The purpose of this study was to assess the reduction in polymerization contraction stress of two resin composites during a two-step light-activation process. The authors measured the composites' polymerization stress using a servohydraulic machine and their shrinkage using a mercury dilatometer. The degree of conversion of the resin's double bonds was also measured using spectroscopy. Three composites were tested: Herculite (SDS/Kerr), Heliomolar (Ivoclar Vivadent), and Z100 (3M ESPE). Two light-activation procedures were used for curing each composite. The first technique used a 60-second continuous light exposure at 330 mW/cm$^2$, while the second used a two-step technique involving an initial 5-second exposure at 60 mW/cm$^2$ followed (after a two-minute waiting period) by a 60-second exposure at 330 mW/cm$^2$. The influence of varying thicknesses of composite was also assessed but only with Herculite. The authors found that using the two-step light-activation technique significantly reduced the polymerization stress compared to the continuous technique. The percentage reduction ranged from 19.0% for Z100 to 29.7% for Heliomolar. Total volumetric shrinkage and degree of conversion were not significantly affected for any of the composites by the light-activation techniques.

DIS Comment: Although resin composites have functioned well clinically for many years, one of their shortcomings is that they shrink when polymerized. This creates polymerization stress in a restoration that can disrupt the marginal integrity between the resin and tooth structure. The loss of marginal integrity could conceivably result in microleakage and its associated problems of post-treatment sensitivity, marginal staining, and recurrent caries. To minimize this disruption, some manufacturers have marketed quartz-tungsten-halogen (QTH) light-curing units that use a "soft-start" method of curing the resin. Although there are several types of "soft-start" light curing, the one that this study is based on is called "pulse-delay cure." Bisco has marketed the VIP (Variable Intensity Polymerizer) light unit which employs this technique (see DIS 60-11). It initially emits low-intensity light (200 mW/cm$^2$) for 3 seconds and then, after a 3-minute waiting period, emits high-intensity light (600 mW/cm$^2$) for 30 seconds. It is believed that this reduces stress in the restoration and helps maintain the integrity of the restoration/tooth interface. This study found that polymerization stress was, in fact, reduced when this type of protocol was followed. Importantly, the authors also reported that the degree of conversion, which is an indicator of how well the resin has cured, was not adversely affected. This means that the resin’s physical properties such as strength and rigidity should not be reduced. Of course, as with all laboratory research, these findings will have to be tested in the clinical environment to determine if such light-curing techniques yield meaningful benefits. But at least it gives credence to the theory behind some types of "soft-start" polymerization lights.