♦03

Microfocus X-ray CT Analysis of Shrinking Direction in Resin Composite.

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Objectives: The aim of the study was to determine the direction and the rate of polymerization shrinkage of light-cured resin composite. Materials and Methods: A microfocus x-ray CT (computed tomography) instrument (SMX-255CT, Shimadzu Co., Kyoto, Japan) was used to analyze and characterize the pre- and post- gel phases. A microfocus x-ray tube was used to enable a focus dimension of 4 microns. Experimental resin composite (Tokuyama Co., Tokyo, Japan) containing spherical particles of zirconium oxide (average particle size of 60 microns in diameter), was used as a contrast medium. The resin mold, 6mm in depth and 4mm in diameter, was filled with the experimental resin paste to prepare a cylindrical specimen. The specimen was rotated at the point between an x-ray tube and a detector to acquire fluoroscopic images from every direction. The displacement of the radiopaque particles between before and after polymerization was determined on the same slice phase. Results: The displacement of filler particles on the central axis directed to the subsurface area (1.4-1.5mm from the surface) and was larger in the bottom layer than in the top layer. The polymerization shrinkage in the top layer was 0.13%, and 3.10% for the bottom layer. The particles in the cavity wall side did not move to the same range of the particles on the central axis, but to the central axis. Discussion and Conclusion: It should be important to think about the gel point for a reason why the filler displacement did not direct to the same area depending on the location of the filler particles in resin composite. The gel point should move from the top to the bottom area with time and the direction of polymerization shrinkage should be altered depending on the movement of the gel point Conclusion: The microfocus x-ray CT system was available for the evaluation of shrinking direction and rate in resin composite. The light cured resin composite does not shrink toward the exposed surface, and the shrinking direction depends on the location in resin composite. Supported by Grant-in-aid for Scientific Research No. 12307043 from the Japan Society for the Promotion of Science.

♦04

Effects of filler addition to bonding agents on shear bond strength

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Objectives Fanning et al. (1995) suggested that the incorporation of filler particles into a system's adhesive could increase the shear bond strength by improving the mechanical properties. In this study, shear bond strengths of experimental filled adhesives with varying filler levels were tested to determine the optimal filler level. The diametrile tensile strength and thickness of each experimental adhesive were also examined to evaluate if there is a relation between shear bond strength and mechanical properties of adhesive. Materials and methods For shear bond strength measurement, the experimental adhesives (Vericom, Korea) with 0,5, 10, 15, 20, 30, 45wt% of 1㎛ Barium glass fillers were produced. Cylinder-shaped specimens with 4mm diameter and 2mm height over exposed occlusal dentin were subjected to universal testing machine at cross head speed of 0.5mm/min until failure occurred. They were examined under optical microscope of 40x to define whether the failure was cohesive or adhesive. Cylinder-shaped specimens with 4mm diameter and 6mm height were formed for diametrile tensile strength measurement. They were loaded in compression to failure in a universal testing machine at cross head speed of 1mm/min. The results were analyzed by Kruskal-Wallis test, and then subjected to Mann-Whitney test. For adhesive thickness measurement, five Specimens in each group were prepared in a same manner in shear bond strength tests. The specimens were observed under scanning electron microscope of 1000x and the thickness of adhesive layer was measured ten times at random position in each specimen using Sigma scan image version 2.0. Results Filler level had a statistically significant influence on shear bond strength ($p<0.05$). In Mann-Whitney test, significant differences in shear bond strength between 5, 10, 15, 20% filled groups are found. The maximum shear bond strength (19.9 ± 1.38 Mpa) was obtained when 15% filler was added to the bonding agent. When fillers are added more than 20wt%, bond strengths were gradually decreased with increasing filler level. The diametrile tensile strengths for the experimental adhesives were slightly increased with increasing filer levels in 0, 5, 10, 15, 20% filled groups but, showed no significant differences ($p>0.05$). But, the diametrile tensile strengths were significantly decreased in experimental adhesives with over 30% filler levels ($p<0.05$).

A relation between shear bond strength and diametrile tensile strength was denied by Pearson's correlation coefficient. In the SEM