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Polymerization Shrinkage Stress of Bulk-Filling, Nano- and Microhybrid-Composites

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Introduction:

Bulk-filling and nano-composites are new generations of composite materials and both claim to show less polymerization shrinkage. Because of this special property they either allow the use of bulk-filling technique and are so time-saving for the dentist (bulk-filling composites) or improve the quality and longevity of composite restorations (nano-composites). The reduced polymerization shrinkage of these new types of composites is mainly presented as a result of volumetric shrinkage in %. It should be noted, that polymerization shrinkage stress (which is measured in MPa and is the result of the product of shrinkage and E Modulus) is clinically more relevant as it affects the bonded interface to the tooth structure.

Objectives:

Nano-composites and bulk-filling composites claim to have low polymerization shrinkage and therefore to be superior to microhybrid-composites. The purpose of this study was to determine and compare polymerization shrinkage stress, which is clinically more relevant, of different bulk-filling, nano- and microhybrid-composites.

Methods:

The bulk-filling/nano-/microhybrid-composites tested were: x-tra fil U (XF) (Voco) and Quixfil U (QF) (Dentsply)/ Filtek Supreme XT A2 (FS) (3M ESPE) and Grandio A2 (GR) (Voco)/ Spectrum TPH3 A2 (TPH) (Dentsply), Filtek Z250 A2 (Z250) (3M ESPE) and KRIS A3 (KR) (Heraeus Kulzer), a chemically improved Charisma®-update and which will be launched as Charisma Opal in autumn 2008. To determine polymerization shrinkage stress, cylindrical cavities (∅ 4mm) were prepared in Araldit B epoxy resin plates (40x40x4mm) and pretreated with the Rocatec system (3M ESPE) to ensure bonding of the resin composites. The resin composite specimens (n=10) were exposed to light for 60s with a QTH curing device (Translux Energy, Heraeus Kulzer). The samples were stored dark and dry (23°C) during the first hour and after that in distilled water (37°C). Polymerization shrinkage stress data (MPa) 1h and 24h post exposure were calculated based on the diameter of the isochromatic curves of first order, obtained from the Araldit plates. Data was statistically analyzed with ANOVA (p≤0.05, LSD adjustment).

Figures 1 a/b/c: Preparation of the sample and measurement of shrinking force with polarized light.

Results:

Mean values for shrinkage stress in MPa

		after 1h	after 24 h
bulk-filling composites	x-tra fil U	3,97^{A}	4,91^{b,c}
	Quixfil U	4,33^{B}	5,04^{c}
nano-composites	Filtek Supreme XT A2	4,02^{A}	4,23^{a}
	Grandio A2	4,73^{D}	5,69^{e}
microhybrid-composites	Spectrum TPH3 A2	4,92^{E}	5,48^{d}
	Filtek Z250 A2	4,53^{C}	4,96^{b,c}
	KRIS A3	3,95^{A}	4,84^{b}

Letters indicate statistical significance (p≤0.05).

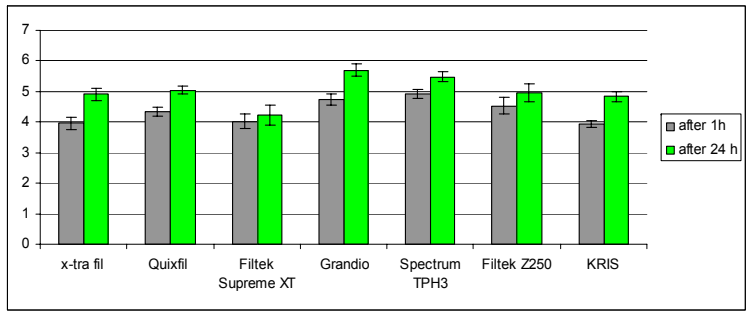

Figure 2: Mean values for shrinkage stress in MPA after 1h and 24h with standard deviation.

Conclusions:

Within the limits of this study, there were significant differences in polymerization shrinkage stress after 1h and 24h between all composites tested whereas bulk-filling and nano-composites did not necessarily show the best results. The nano-composite Filtek Supreme XT showed the best results after 24h, but Grandio and the bulk-filling materials only showed equivalent or even worse results than the microhybrid-composites Filtek Z250 and KRIS/Charisma Opal.

References:

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