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High strength, antibacterial releasing dental composites with re-mineralising and adhesive potential

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Abstract

Problems with dental composite restorations can include toxicity and or insufficient strength due to low monomer conversion (~50%). Furthermore, complex dentine adhesion processes,high polymerisation shrinkageand low toughness can lead to bond failure, bacterial microleakage and dentine demineralisation. The study aim was therefore development ofhigh strength dental composites using flexible high molecular weight methacrylate dental monomers and high glass filler content to increase conversion and reduce shrinkage. The glass particles were then partially replaced by glass fibresto improve toughness, chlorhexidine (CHX) to provide antibacterial actionand an adhesive monomer (PMDM) for dentine bonding. Monoand tri calcium phosphate (CaP) was also included. In the bulk these may react with absorbed water increasing volume to counteract shrinkage but at the surface remineralise carious dentine.
From FTIR studies,the base compositemonomer conversion was~70%. Flexural strength at 180MPa was also comparable with the highest strength commercial dental composites. Fibres added up to20wt%significantly improved toughness without reducing strength. 5wt% PMDM had no detrimental effect on strength. High strength (above 150 MPa) could also be maintained provided CaP and CHX levels were at or below 20 and 5 wt% respectively. 20 wt% CaP enabled sufficient expansion to balance polymerisation shrinkage. High PMDM levels could inhibit CHX release but CaP enhanced release. Noveltough, high strength, antibacterial – releasing dental composites have therefore been produced that arepotentially also remineralising and self - adhesive to dentine.

Biography

AnasAljabo gained anMSc in dental materials from Queen Mary, University of Londonin 2010 after a degree in dental technology. He is currently in the second year of his PhD at UCL Eastman Dental Institute under the supervision of Dr. Anne Young. Dr.Young is a Reader in Biomaterials. Her research group consists of 11postgraduate students whose studies cover various aspects ofthe materials described above including their chemistry, mechanical properties and adhesion, biocompatibility, microbiological activityand clinical application.