Depth of Cure and Polymerization Shrinkage of the SonicFill Composite and a Nanohybrid Composite: A Comparative Study

Thesis

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Dedicated to

My Father

&

My Mother

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1.	**ANOVA**	= Analysis of variance.
2.	**Bis-EMA**	= Bisphenol A ethoxylated dimethacrylate
3.	**Bis-GMA**	= Bisphenol glycidyl methacrylate.
4.	**DC**	= Degree of conversion
5.	**DOC**	=Depth of cure
6.	**EBPDMA**	= ethoxylated bisphenol-A-dimethacrylate.
7.	**FTIR**	= Fourier transform infrared spectroscopy
8.	**h**	= Hour
9.	**ISO**	=International Standards Organization
10.	**KHN**	= Knoop Hardness Number.
11.	**LCU**	=Light curing unit
12.	**LED**	=Light emitting diodes.
13.	**min**	= minutes.
14.	**mm**	= millimeters.
15.	**MPa**	= Mega Pascal.
16.	**mW**	= milli Watt
17.	**nm**	= nanometer.
18.	**RBCs**	=Resin based composites.
19.	**s**	= seconds.
20.	**SD**	= Standard deviation
21.	**SDR**	= Stress decreasing resin.
22.	**SiC**	= Silicon Carbide.

23. **TEGDMA** = Triethylene glycol dimethacrylate.

24. **UDMA** **=** Urethane dimethacrylate.

25. **µm** **=** micrometer

INTRODUCTION

Introduction

Dental caries is a public health problem that affects preschool and high-school children throughout the world, leading to pain, chewing difficulties, speech problems, general health disorders, psychological problems, and lower quality of life. Although advanced preventive procedures significantly decrease the prevalence of caries on occlusal surfaces and buccal/lingual surfaces is still a considerable problem. (1)

During the last few decades, the increasing demand for esthetic dentistry have led to the development of resin composite materials for direct restorations with improved physical and mechanical properties, aesthetics and durability.(2)

Composite resins have better mechanical properties, such as compressive strength, than other aesthetic restorations such as conventional or resin-modified glass ionomers, suggesting a longer clinical life in regions submitted to occlusal loads. (3)

Research has indicated that the placement time of resin based composite restorations is significantly longer than the placement of amalgam restorations. The lack of cooperation of a child may determine that a resin-based composite is not the material of choice. (4)

In 2010, a recent development has been the introduction of SonicFill* composite which was the first and only easy-to-use, single-step bulk fill composite system that doesn't require an additional capping layer. It provides according to the manufacturer's data the ability to place, adapt and cure posterior restorations with a single increment of material in cavities up to 5 mm deep.

The SonicFill system's composite incorporates a highly filled proprietary resin with special rheological modifiers that react to sonic energy. As sonic energy with specific amplitude is applied through the handpiece, the modifier causes the viscosity to drop (up to 87%), increasing the flowability of the composite, enabling quick placement and precise adaptation to the cavity walls. When the sonic energy is stopped, the composite returns to a more viscous, non-slumping state that is perfect for carving and contouring.

Little information is available about depth of cure and polymerization shrinkage of SonicFill composite which needs to be validated by doing more researches.

* Kerr, USA.

REVIEW OF LITERATURE

Review of Literature

1. Resin based composites (RBCs):

1.1. Composition of RBCs:

Dental resin composites can be distinguished by differences in formulations tailored to their particular requirements as restoratives, sealants, cements and provisional materials as well. These materials are similar in that they are all composed of a polymeric matrix; typically a dimethacrylate, reinforcing fillers; typically made from radiopaque glass, a silane coupling agent for binding the fillers to the matrix, and chemicals that promote or modulate the polymerization reaction [(5)].

The most common matrix monomers are aromatic dimethacrylates. The double bonds at each end of these molecules undergo addition polymerization by free-radical initiation. Although these monomers can provide optimum optical, mechanical, and clinical properties, they are rather viscous and have to be blended with low molecular- weight diluent monomers so that a clinically workable consistency may be obtained upon incorporation of the fillers. More recently low-shrinkage composites have been introduced that contain, for example, monomers with epoxy (also known as oxirane) functional groups at the ends. The polymerization of these monomers is initiated by cations. Other commercial resin composites utilize various monomers and filler technology to reduce polymerization shrinkage and consequently the shrinkage stresses [6].

The vast majority of monomers used for the resin matrix are dimethacrylate compounds. Two monomers that have been commonly used are bisphenol A glycidyl methacrylate (Bis-GMA) and urethane dimethacrylate (UDMA). Both contain reactive carbon double bonds at each end that can undergo addition polymerization initiated by free-radical initiators. The use of aromatic groups affords a good match of refractive index with the radiopaque glasses and thus provides better overall optical properties of the composites. Few products use both Bis-GMA and UDMA monomers [7].

The viscosity of the monomers, especially Bis-GMA, is rather high and diluents must be added, so a clinical consistency can be reached when the resin mixture is compounded with the fillers. Low molecular-weight compounds with difunctional carbon double bonds, for example, triethylene glycol dimethacrylate (TEGDMA), are