Effect of Light Curing Time and Depth of Cure on Degree of Polymerization of Bulk-Fill Resin Composites

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Abstract

Objectives: To investigate the effect of curing time on the degree of polymerization to bulk-fill resin composites, and to investigate the effect of depth of cure on the degree of polymerization of bulk-fill resin composites. *Methodology*: There were three types of bulk-fill resin composites used in this study which were Filtek™ Bulk Fill, Tetric® N-Ceram and SureFil® SDR flow+. Each type of resin composites was prepared in 2, 4 and 5 mm. Then they were light-cured for 20, 40, and 60 seconds which could be divided into 27 groups with different types of bulk-fill resin composites, depths of cure and lengths of curing time. Each specimen was cured with light having intensity of 1,200 mW/cm^2 in conventional mode. All of the specimens were kept in artificial saliva where they were incubated at 37°C for 24 hours. After the incubation, all of the specimens were tested using Vickers microhardness tester on the top and bottom surfaces. Then the bottom-to-top-surface microhardness ratio were used to analyze the degree of polymerization of each bulk-Fill resin composites. The data were analyzed with One-way ANOVA and T-test. *Results and Discussion*: All types of bulk-fill resin composites in the study could be significantly improved in degree of polymerization when increased curing time from 20 to 40 seconds and from 40 to 60 seconds. As the depth of cure increased, it became more statistically significantly decreased in degree of polymerization. Therefore, the more curing time and less depth of cure, there was an improved degree of polymerization. *Conclusion*: This study found a positive relationship between the level of bottom-to-top-surface microhardness ratio and curing time. Moreover, there existed a strong negative relationship between bottom-to-top-surface microhardness ratio and depth of cure. Last but not least, this study found an interaction effect of curing time and depth of cure.

Keywords: *Bulk-fill resin composites, Degree of polymerization, Microhardness ratio*

1. Introduction

Recently with increasing demand for esthetic, tooth colored restorations like resin-based composites are used for posterior teeth restoration. Also, patient awareness toward the use of mercury restoration has increased demand for resin-based composites even more. Resin composites are the type of materials which has the broadest application in restorative dentistry due to its optical and physical properties being very similar to natural dental tissue. The material presents as its principal characteristic adhesion to the dental structure, avoiding further damage to dental tissue (Barros, Lins, & Martins, 2017). However, the conventional resin composites require the maximum thickness of 2 mm depth of cure, which should be placed with incremental techniques to achieve the appropriate polymerization in a deep cavity. The incremental technique requires more clinical time and might produce voids due to the placing of multiple increments. In order to save the procedure time, less pronounced void with low-polymerization contraction, there is an innovation created with a single placement called bulk-fill resin composites.

Microhardness measurement is an indirect method to evaluate the degree of the polymerization of resin composites (Lenug, Fan, & Jonston, 1983; Silva, & Dias, 2009). The level of hardness is referred to strength and resistance against a compressive force. The surface hardness of the resin composites relates to its resistance to deformation and the capability to remain stable. Many studies demonstrated significant positive correlation between hardness and degree of conversion (Ferracane, 1985; Lombardini, Chiesa, Scribante, Colombo, &