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Comparison Depth of Cure of Different Viscosities Bulk Fill Composite Materials

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Abstract: ***Background: Sufficient curing of resin composites considered is very important for good clinical success. An insufficient curing affects composite properties. The aim of this study was to compare the depth of cure of different viscosities bulk fill composites materials. Materials and methods: eight bulk fill composite materials used in this study. These materials divided in eight groups of ten samples for each group. These groups were: group I Alert, group II Filtek Bulk Fill Posterior, group III Tetric N Ceram bulk fill, group IV Tetric EvoCeram Bulk Fill , group V QuiXfil, group VI SonicFil, group VII Filtek Bulk Fill Flowable, group VIII SureFil SDR. Depth of cure was determined by ISO4049 method. Results: Statistical analysis done and QuiXfil (5.25) showed with highest mean value and the lowest mean value was seen at group I Alert (2.51). There were high significant and significant differences between all tested groups and there were non significant difference between group II (Filtek Bulk Fill Posterior) and group IV (Tetric EvoCeram Bulk Fill).Conclusion: This study showed that all tested groups showed different depth of cure values and these results affected by composition, viscosity, filler contents and translucency of the bulk fill materials.***

Keywords: depth of cure, composite, bulk fill composite

1. Introduction

The evolution and improvement of the chemical and physical properties of composite materials increased their use for posterior teeth[(1)]. The improvements include increase of filler content, variations in shape and size, type of the fillers [(2)]. The incomplete polymerization of composite restorations regarded one of the major clinical problems that should be avoided since inadequate resin activation compromised the restoration both biologically and mechanically [(3)]. Incomplete light curing might be influenced the material's stability, which increases the possibility of pulpal responses and lead to color change and wear reaction[(4)].

Several manufacturers developednew posterior bulk fill composite resins, stated that used to the cavity with thickness of 4 mm [(5)].

The depth of cure was the depth to which the light was able to harden the material [(6)]

There were many factors influencing the depth of cure, these factors are the composite composition, thickness, shade, translucency, distance from the tip, intensity of the curing light and irradiation type [(7)].

The ISO 4049 method was developed as one of the methods that used to measure the depth of cure of the restorative composite filling [(8)]. This study investigated the depth of cure of eight different types of bulk fill composite resin materials by the using of the ISO 4049 method.

2. Materials and Methods

Eight composite resin types were selected to measure their depth of cure, the composite were randomly divided into eight groups of ten samples for each.

These groups were: group I Alert (Pentron, USA) , group II Filtek Bulk Fill Posterior (3M ESPE,USA) ,group III Tetric N Ceram bulk fill (Ivoclar Vivadent – Italy), group IV Tetric EvoCeram Bulk Fill(Ivoclar Vivadent – Italy) , group V QuiXfil (Denstply Detrey,Germany), group VI SonicFil (kerr, USA), group VII Filtek Bulk Fill Flowable Restorative (3M ESPE,USA) , group VIII SureFil SDR (Denstply Detrey,Germany).

All the groups had the same shades, which were A2 except for group V QuiXfil,and group VIII SureFil SDR had universal shade. All these groups were used according to manufacture instruction of each types of composite. All light-curing performed with an LED light curingunit (Demi Ultra, Kerr Corporation, USA) and light power density was verified to be at 1000 mW/cm2 at the with a radiometer (Kerr Corporation,USA).

3. Measurement depth of cure by ISO 4049

Cylindrical stainless steel molds were used in this study according to ISO 4049:2000 (8) the mold should be 13 mm long and 4 mm in diameter, since the manufacturer claimed a depth of cure in excess of 5 mm for some type of the composite used in this study the mold should be at least 2 mm longer than twice the manufacturer claimed depth of cure. The mold was placed on glass slide covered by Mylar strip then the mold was filled with one of the bulk fill resin composite of the eight groups, a second Mylar strip was used to cover the top side of the mold and the material was flushed with the mold by use of other glass slide, the mold should be placed on white filter paper. The top glass slide was removed and the composite was light cured for 20 sec. The light tip should be in contact and centered on the second Mylar strip. After curing, the specimens were pushed out of the mold and plastic spatula was used to remove the uncured composite. The absolute length of the cylindrical specimens of cured composite was measured with a the use of digital caliper of ± 0.01 mm accuracy (Japan) and this length divided by two to had the measured depth of cure value.

Table 1: Mean value & standard deviation of depth of cure for eight composite restorative materials determined by ISO 4049 method

Studied groups	N	Depth Of Cure	
		Mean%	±SD
group I (Alert)	10	3.25	0.11
group II (Filtek Bulk Fill Posterior)	10	3.95	0.20
group III (Tetric N Ceram bulk fill)	10	3.67	0.20
group IV (Tetric EvoCeram Bulk Fill)	10	3.88	0.10
group V (QuiXfil)	10	5.25	0.28
group VI (SonicFil)	10	3.46	0.26
group VII (Filtek Bulk Fill Flowable bulk fill)	10	4.22	0.14
VIII (SureFil SDR)	10	4.87	0.18

(Table 1): the highest mean value for the depth of cure of resin restorative material was seen at group V QuiXfil (5.25) and the lowest mean value was seen at group I Alert (2.51). The rest mean values for the study groups were fluctuating between these values.

4. Results

This study showed the following results (Table 1)To compare between the eight restorative composite materials ANOVA test and The least significance difference test (LSD) were performed to evaluate the significant differences between each two restorative materials groups and the following results obtained: There were high significant difference ($p \leq 0.000$) between all groups except for the following groups:

1) There were significant difference between group II (Filtek Bulk Fill Posterior) group III (Tetric N Ceram bulk fill) and group VII (Filtek Bulk Fill Flowable bulk fill) .
2) There were significant difference between group III (Tetric N Ceram bulk fill), group IV (Tetric EvoCeram Bulk Fill) and group VI (SonicFil).
3) There were significant difference between group III (Tetric N Ceram bulk fill) and group IV (Tetric EvoCeram Bulk Fill).
4) There were non significant difference between group II (Filtek Bulk Fill Posterior) and group IV (Tetric EvoCeram Bulk Fill).

5. Discussion

Composite resin widely used for restorative dentistry. One of the most important factorsfor composite resistance to stress was depth of cure[10]. Unfortunately, the dentist had no means of observing the cure of the resin surfaces not exposed directly to the light cure [11,12]. This study showed high significant differences between most of the eight groups of tested restorative bulk fill composite materials as regard to the depth of cure determined by ISO 4049 method.

Possible explanations for these results might be related to different factors such as differences in compositions, viscosity,and translucency of these materials.

The high depth of curing in Quixfil could be because of the difference in organic matrix (monomer type, concentration and photoinitiator concentration, greater filler size and translucency of the material). Light scattering in composite with a smaller filler particle size could be caused a lower depth of cure [13], So Quixfil with a higher filler size (1-10 µ) had a higher depth of cure. Translucency was another factor in the depth of curing [15]. Glass particles played an important role in light transmission [14]. Quixfil contained glass fillersin addition to translucency these could be the cause of higher depth of cure of this composite [15]. Both SureFil SDR and Filtek Bulk Fill Flowable bulk fill showed good values for depth of cure these results might be related to the lower viscosity of these types of bulk fill composites.Typically the resin had a refractive index that's lower than that of the filler but Filtek Bulk Fill Posterior Restorative was formulated with aromatic resins which allowed the refractive index to more closely match the filler so the the light would not be significantly bent and successfully transmitted through the material which increased the material's depth of cure. Tetric EvoCeram Bulk Fill and Tetric N Ceram bulk fill both materials utilized in addition to standard photo initiators camphorquinone newly patented initiator Ivocerin which play an important role in increasing depth of cure of their materials[16,17]. The manufacturer of SonicFill suggested that it should be cured with more 10 seconds forfurther light curing on the buccal and lingual with additional light curing from the both proximal which increased the polymerization of the composite resins and this might be the cause of the lower depth of cure value obtained for Sonifill composite in this study [18]. The lower values of depth of cure of Alert composite material might be related to thehigh filler loading.

6. Conclusion

Curing depth was a property, which was material specific; so factors such as differences in compositions, fillers, viscosity, and translucency of these materials play an important role in curing of the bulk fill composite materials.

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