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Research Article

EFFECT OF TWO LIGHT CURING UNITS ON TWO COMPOSITE RESINS: A MICROHARDNESS ASSESSMENT

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ABSTRACT

Aim: To evaluate the efficacy of polymerization of two composite resins with QTH and LED light curing units.

Materials and methods: Total 40 specimens were prepared with Microhybridcomposite (Filtek Z250) and Nanofilled composite (Filtek Z350 XT) and cured with LED light curing unit Stealth SOFT (Equinox) and Quartz tungsten halogen (QTH) light curing unit QHL75 curing light (Dentsply).Thus, 4 experimental groups (n= 10) were prepared according to the composite resin and light curing unit that was used. The specimens were stored in distilled water in a container for 24 hours and microhardness was determined by a Vickers Microhardness Tester (Reichert, Austria). Microhardness measurements were performed by applying a 10 gm load for 10 seconds at three points, 1 mm apart on the specimens bottom surface. The comparison of means of different groups was done using statistical analysis by Tukey's test and Kruskal Wallis test.

Results: The results showed no statistically significant differences between the light curing units and composite resins (p=0.9333). Vickers Hardness number (VHN) or microhardness value for LED cured Microhybrid composite was found to be 60.23 whereas LED cured Nanofilled was 58.Vickers Hardness number (VHN) for Halogen cured Nanofilled was 59.6 as compared to Halogen cured Microhybrid which was found to be 58.7.

Conclusion: The LED curing light provided the maximum hardness values for the microhybrid composite resin as compared to the conventional QTH curing light.The QTH curing light provided the maximum hardness values for the nanofilled composite resin as compared to the LED curing light

INTRODUCTION

Light cured resin composites were introduced in 1970[1].In recent years the popularity of tooth colored restorative materials has promoted a rapidly increasing use of composite resins[2].The developments in resin chemistry and light curing units have led to the production of resin composites with improved physical and mechanical properties[4].Adequate polymerization is a crucial factor in obtaining adequate physical properties of composite resins and thereby achieving long term clinical success[6].Studies have revealed that inadequate polymerization can contribute to a variety of clinical conditions such as discoloration, pulpal irritation, post-operative sensitivity, reduced hardness, increased wear, increased marginal breakdown, increased marginal leakage and weak bonding leading to failure of restoration[6].

Microhybrid composites

They are the most traditional composites used for restorative procedures. The inorganic filler content is approx. 75 to 85 % of weight. They consist of zirconia/silica filler particles of size ranging from 0.5 – 4 μm.The presence of microfiller particles interspersed among the larger particles provides a smooth surface texture in the finished restoration.

Nanofilled composites

They consist of zirconia/silica filler particles of size ranging from 5 – 100 nm (0.005-0.01μm).They have better aesthetics and mechanical properties as compared to microhybrid composites. The small particle size also makes them highly polishable.

Quartz tungsten halogen curing light

They are the most commonly used devices for the polymerization of composite resins. They produce light by incandescence. The quartz tungsten halogen light causes excitation of atoms over a wide range of energy levels.Hence filters are needed to restrict the emitted light to blue spectrum.[1]

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LED curing light

The first light emitting diode (LED) light curing unit was introduced in 2001 as an alternative to halogen lamps.It uses junctions of doped semi-conductor (p-n junctions) to generate blue light.

Aim

To evaluate the efficacy of polymerization of two composite resins with QTH and LED light curing units.

MATERIALS AND METHODS

Total 40 specimens were prepared with Microhybrid composite (Filtek Z250, 3M ESPE) and Nanofilled composite (Filtek Z350 XT, 3M ESPE).The LED light curing unit used was Stealth SOFT (Equinox) and the Quartz tungsten halogen (QTH) light curing unit used was QHL75 curing light (Dentsply) (Fig. 1).

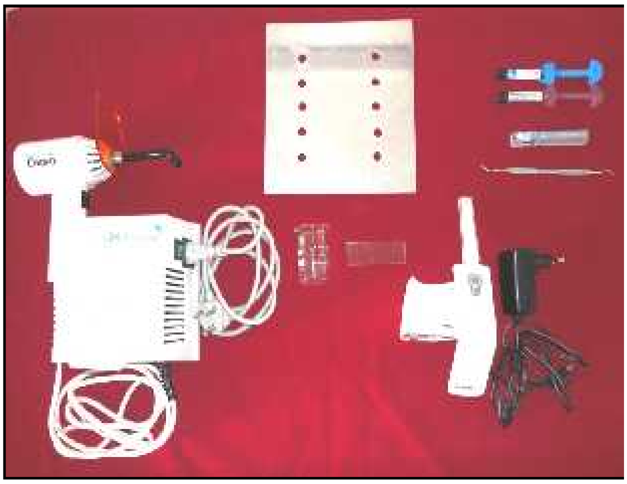


Fig. 1 Armamentarium

Disc shaped specimens were prepared from aluminum mold by a standardized method.

Fig. 2 Vickers Microhardness Tester

The dimensions of the specimen were 10 mm in diameter and 2 mm in thickness. A glass slide was placed below the mold. The composite material was placed in the mold in a single increment. After resin insertion, a matrix strip was placed on the top of the mold. In order to ensure a level plane on the top and bottom surfaces, a glass slide was placed on the top of matrix strip. Light curing was performed by touching the tip of the light curing unit on the top surface of glass slide for 40 seconds. Thus, 4 experimental groups (n= 10) were prepared according to the composite resin and light curing unit that was used. The specimens were stored in distilled water in a container for 24 hours and microhardness was determined by a Vickers Microhardness Tester (Reichert, Austria)(Fig. 2). Microhardness measurements were performed by applying a 10 gm load for 10 seconds at three points, 1 mm apart on the specimens bottom surface (Figure 3).

Fig. 3 Vickers Microhardness testing of sample

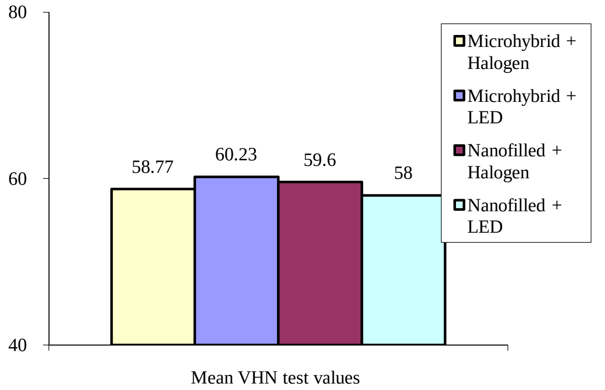
The three measurements obtained were converted into a Vickers Hardness Number (VHN) and the average was calculated (Table 1). The comparison of means of different groups was done. Statistical analysis was performed by Tukey's test and Kruskal Wallis test.

Table 1 Table showing mean hardness values and standard deviations (SDs) for each composite resin and the light curing unit.

GROUPS	Mean Vhntest Values	SD	RANGE
Microhybrid +Halogen	58.77	10.04	35.64 to 69.51
Microhybrid + LED	60.23	4.7	55.32 to 68.97
Nanofilled + Halogen	59.6	2.9	56.28 to 66.03
Nanofilled + LED	58	2.8	55.71 to 62.99

RESULTS

The results showed no statistically significant differences between the light curing units and composite resins (p=0.9333)(Graph 1).



Graph 1 Graphical representation showing mean vicker's hardness number (VHN) values for each group.

Vickers Hardness number (VHN) or microhardness value for LED cured Microhybrid composite was found to be 60.23 whereas LED cured Nanofilled was 58.Vickers Hardness number (VHN) for Halogen cured Nanofilled was 59.6 as compared to Halogen cured Microhybrid which was found to be 58.7. Mean hardness values and standard deviations (SDs) for each composite resin and the light curing unit are shown in the table.

DISCUSSION

Halogen light curing units are currently the most commonly used for the curing of dental composites, but this technology has certain drawbacks which includes limited life span, degradation of bulb, degradation of reflectors, degradation of filters with passage of time[1]. Hence a new technology like Light emitting diode (LED) is needed[1]. The spectrum output of blue LED (400-500 nm) falls within absorption spectrum of camphoroquinone photo initiator (470 nm)[8]. Hence no filter is needed[8]. Hence in this study, the efficiency of QTH and LED curing system was evaluated in terms of micro hardness of composite resins used, since micro hardness is a widely used test for investigation of composite curing and determination of efficiency of light sources.

Since the newer composite nanofilled promises of enhancing the polymerization depth, this study compared the nanofilled with the conventionally used micro hybrid composite. Shade A2 was selected to minimize the effect of colorants on light polymerization. Curing depth depends on the penetration of curing light, the filler content, and the distance of curing tip[4]. Efficiency of polymerization is influenced by irradiation intensity, exposure time and light source[5]. Ratio of double carbon bonds that are converted into single bonds determines the degree of conversion[5]. The light that initiates the polymerization may be either absorbed or scattered throughout the body of resin[6]. Decreased transmission of light which is strongly influenced by opacity & filler content leads to decreased degree of conversion which results in decreased micro hardness[6].

In this study, irrespective of light source when curing of the two composites were compared, the results showed that overall the Vickers Hardness Number (VHN) for micro hybrid was more than nanofilled composite. Both QTH and LED increases the microhardness of microhybrid, but LED has slightly higher hardness value which was statistically insignificant. The reason attributed for the above phenomena might be that sincemicrohyrid contains pigment and filler content, so there is increased light absorption which causes attenuation of light which leads to increased curing which results in increase in microhardness[7].

In this study second generation LED was used which has similar curing efficiency as that of QTH. Hence the micro hardness values obtained were comparatively similar (non significant)[2]. Overall, the LED cured nanocomposite showed comparatively less value than the other three groups. This might be accounted for Nano fillers and nanoclusters which causes accentuation and scattering of light leading to decreased transmissibility of light leading to decreased intensity of light at the bottom surface leading to decreased degree of conversion which results in decreased micro hardness[2]. Also the other reason for this might be decreased irradiant energy reaching at the bottom surface leading to decreased cross linkage leading to decreased density which results in decreased microhardness[3]. No statistically significant difference was found when the two light curing sources were used. Increase in micro hardness due to QTH was because of increased heat generation & speedy induction of polymerization[9].

CONCLUSION

The LED curing light provided the maximum hardness values for the microhybrid composite resin as compared to the conventional QTH curing light. The QTH curing light provided the maximum hardness values for the nanofilled composite resin as compared to the LED curing light. Overall, irrespective of curing light no significant difference was observed between microhybrid and nanofilled composite. The microhardness of resin composites vary according to the type of resin (microhybrid and nanofilled) and the type of light curing unit used. However there is no statistically significant difference.

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