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INFLUENCE OF TWO TYPES OF LIGHT CURING SYSTEMS WITH DIFFERENT CURING TIME REGIMENS ON POLYMERIZATION EFFICACY OF MICROHYBRID AND NANOCOMPOSITES AT TWO DIFFERENT DEPTHS

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ABSTRACT

The clinical performance of composite resins is greatly influenced by the quality of the light-curing unit used. The aim of this study was to compare the efficiency of a newer short duration curing device with that of traditional long duration devices. The effectiveness of cure was investigated by checking compressive strength of two composites cured with standard regimens of two LED LCUs viz, Dentamerica LCU at 20 sec and Wood pecker iLed LCU at 2 sec. Two light cured resin based composites, nano-composite (Z350, 3M ESPE) and micro-hybrid composite (Z100, 3M ESPE), were formed into eighty disks of two dimensions 6-2 and 6-4 and cured by two LCUs at standard regimens. The compressive strength test was performed using a Universal Testing Machine at a crosshead speed of 1 mm/min. Data was subjected to the parametric statistical analysis (ANOVA, t test) at significant level of P = 0.05. Results of the present study showed that, some nanofilled composites may have higher compressive strength than the microhybrid composite resins. No significant differences were found between the compressive strengths of both the resin composites cured by two different units at different time regimens of 20 sec and 2 sec used in the study.

Keywords: composite, light curing, curing time,polymerization

Introduction

In keeping pace with improvements in composite resins, light-curing units have also attained better properties for complete restoration polymerization. Halogen or quartz tungsten halogen lamps have been replaced by more efficient and less cumbersome LEDs.[1]LEDs with gallium nitride semiconductor in the energy range between 450-490 nm, demonstrated advantages in preventing overheating due to spectral purity, achieving highly efficient dental composite polymerization.[2]The clinical goals of curing are short irradiation time in combination with high and uniform conversion throughout the whole restoration and low shrinkage stress. The hardening of dental composite results from a chemical reaction between dimethacrylate resin monomers that produces a rigid and heavily cross-linked polymer network surrounding the inert filler particles .[3]The extent of this reaction often referred to as the degree of conversion or effectiveness of cure, which is very important in that it dictates many physical and mechanical properties of the composite restoration. The term degree of conversion describes the percentage of double bonds that react during polymerization process .[4] This conversion (monomer to polymer) is dependent on several factors, such as the resin composition, the transmission of the light through the material, the amount of activator-initiator and inhibitor that is present. Among the Various factors intensity and time duration for polymerization are most important.[5]The degree of conversion of resin-based composites is always proportionally associated with both shrinkage and hardening.[6]The hardness and effectiveness of cure of composites have been extensively investigated.

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Despite the recent developments, degree of polymerization of nano hybrid composites remains a concern. With the claim of 1 sec curing from newer LEDs like i LED from Wood pecker, it becomes pertanent to evaluate the effeciacy of these curing devices compared to traditional 20 sec curing unit devices. The purpose of the study was to investigate the effect of different light cure units with different time durations on hardness of the polymerized nano and micro hybrid composite material. The effectiveness of cure was investigated by checking compressive strength of two composites cured with standard regimens of two LED LCUs viz, Dentamerica LCU and Wood pecker I Led LCU.

Materials and methodology

Two light cured resin based composites, nano-composite (Z350, 3M ESPE) and micro-hybrid composite (Z100, 3M ESPE), were used in this study. Customised mold of plastic were used to prepare samples. Twenty disk shaped specimens measuring 6 mm in diameter and 2 mm in thickness and another twenty disks with dimensions 6mm in diameter and 4 mm in thickness were prepared. Twenty specimens with 6x2 dimensions were irradiated by touching the LCU guide on the top of mylar matrix strip for 20sec using the Dentamerica LCU and the other twenty were then irradiated by touching the LCU guide on the top of mylar matrix strip for 2sec using the Woodpecker i Led LCU. Similarly other twenty disks with diamensions of 6-6 were irradiated by same protocol. One hour after completing light curing, the composite specimens had been removed from the molds. Method for assessing the effectiveness of cure was in accordance with that used by Yap.[7] The effectiveness of cure was assessed by means of compressive strength testing. The specimens were then stored in a light proof container in distilled water at 37±C for 24 hr prior to compressive strength testing. The compressive strength test was performed using a Universal Testing Machine at a crosshead speed of 1 mm/min. Specimens were positioned vertically on the testing machine base and subjected to compressive load until failure. Samples were divided into 4 groups according to type and dimension of sample.

Statistical analysis

Data was analyzed using SPSS (Statistical Package for Social Sciences) for Windows release 11 (SPSS, Chicago, IL, USA). Data was subjected to the parametric statistical analysis (ANOVA, t test) at significant level of P = 0.05. Compressive strength values (MPa) of composite after curing was tabulated in table 1.

Table 1:

Composite type	N	20 sec curing	SD	2sec curing	SD
GROUP 1 Microhybrid 6x2	20	213.5	51.2	216.3	52.0
GROUP 2 Microhybrid 6x4	20	268.4	50.1	256.3	49.4
GROUP 3 Nanocomposites6x2	20	206.4	48.7	208.6	46.8
GROUP 4 Nanocomposites6x4	20	274.4	56.3	268.6	53.3

Results of the present study showed that, some nanofilled composites may have higher compressive strength than the microhybrid composite resins. No significant differences were found between the compressive strengths of both the resin composites cured by two different units at different time regimens of 20 sec and 2 sec used in the study.

Discussion

In the present study, the impact of different light curing regimens, in terms of duration of curing of two different curing units, on the

compressive strength of two types of composite resins at different curing depths was assessed. Several methodologies have been proposed to evaluate the polymerization efficacy of LCUs. Compressive strength, an indirect method, is a good indicator of the degree of conversion.8 A way to determine the true conversion is by measuring the residual double bonds (RDB) in the resin-based composites with Fourier Transform Infrared Spectroscopy (FTIR).[9,10] To minimize the effects of colorants on light polymerization, A2 shade of both the composite resins was used. As light intensity decreases with increasing distance from the light cure tip, the light cure tip was kept touching the acetate strip to standardize the procedure.[11]Curing time was followed as per the manufacturer's recommendations. The results indicate that the exposure time of different units as proposed by manufacturer is sufficient for the curing of different composites. The newer i LED light curing units by woodpecker has an added advantage of decreasing the curing time thus making composites less technique sensitive and saving clinical time.

Conclusion

For the dental practice, a short irradiation time combined with high, uniform conversion and low shrinkage stress is desired. Woodpecker i LED unit serve the clinical goal of curing both nano hybrid and microfill composites.

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