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COMMENTARY

EFFECT OF RESIN LINERS AND PHOTOACTIVATION METHODS ON THE SHRINKAGE STRESS OF A RESIN COMPOSITE

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This study evaluated the effects of two clinically relevant methods for reducing the potentially deleterious contraction stresses generated in dental composite restorative materials during photopolymerization. The use of low elastic modulus liners and modifying the method of light application have previously been shown to be beneficial for reducing stresses. However, the results of previous and the current study point to the complex nature of this problem and the difficulty encountered when trying to make generalized statements about the potential benefits of these different methods. The reader should be made aware of the difficulty in assigning clinical relevance to the values of stress reported in these types of studies as the results are highly variable and largely dependent upon the testing setup.

In the current study, one brand of flowable liner (Protect Liner F) was shown to be more effective than a single layer of unfilled adhesive (Scotchbond Multipurpose) but equivalent to three coats of adhesive resin in terms of reducing the contraction stress of a dental composite (Filtek Z250). This result is consistent with previous work reported by Choi and colleagues, in which the contraction stress of a composite was shown to be reduced as the number of adhesive layers was increased.[1] This stress-relieving phenomenon has further been explored by Ausiello and colleagues using three-dimensional finite element analysis.[2] The numeric analysis showed that the use of several layers of higher elastic modulus material as a liner can have the same effect as a thinner layer of very low elastic modulus in terms of reducing

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stress generation in the contracting composite restorative. Furthermore, they suggested an optimum relationship between the thickness of the liner and its stiffness to both reduce stress and enhance the marginal integrity of the bonded restoration. This relationship was also emphasized in the current study in which multiple debonding events occurred during the tests with one and three layers of adhesive but not at all with the flowable liner. Thus, as explained by the authors of the present study, it is likely that the beneficial effect of the flowable composite chosen for testing is due to two factors: the low elastic modulus of this lightly filled material and its thickness (0.7 mm), which would equate to 4 to 5 coats of unfilled bonding resin as a liner.

It should be noted, however, that the same result cannot be expected from every flowable composite owing to differences in filler content and rigidity. In a previous study, the effect of a flowable composite liner on the polymerization contraction stress of a dental composite was only shown to be effective for one of four materials tested.[3] The reason for the lack of beneficial effect for three of the four flowable composites was related to differences in their composition that affected their stiffness and stress-relieving ability.

The second method attempted in this study to reduce composite contraction stress was to modify the light-curing method using a soft-start mode, but the effect was not significant. The lack of benefit of the soft-start method may be due to the type of composite chosen—Z250, which is considered a very reactive composite and may not be amenable to slowing of the polymerization reaction to a significant extent. However, it is also possible that the initial irradiance of 150 mW/cm^2 chosen in this study was too high during the first curing stage, thus minimizing the possibility for extensive composite flow to relieve stresses during the second light application (ie, significant curing occurred throughout the composite during the first exposure). The experimental method of an intermittent light-curing method using an experimentally modified curing unit did produce reduced stress in this study, but this was explained by a reduced degree of cure and therefore less shrinkage and likely a lower elastic modulus of the contracting composite. Thus, this method may not be clinically acceptable. The results of this study therefore confirm those of previous authors and further demonstrate the complex and material/device-specific nature of contraction stress relief for dental composites.

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