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## Shrinkage stress – University of Mainz, Germany Investigation of shrinkage stress.

Because of the bonding to the cavity walls and the shrinking of the resin, a certain stress develops in the system tooth, adhesive layer and composite during polymerisation<sup>1</sup>. This stress is also described as shrinkage stress, polymerisation stress or contraction stress. High stress values can lead to failure of bond formation with the surrounding tooth structure<sup>2</sup>. Several variables like the elasticity of a composite or adhesive, the rheology during curing, light curing or the type of monomer, influence the development of this stress. This explains why low shrinkage is not seen as the only important property of a dental composite. More important are factors which help to reduce shrinkage stress<sup>3</sup>. So a low degree of volume loss and shrinkage stress help improve marginal adaptation, thus minimising the risk of a loss of retention, secondary caries, marginal staining, deterioration and hypersensitivity<sup>4</sup>. And this, in turn, contributes to the longevity of composite fillings.

The following study of the University of Mainz, Germany, confirms the excellent low shrinkage stress behaviour of Venus Bulk Fill, Venus Diamond and Venus Pearl.

Giving a hand to oral health.

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### Objective

Objective of this study was to evaluate the polymerisation contraction stress of different composites.

### Materials and Methods

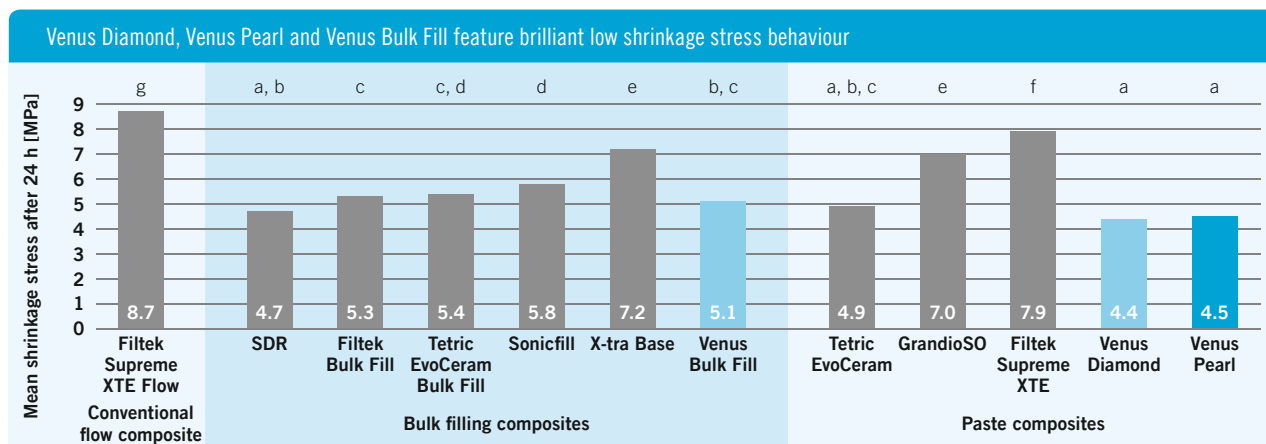
Stress free prepared cylindrical cavities (4 mm diameter, n=10/composite) in Araldit B epoxide resin plates (40x40x4 mm) were silanised at the inner surfaces using the Rocatec system (3M ESPE) without blasting the top and bottom surfaces. Afterwards a silane (Espe-sil, 3M ESPE) was applied in these inner surfaces followed by a bonding application (Visio-Bond, 3M ESPE). Light polymerisation was done by a light curing unit (Elipar S10 – 3M ESPE, 20 seconds).

The test composites (Venus Pearl, Venus Diamond, Venus Bulk Fill – Heraeus Kulzer; Filtek Supreme XTE, Filtek Supreme XTE Flow, Filtek Bulk Fill – 3M ESPE; Tetric EvoCeram, Tetric EvoCeram Bulk Fill – Ivoclar Vivadent; GrandioSO, X-tra base – VOCO; Sonicfill – Kerr; SDR – Dentsply) were filled into these cavities and light cured with the same light curing unit for 2x20 s. Specimens were stored in the dark and dry (23 °C). The specimens were then evaluated under polarised light.

Polymerisation shrinkage stress (in MPa) was calculated based on the diameter and localisation of the first order of the isochromatic curve 24 hours after curing.

For statistical analysis Wilcoxon tests followed by Bonferroni correction were performed ( $p < 0.0006$ ).

### Results



Statistical tests revealed significant differences between materials. Same superscript letters show no significant differences between materials.

### Conclusion

Venus Diamond and Venus Pearl exhibit lowest shrinkage stress in this test. Venus Pearl, Venus Diamond, SDR and Tetric EvoCeram are on the same level of statistical significance after 24 h. Shrinkage stress of Venus Bulk Fill was on the same low level as SDR, Filtek Bulk Fill and Tetric EvoCeram Bulk Fill.

### Source

Ernst CP: Investigation of shrinkage stress of Venus Pearl. Test report December 2012. Unpublished data. Data on file. The study was abbreviated and summarised and all diagrams and titles have been established by Heraeus Kulzer.

<sup>1</sup> Braga RR, Ferracane JL: Contraction stress related to degree of conversion and reaction kinetics. Dent Res. 2002 Feb; 81(2):114-8.

<sup>2</sup> Koplin C, Jaeger R, Hahn P: Kinetic model for the coupled volumetric and thermal behavior of dental composites. Dent Mater. 2008 Aug; 24(8):1017-24.11

<sup>3</sup> Tandbirojn D, Versluis A, Pintado MR, DeLong R, Douglas WH: Tooth deformation patterns in molars after composite restoration. Dent Mater 20 (6), 2004:535-542.

<sup>4</sup> Kurokawa R, Finger WJ, Hoffmann M, Endo T, Kanehira M, Komatsu M, Manabe A. Interactions of self-etch adhesives with resin composites. J Dent 2007; 35: 923-9.