



## Letter to the Editors

Through the years, numerous articles dealing with dental adhesives have been published in this journal as well as in many others. In reviewing the results, one is struck by the large differences in strength values. Just in the last issue of the *Journal of Adhesive Dentistry* (No. 2, 2008), there were four articles on bond strength values. In one article, the tensile bond strength values were within the 47 to 93 MPa range,<sup>1</sup> while in another article, the tensile bond strength was in the range of 4 to 7 MPa.<sup>2</sup> Even though the products differ, the differences seem unreasonably high. In the other two articles, the shear bond strength values ranged from 1 to 12 MPa,<sup>3</sup> and the push-out strength values ranged from 2 to 5 MPa.<sup>4</sup>

Many explanations can be given for these differences. First of all, in the above examples, different products, test methods, and operators were involved. Other reasons, often neglected when we talk about "bond strength," may also be key explanations. For example, presented bond strength values are seldom the true stress level that causes a crack to grow. Besides, the crack may not even grow at the bonded interface even though a "bond strength" value is reported. The crack may have grown within the composite or the dentin, or within all the different materials forming the adhesive joint. Under such circumstances, it seems obvious that the determined strength values for such failures are not true "bond strength" values and should not be included in the final analysis, because they are simply strength values of the different materials rather than of the bond between an adhesive and a substrate. Unfortunately, many strength values published under bond strength

values are not bond strength values, just strength values of substrates and adhesive resins.

An even bigger problem with the strength test results is that so-called strength values are usually not the true stress values triggering the failures. The triggering stress is usually concentrated at a flaw tip, and when a critical stress level is reached in that region, the crack starts propagating. It's like breaking a glass tube by making a scratch. When one pulls the scratched glass tube it fails at the scratch (flaw) site. The force needed to fracture the scratched glass tube is not representative for the true strength of the glass. By making a scratch, we concentrate a localized stress at the flaw tip, and when the localized stress level reaches the critical stress level at the flaw tip, a crack propagates and causes a failure. In this case, we may agree that it would be incorrect to take the force needed to break the glass tube, divide it by the fracture area, and call it the tensile strength of the glass.

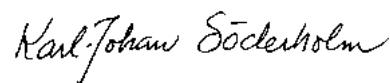
Based on the above arguments, it makes sense to conclude that values presented as "bond strength" values are usually not the true stress levels triggering failures. Rather, it seems that local defects introduced during bonding and sample preparation will often act as local stress concentrators and trigger failures. Technique sensitivity and variation in test results can be explained by taking a fracture mechanical approach. Because of these considerations, it seems reasonable to suggest that future adhesive studies should focus on fracture mechanical aspects rather than determining overall strength values. However, even if we approach testing from a fracture mechani-

cal point of view, it is important to realize and accept that we do not yet have strong evidence correlating clinical success with any particular adhesive test method. Because of this lack, in vitro tests should not be used as predictors of clinical performance until we have such evidence. It is only when we have reliable correlations between in vitro test results and clinical performance that such methods will have true practical meaning.

Considering what has been argued above, there seems to be a need to resolve the bond testing issue by organizing a symposium focusing on adhesive testing and clinical evidence supporting particular tests. We need to reach some kind of consensus when it comes to getting results that make sense for the dental community. Many individuals have built their careers on adhesion testing, and it seems important to include their views on this topic, even though they may not be working in the dentin adhesive field. By including individuals from other fields with a basic understanding of adhesion testing and asking them to critically look at our testing procedures and give advice about directions we should take, I strongly believe we as a profession could benefit greatly. By also including clinicians, who have performed in vivo testing, we may be able to identify something useful by bridging gaps in this field. In other words, to progress further in the field of adhesive dentistry, it seems quite important to develop some kind of consensus regarding adhesive testing and its use in dentistry. To achieve such a goal, it would be much appreciated if you, who are reading this editorial, could give some feedback about whether or not you would be interested in participating in such

a symposium as a listener or presenter, and if there are any specific topics related to adhesion testing you would like to see addressed during such a symposium. It would also be most encouraging to get a commitment from the editor and publisher of this journal, in which they express their support for such a symposium. This support could include publishing the content presented at that symposium in a future issue of the *Journal of Adhesive Dentistry*.

Sincerely,



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## REFERENCES

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