DETECTING DEBONDING IN COMPOSITE RESTORATION USING DIC-MEASURED SHRINKAGE DISPLACEMENT

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ABSTRACT: Objectives: Polymerization shrinkage of dental composites results in distortion of the restoration and internal stress that can cause debonding at the resin–tooth interface. Mechanics of materials indicates that debonding at the cavity floor, which cannot be readily detected from assessment of the occlusal margins, would halve the shrinkage displacement at the occlusal surface. The aim of this study is to compare occlusal displacements in model Class-II composite restorations with or without cavity floor debonding using Digital Image Correlation (DIC).

Methods: A commercial dental composite (Z100TM) and bonding system (AdperTM Single Bond Plus) were used to restore 2 groups of 5 model Class-II cavities (8-mm long, 4-mm wide and 4-mm deep) in aluminum blocks. Group I had the restorations bonded to all cavity surfaces, while Group II had the restorations not bonded to the cavity floor to simulate debonding. One of the proximal surfaces of each specimen was sprayed with fine carbon powder to facilitate surface displacement measurement. The restorations were cured from the top for 100 s using an Elipar Freelight operated at 1200 mW/cm². Images of the speckled surface were taken before and 10 minutes after curing for displacement calculation using DIC.

Results: Group I showed a maximum occlusal displacement of 34.7±6.7 microns and a center of contraction near the cavity floor. Group II shrank more towards its geometric center and showed a maximum occlusal displacement of 21.3±3.4 microns. The difference between the two groups was statistically significant (p-value = 0.0007). The theoretical shrinkage displacement, based on a volumetric shrinkage strain of 2.5%, was 33.3 and 16.7 microns for the two groups. The higher experimental displacements were probably caused by slumping of the composite.

Conclusions: The hypothesis that the occlusal shrinkage displacement of a composite restoration was reduced significantly by pulpal floor debonding was confirmed.

References