).

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

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Keywords: Bisacrylic composite resin, exothermic heat, polymethyl methacrylate resin, provisional restorations.

1. INTRODUCTION

A interim prosthesis is a fixed or removable dental prosthesis designed to restore aesthetics, structure, and/or function for a short period of time, after which it will be replaced with a definitive dental prosthesis[1]" . Any interim prosthesis must meet mechanical, biological, and aesthetic standards, and its fabrication must be done with caution because the materials and methods employed may affect the pulp's vitality[2]. One of the key goals of any restorative process is to retain pulp health or vitality.

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, such as quartz-tungsten-halogen (QTH) and light emitting diode (LED) used for curing restorative materials, can affect the temperature of the pulp[2]. The existence of free residual monomer, which may cause soft tissue trauma, and the exothermic heat created during polymerization of the materials pose two major challenges when fabricating provisional prostheses utilising the direct technique[3]. Provisional restorative materials are essentially self-curing in nature, and during polymerization, they emit exothermic heat, which can cause thermal pulp damage when used in a direct mode of manufacturing[4]. According to Stanley, a 5.6°C increase in the temperature of the pulp causes 15% of the pulps to lose vitality, an 11.2°C increase causes 60% of the pulps to lose vitality, and a 16.8°C increase produces irreversible pulpal necrosis in 100% of the pulps[5]. On the contrary , Khajuria et al. observed that PMMA has a higher temperature rise than bis-GMA; they reported a mean temperature of 40.39+0.46 °C in the PMMA group vs 39.460.26 °C in the Bis-GMA group[2].The purpose of this study was to compare the temperature rise inside the pulp chamber when two distinct provisional restorative materials, PMMA Polymethyl methacrylate resin and bis-glycidyl methacrylate resin, were used to directly fabricate provisional restorations for prepared teeth (Bis-GMA). This study will aids in the prevention of future by opting for material will less temperature rise during setting procedure.

2. MATERIAL AND METHODS: The study was conducted In vitro at Prosthodontic department dental Out patient department laboratory, Liaquat University Hospital Jamshoro. Total 60 permanent teeth with sound morphology,usually extracted for orthodontic treatment were selected using non probability consecutive sampling technique.
The teeth were divided into two groups based on provisional 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. Firstly a soft plaster slab was prepared to hold the tooth. Afterwards, access cavity was made into the pulp chamber through radicular approach to facilitate the insertion of thermal probe in order to assess the temperature rise in pulp chamber. Two impressions of each intact extracted tooth were taken using Heavy bodied- C silicone (Lab Putty) to make a mould.Teeth were prepared following principles of tooth preparation. Temporary crowns were fabricated for each tooth using two moulds, one with PMMA and other with Bis-GMA. Rise in mean temperature during the process of polymerisation was measured using thermo-probe kept inside the pulp chamber via radicular approach connected to the digital thermometer. All the reading were noted on a pre-designed Proforma. The data collected and analysed using SPSS v23 software. Frequency and percentage were measured for qualitative variables such as side of tooth arch. Mean and standard deviation were used to present mean rise in temperature during restoration. Independent sample t-test was applied to compare rise in temperature between the groups. P-value ≤ 0.05 was taken as significant difference.

3. RESULTS

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 (Figure 1).Mean rise in pulp chamber temperature was 40.0±0.81 °C. Minimum temperature was 38.90 °C and maximum temperature was 41.30 °C (table-1).On comparison of mean rise in pulp temperature between the PMMA and Bis-GMA group, temperature was significantly higher in PMMA group; 40.59±0.56 °C versus 39.40±0.53 °C in Bis-GMA group. This difference was statistically significant with p-value <0.0001 (Table 2).

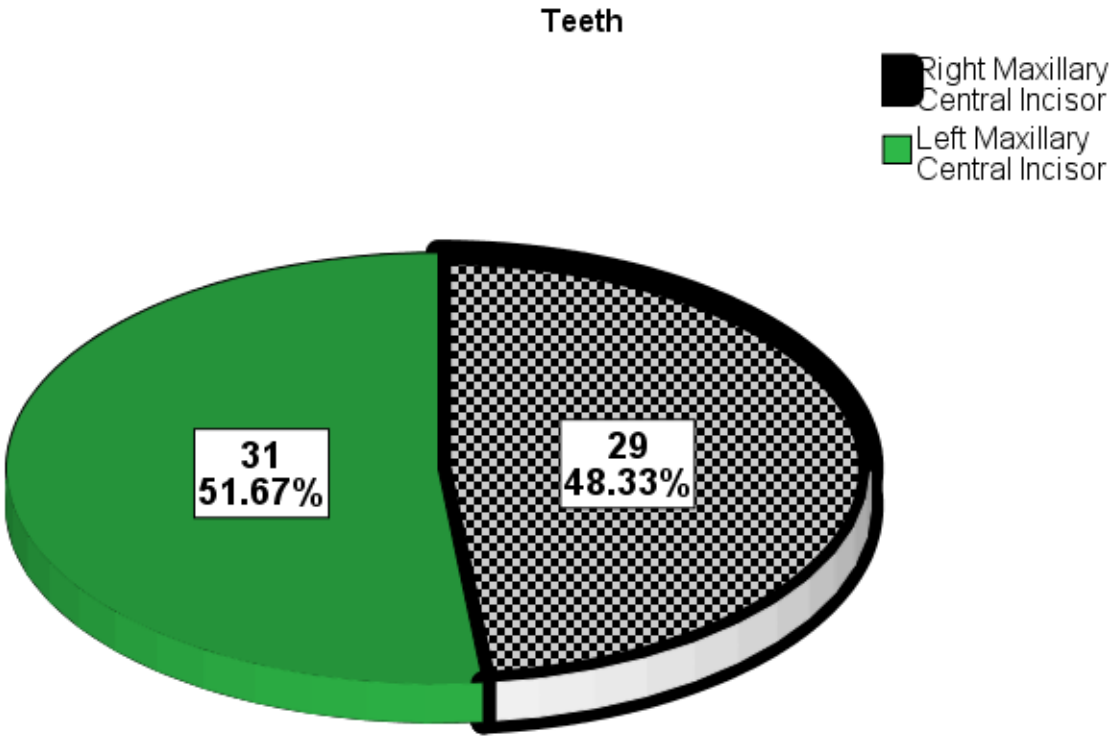

Figure 1. Frequency of Teeth Arch for Provisional Restoration.

Table 1. Descriptive Statistics of Mean Rise in Temperature During Provisional Restorations.

Mean	40.0
S.D.	0.81
Minimum	37.90
Maximum	41.30

Table 2. Comparison of Mean Rise in Temperature During Provisional Restoration Using Polymethyl methacrylate resin (PMMA) versus bis-glycidyl methacrylate (Bis-GMA) material.

Mean Rise in Temperature	PMMA Group	Bis-GMA Group	P-value
Mean	40.59	39.40	<0.0001
S.D.	0.56	0.53	

4. Discussion:

Provisional fixed partial dentures are a critical part of fixed prosthesis treatments must be used to maintain the health and longevity of prepared tooth[6,7] Since the introduction of chemical cured PMMA, they became the most frequently used interim fixed prostheses material [8].Developments in Bis-GMA structure and filler content led to the development of other molecules such as: ethoxylated Bis-GMA, triethyleneglycol dimethacrylate (TEGDMA) and urethane methacrylates (UDMA) which found their way and have become popular for fabrication of interim fixed prostheses.[9]It has been observed that slight increases of pulpal temperature by all interim prosthesis can devitalize a considerable proportion of pulp cells, through various mechanisms. This temperature increase depends on the extent of polymerization, the size of restoration and thickness of intermediate dentin, and light curing (up to 6 °C increase). [10,11]This present *in vitro* study demonstrated that PMMA resin when used on incisor produced highest exothermic reaction. Throughout the study procedure, both the materials tested showed a rising trend in temperature due to the release of exothermic heat during polymerization .[12] Akova et al. and Usumez et al. investigated the effects of different matrices and application of desensitizer on rise in temperature and found no effects of matrix and desensitizer on the temperature rise. [13,14.] Yondem et al. conducted a study to evaluate the temperature rise during polymerization of resin composite by various light polymerization units and found the temperature rise much below the critical temperature of 5.5°C. Hence, light cure or dual cure composites can also be suggested as provisional crown materials.[15] Malčić et al. stated that care should be taken while using blue phase light emitting diode light for polymerization of resins and suggested to use it at low power modes and with small duration of exposers.[16] Our study suggested that the type of resin used during direct fabrication of provisional restorations affects the intrapulpal temperature rise. The PMMA self curing resin produced a significantly higher exothermic heat release than the bisacrylic composite resin and should be avoided to reduces the chances of thermal injury to pulpal tissues.

5. **Conclusion:**

The mean rise in pulp temperature using Bis-GMA resin was significantly less as compared to the PMMA material which must be avoided for future interim restorations.

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COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.