Assessment of Re-mineralising Dental Composites Through ISO Testing

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Objectives:

The aims of this study were to assess light curing re-mineralising dental composites according to ISO standards. The effect of reactive calcium phosphate on polymer based composites was measured through their flexural strength, and other physical & chemical properties.

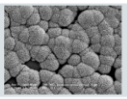
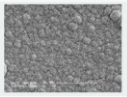
Methods:

Composites containing 10 and 20 wt.% calcium phosphate (CaP) (1:1 weight ratio of mono-calcium phosphate and β-tri-calcium phosphate) were prepared. Flexural strength, depth of cure, water sorption, and solubility were tested according to ISO 4049:2009. Polymerisation shrinkage was measured as volume change before and after curing. Re-mineralising property was assessed by formation of hydroxyapatite (HA) precipitated on the surface of the composite through observation of scanning electron microscope (SEM) and the thickness was quantified through Raman spectroscope.

Results:

The results shown in table 1 demonstrate that water sorption, solubility, and flexural strength of the composites depend on CaP content. Comparison between water sorption in water and simulated body fluid (SBF) was made and both formulations absorb more water in SBF than in H_2O. The 20 wt.% CaP Composite dissolves more in H_2O than in SBF, while solubility of 10 wt.% CaP composite has negative value in both medium. As the monomer conversions are high in both composites, the solubility would reflect the dissolution of CaP rather than monomers.

Table 1: Assessment results

	Flexural strength (MPa)	Depth of curing (mm)	Water sorption (μg/mm^3)	Solubility (μg/mm^3)	Polymerisation shrinkage (vol.%)	Monomer conversion (%)	HA precipitation
10 wt.% CaP	88.1 105.1 109.7 123.5 125.3	2.06	16.7 (H_2O) 18.4 (SBF)	-2.2 (H_2O) -3.9 (SBF)	2.1	90	
20 wt.% CaP	80.9 82.2 83.3 83.3 106.0	2.00	28.7 (H_2O) 38.2 (SBF)	2.2 (H_2O) 0.24 (SBF)	1.9	84	

The HA layer precipitated on the surface after 7 days soaking in SBF confirms the re-mineralisation property of the composites. The layer formed on 20 wt.% CaP composite is denser and thicker than that on 10 wt.% CaP composite.

Conclusions:

The water sorption and solubility test according to current ISO standard has limitations. The results can only be understood with the aid of SEM and Raman spectroscopy especially for re-mineralising composites.