Influence of Photoirradiation Times of Composite Resin on the Pulp Temperature

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Abstract

Aim: The present study was performed to measure in vitro intrapulpal temperature when photoirradiation of composite resin at different times. Material and Method: Thermocouple was placed intrapulpal space of an extracted human mandibular premolar which had a ClassV cavity preparation (1.5mm dentin thickness remaining on the buccal surface) and restored with a bulk fill composite resin and with used a high-intensity LED unit at different photoirradiation times (10, 20.40sec). A temperature increase was obtained during photoirradiation times and no significant in each study groups (P<0.05). Result: Rise intrapulp temperature associated with an increase in photoirradiation times and no significant in each study groups. Conclusion: intrapulpal temperature increase was attributed to photoirradiation's time of composite resin. However, temperature's increase during polymerization was below the critical value.

Keywords: Photoirradiation Composite resin intrapulpal.

INTRODUCTION

Vitality of pulp tissue is influenced during restorative procedures [1]. The photoirradiation process of composite resin may cause a heat generation theoretically damage the pulp tissues. Although, the sensitivity of the pulp tissue to thermal changes which can be tolerate by the pulp is still unknown [2]. Intrapulp temperature rise during photoirradiation process pointed to the contributing factors such as the type of light curing unit, density power, duration of exposure, the space between composite surface and tip of light, composite shade and thickness of composite material and remaining of dentin [3, 4]. Introduction of light emitting diode LED unit which is predicted to result in less temperature and less pulp injury in deep cavity close to the pulp the problem perseveres remain [5]. LED units do not require filters presence and (93%) total output of energy is converted to heat [6].

The glass inommer GI liner protect the pulp tissue from restorative material and from the heat generated by the hardening of the restorative material [7].

The purpose of this study was to measure the temperature at the pulp space during photoirradiation of composite by LED units lining with glass ionomer cement and without lining glass ionomer cement.

MATERIAL AND METHOD

Thirty non-caries permanent mandibular premolars extracted for orthodontic were stored at room temp. In distilled water until use, teeth were scaled and polished for removal calculus deposits and stain when present. All teeth thickness of dentin at the buccal surfaces one mm above the cemento-enamel junction and axial depth of cavity (1- 1.25 mm) using radiographs which varied from (2.5 to 3mm) measure by vernia ruler. ClassV cavities were prepared on buccal surfaces one mm above the cemento-enamel junction and axial depth of cavity (1- 1.25 mm) using high speed hand piece (turbine) with dental round bur with cooling Moreover, this method allows a standardization of the thickness of dentin between the cavity floor and the pulp chamber as well as a standardized cavity size and subsequently, a standardized volume of composite resin. The occlusal surface was perforated at the top surface of the pulp camber also using high speed hand piece (turbine) with dental round bur until reach the chamber room. The thermocouple (Digital Ki and BNT model: ST-1, China) was inserted into the pulp camber through occlusal surface. Inside the pulp chamber, the thermocouple was...
fixed by red wax the position of the thermocouple was then determined by a radiograph [8, 13]. Prepared teeth were distributed into two groups randomly, (one group with GI liner and second group without GI liner). Each group was subdivided according to photoirradiation time (second) into three subgroups (n=5).

**First group**

The bulk fill composite was injected in the ClassV cavity without acid etch and bound after GI liner place, cured with a high-intensity LED unit (woodpecker model: YZB155-2013, china), light tip was directly placed over a celluloid strip for different curing time (10sec, 20sec and 40sec) with intensity 1600mW/cm² temperature was measured during curing process using the digital thermocouple inside pulp chamber.

**Second group**

The bulk fill composite without acid etch and bound was injected in the ClassV cavity without GI liner place, cured with a high-intensity LED unit and light cure tip were directly placed over a celluloid strip for different curing time (10sec, 20sec and 40sec.) with intensity 1600mW/cm² temperature was measured during curing process using the digital thermocouple inside pulp chamber. The temperature increase during the curing process of the composite restorative material was recorded.

Temperature data were analyzed using methods of descriptive, Post Hoc Tests and one-way analysis (ANOVA) at the level of significant set at 0.05.

**RESULT**

Representative temperature for each curing time tested is presented in Table 1 the mean of temperature in terms of the curing time with and without GI liner (in all groups).

One-way analysis of the temperature within the different curing time were not significantly different among groups (first group and second group): p>0.05 presented in table2 influenced by the presence of the celluloid strip or increased exposure time to light when the remaining dentin thickness at the cavity floor was 1.5±0.25 mm.. Temperature change without GI liner and with GI liner were 3.02 ± 1.33°C and 2.63 ± 1.06°C, respectively, the greatest intrapulp temperature in the first group.

Comparisons of different curing time at each groups the result shows no significant differences in temperatures are presented (p˂0.05) in (Table3).

Figure 1 presents real temperature measurements at the end of curing procedure without GI liner while figure 2 presents real temperature measurements at the end of curing procedure with GI liner.

### Table-1: Mean and stander deviation

|                  | N  | Mean | Std. Deviation |
|------------------|----|------|----------------|
| Temp without GI liner | 10 | 5 | 1.4600 | .31305 |
|                  | 20 | 5 | 3.1000 | .34641 |
|                  | 40 | 5 | 4.5200 | .40866 |
| Total            | 15 |    | 3.0267 | 1.33602 |
| Temp with GI liner | 10 | 5 | 1.4600 | .18166 |
|                  | 20 | 5 | 2.5200 | .35637 |
|                  | 40 | 5 | 3.9200 | .13038 |
| Total            | 15 |    | 2.6333 | 1.06682 |

### Table-2: one- way ANOVA

|                  | Sum of Squares | df | Mean Square | F     | Sig. |
|------------------|----------------|----|-------------|-------|------|
| Temp. Without GI liner | 23.449         | 2  | 11.725      | 91.361 | .000 |
| Within Groups     | 1.540          | 12 | .128        |       |      |
| Total             | 24.989         | 14 |             |       |      |
| Temp. With GI liner | 15.225         | 2  | 7.613       | 129.028 | .000 |
| Within Groups     | .708           | 12 | .059        |       |      |
| Total             | 15.933         | 14 |             |       |      |
Table-3: Multiple Comparisons of curing times (Post Hoc Test)

| Dependent Variable | (I) time | (J) time | Mean Difference (I-J) | Std. Error | Sig. |
|-------------------|----------|----------|-----------------------|------------|------|
| Temp. without GI liner | dimension2 | 10 | 20 | 1.64000 | .22657 | .000 |
|          |          | 40 |            | 3.06000 | .22657 | .000 |
|          |          | 20 |            | 1.64000 | .22657 | .000 |
|          |          | 40 |            | 1.42000 | .22657 | .000 |
|          |          | 10 |            | 3.06000 | .22657 | .000 |
|          |          | 20 |            | 1.42000 | .22657 | .000 |
| Temp. with GI liner | dimension2 | 10 | 20 | 1.06000 | .15362 | .000 |
|          |          | 40 |            | 2.46000 | .15362 | .000 |
|          |          | 20 |            | 1.06000 | .15362 | .000 |
|          |          | 40 |            | 1.40000 | .15362 | .000 |
|          |          | 10 |            | 2.46000 | .15362 | .000 |
|          |          | 20 |            | 1.40000 | .15362 | .000 |

*. The mean difference is significant at the 0.05 level.

Fig-1: Mean of temperatures without GI liner

Fig-2: Mean of temperature with GI liner
DISCUSSION

The research hypothesis was accepted not in the manner expected. There was not significant difference in temperature value when photoinitiation of composite restorative without GI liner developed higher temperatures than intrapulpal temperature with GI liner, over all. However, these differences are minor, as in table1 and table2.

ClassV cavities in the present study allowed heat transfer by the surrounding enamel and dentin instead of disk-shaped specimens used in previous studies [9, 10]. A thermocouple placed at the perforation site in contact with the surrounding dentin. Temperature measured by the thermocouple in this in vitro setup relates to the temperature to which the pulpal tissue would be exposed during photoinitiation of composite restorative material.

In vitro studies, extracted teeth using will not give the same results to be found in vivo, where there is blood movement through the pulp with heat distribution. However, in vitro studies can results that may serve to alert the clinicians of the potential hazards to the pulp health [11, 12]. In my study, noted temperature is not from the curing times only, but is also the heat-generated result by the composite itself during polymerization, a GI liner use with the curing times allows for a better comparison of intrapulpal temperature changes.

In both groups, there was no significant difference in the temperature rise during the curing of composite immediately after the curing procedure find pulp temperatures were lower which can be attributed to the thermal insulation offered by the material itself. There was no significant temperature rise in first groups which could be attributed to the small standard deviation in temperature can be seen in the present study this was most likely due to the thermal insulating effect of GI liner this agree with Millen C. et al. [13] and figure 2.

Zach and Cohen found increase in intrapulpal temperature more than 5.5°C lead to irreversible pulpitis turn to necrotic [14]. In my study, in all groups the temperature increases were less than 5.5°C to protect of the pulp vitality from thermal damage must be GI liner use for distributed of heat in the area and curing time of composite according to manufacturer’s recommend a curing time 20 second for the high powered LED light.

The temperature rise which accompanies light curing of composite material is caused by both the heat generation from composite during photopolymerisation and heat from light source. In addition, different factors, such as curing time, the amount of remaining dentin thickness, the position of light curing units, the space between curing units and material surface, and the light intensity of the light curing units can affect the temperature during the photopolymerisation [15-17], the curing time of the composite resin arise as an important factor for the intrapulpal temperature during polymerization. Present study, we used three different curing times (10,20,40sec.). The highest temperature increase was observed in second group this rise of temperature is probably related to the GI liner absent (Table 1 and figure 1) and the rise of temperature in first and second groups prepared with the three curing times were compared (Table3).

There is a possible risk of pulp damage induced by heat generation during i he photoinitiated of composite resin. However, the blood circulation in the pulp chamber and the fluid motion in the dentinal tubules may play a role in reducing the temperature rise induced by the composite resin polymerization [18]. The surrounding periodontal tissue can also promote heat distribution, which results in reduction of the intrapulpal temperature rise [19].

CONCLUSIONS

The rise of intrapulpal temperature was attributed to photo irradiation’s time of composite resin and temperature’s increase during polymerization. However, this rise in temperature is below the critical value.

The use of GI liner under composite restorations does not reduce the rise of the intrapulpal temperature.

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