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Comparing Methods for Bond Strength Evaluation of Fiber Posts

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Objectives To assess the differences in measured bond strength of adhesively cemented fiber posts using pull-out and push-out tests.

Methods Three different fiber posts were luted with their respective bonding systems: 1) Futurabond U with Rebuilda DC (Voco, Cuxhaven, Germany), 2) LuxaBond Universal with LuxaCore Z dual (DMG, Hamburg, Germany) and 3) control: RelyX Unicem 2 (3M, Minnesota, USA). After post cementation, push-out samples were each sawed into 3 discs (thickness 1 mm) from the coronal, middle and apical roots third, while pull-out samples were embedded as a whole into a trigger hook for the universal testing machine. Following testing, fracture patterns were analysed using high-resolution digital microscopy. For each group additional samples were scanned using computed tomography (μ CT) and void formation was investigated using CTVox software (Bruker, Billerica, USA). Statistical analysis was conducted using UNIANOVA with Tukey tests and Chi-Square tests; significance level $p < 0.05$.

Results Pull-out samples bonded with Futurabond U ($11.37 \text{ MPa} \pm 2.0$) revealed significantly higher bond strength compared to LuxaBond Universal ($9.18 \text{ MPa} \pm 2.2$) and RelyX Unicem 2 ($9.28 \text{ MPa} \pm 1.6$), both $p = 0.03$; Tukey. Push-out samples revealed significantly higher bond strength for LuxaBond Universal ($23.6 \text{ MPa} \pm 1.8$) compared to Futurabond U ($14.7 \text{ MPa} \pm 1.3$; $p = 0.000$) with no significant difference to RelyX Unicem 2 ($18.2 \text{ MPa} \pm 0.2$; $p = 0.087$; Tukey). In both pull-out ($p = 0.006$) and push-out ($p = 0.000$; Chi-Square) samples, failure modes were significantly influenced by the material. Pull-out samples revealed more fractures at the fiber post surface, while push-out samples revealed a variety of fracture patterns. Voids did not have a significant influence on bond strength for either test ($p = 0.860/0.965$; Chi-Square).

Conclusions The test method seems to influence bond strength values and fracture patterns of adhesively luted fiber posts.