

The Effect of Filler Loading and Packing Technique on Physical Properties and Nanoleakage of Different Composite Formulations

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Dedication

To my beloved family....

All my love and gratitude.

Thank you unconditionally.

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All my gratitude to my professor, advisor, role-model; **Professor Dr. Mokhtar Nagy**. You had always been and always will be an example to follow. I will try to follow your lead. May God rest your kind soul.

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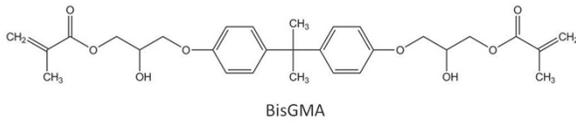
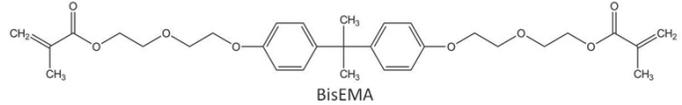
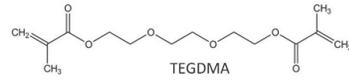
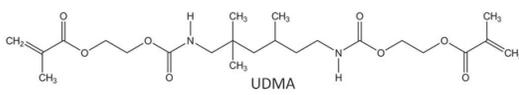
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List of Abbreviations

Acronym	Synonym
Bis-GMA	Bisphenol A glycidyl Methacrylate
 <p style="text-align: center;">BisGMA</p>	
Bis-EMA	Ethoxylated Bisphenol A dimethacrylate
 <p style="text-align: center;">BisEMA</p>	
TEGDMA	Triethyleneglycol dimethacrylate
 <p style="text-align: center;">TEGDMA</p>	
UDMA	Urethane dimethacrylate
 <p style="text-align: center;">UDMA</p>	
Silane	γ -methacryloxypropyl-triethoxysilane
TCD urethane	Tricyclodecane-urethane dimethacrylate
CQ	Camphorquinone
BHT	2,6-Di-tert-butyl-4-methyl- phenol
TMPTMA	Trimethylolpropane trimethacrylate.
PEGDMA	Polyethylene Glycol Dimethacrylate
HEMA	2-hydroxylethyl methacrylate

Introduction

Direct resin composite restorations are currently one of the most prevalent medical interventions in the human body worldwide ¹. It was estimated that more than five hundred million composite restorations are placed annually around the world ². The versatility of resin composite material is continuously growing since their introduction to the dental market in the 1950's ^{3,4}. As a result, an increasingly greater demand to improve and develop these materials continue to date ³. Recently, nano-technology was incorporated into dental materials industries ⁵. This includes incorporation of nanoparticles and nanoclusters as fillers into chemical composition of some resin composite materials ⁶. Eighth generation adhesives also incorporated nanofillers into their chemical structure ⁶.

Maturation of resin composite materials before putting them into function involves polymerization reaction ^{7, 5, 4}. Polymerization of resin composite materials occurs by conversion of monomer molecules into a complex polymeric network, which defines the material degree of conversion. This reaction is accompanied by formation of shorter covalent bonds in place of longer and weaker Van der Waals forces ^{5, 2}. Consequently, volumetric contraction inevitably occurs within the bulk of the material ⁵. Moreover, a rapid rise in the material elastic modulus occurs. As a result, the stiff material is not allowed to compensate for the volumetric shrinkage, especially when bonded to and restrained between cavity walls, leading to increased stress levels within the material ⁸.

Filler loading is a strong factor affecting the resin composite elastic modulus. Therefore, it affects the ability of the material to flow and relief stresses, thus, it affects the amount of polymerization shrinkage stresses within the material.