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Relationship between laboratory bond strengths and clinical performance of dentin adhesives

Q Can we assume that dentin adhesives with high bond strengths guarantee a better clinical performance?

A Bond strength tests are the most common method to evaluate the quality of the adhesive bond simply because they are simple to perform. We can see endless publications on bond strengths of dentin adhesives. We should note that most of the bond strength tests in the literature use an extremely simplified design: a flat, polished, and homogeneous bonding area. Such a design of bonding area may be substantially different from prepared cavities to be bonded in dental practice.

The papers on dental bonding report the values in megapascals (MPa) because the 'bond strength' is defined as the load needed to break a bond divided by the cross-sectional area of the bonding interface. However, this unit 'MPa' may be unfamiliar to many dental clinicians. Let's assume that a dentin adhesive produced a dentin bond strength of 20 MPa. Then, 20 MPa = 20 x 10^6 Pa = 20 N/10^{-6} m^2 = approximately 2 kgf/mm^2. Although the shear bond strength test is simpler than the tensile bond strength test, the former has a limitation of measuring the cohesive strength of the adherend (or sometimes substrate) rather than the true bond strength of the bonding interface. Therefore, the shear bond strength test does not simulate the clinical mode of failure, which is mainly adhesive failure. When the main failure mode is cohesive in a bond strength test, the bond strength values have no definite clinical meaning.

In scientific papers on bonding, we judge that a bond strength value is significantly different from another by the p value. According to a 'Michelin Guide' scale, we can find various signfincances: signfincant ($p < 0.05$), highly signfincant ($p < 0.01$), and extremlely signfincant ($p < 0.001$). However, the term statistically 'significant' has just a simple meaning. When the p value is less than a preset threshold value alpha (commonly 0.05), it doesn't matter whether the p value is very close to alpha or far away. If adhesive A (16 MPa) showed an extremely significantly ($p < 0.0001$) higher bond strength value than adhesive B (14 MPa), does this finding indicate that adhesive A is extremely superior to adhesive B in a clinical bonding performance? Not at all! Do not forget that the p value is greatly dependent on the sample size.

Although *in vitro* studies attempt to mimic clinical situations, clinical trials are considered the ultimate way to provide evidences on the clinical effectiveness of restorative materials. We can infer if an adhesive is truly reliable for routine clinical work from *in vivo* studies in which all possible aging factors act simultaneously. Therefore, when we read a paper regarding dentin bonding, we should try to think what the bond strength says in the context of dentin bonding rather than simply read the value itself.

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