1618 Hertzian indentation testing of filler-reinforced glass-ionomer cement

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Glass-ionomer cement (GIC) has found a useful niche in dentistry due to its adhesive properties and reasonable mimicry of tooth appearance. However, for fundamental reasons its strength and wear-resistance are inadequate for its service in occlusal load-bearing contexts. Attempts have been made to overcome this by including a secondary filler of silver or zirconia, with some claims of improvement. Theory (filler bonding, crack path, volume fractions and chemistry) suggests otherwise. Hertzian indentation (ball on disc) testing (HIT) has been shown to provide a good simulation of clinical occlusal loading conditions (Dong & Darvell, J Dent Res 2002; Wang & Darvell, J Dent Res 2003, 2005), whereas compressive strength and diametral compression tests have problems (Darvell, J Mater Sci, 1990). ***Objectives:*** Using HIT, examine claims of filler-reinforcement of GIC. ***Methods:*** Discs 10 mm diameter, 2 mm thick, 8 ~ 18 replicates, were prepared for Ketac Silver (3M-Espe, Germany), Amalgomer CR (Advanced Healthcare, UK), four unmodified GICs, and four resin-modified GICs (RMGIC), with an amalgam and a filled resin for comparison. These were tested at 23°C after 7d at 37°C in artificial saliva at pH 6, using a 20mm diameter ball at 0.2 mm/min. First failure was detected acoustically, mode was determined visually; at least one-third of each set were examined under SEM for corroboration. ***Results:*** Reinforced and unmodified GICs were not distinguishable by failure load (1-way AoV, P = 0.425; overall 270 ± 60 N), or cracking mode. Failure loads for resin-modified GICs were 360 - 1150 N; amalgam ~680 N, filled resin ~1200 N. RMGICs tended to be tougher (incomplete fracture); all others gave complete fracture (radial cracking). The stronger materials (2 RMGICs, filled resin) showed some cone cracking. ***Conclusions:*** While RMGICs showed variable improvement, consistent with the hybrid chemistry, filler-reinforcement was not evident, in keeping with structural and theoretical expectations.

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