COMMENTARY

SHEAR BOND STRENGTH WITH INCREASING LIGHT-GUIDE DISTANCE FROM DENTIN

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Cusp heights and proximal box depths often dictate the minimum distance between the light guide and the irradiated gingival seat in a Class II preparation. This study stresses the need to increase the exposure time several fold to compensate for the decreased radiant incidence at a distant irradiated surface. Equivalent shear bond strengths were obtained when the product of the exposure time and radiant incidence (power received per unit area) resulted in a radiant exposure equivalent to that for the control (0 mm and 20 s exposure). Radiant incidence is a function of distance and the collimation of the specific light guide and/or curing light. Although the irradiance of curing lights is typically measured with a radiometer in contact with the distal end of the light guide (0.0 mm), most clinical situations dictate that the light guide be positioned several millimeters from the material to be polymerized. The internal surfaces of cavity preparations of all classifications, not just Class II preparations with deep proximal boxes, are at a distance from the light guide as external tooth surfaces, matrices, or rubber dam clamps dictate the minimum distance to the irradiated surface. Since radiant incidence varies between lights and even between light guides with the same light,[1] it would be useful if manufacturers published radiant incidence values for clinically relevant distances.

In addition to concerns regarding distance, other clinical conditions are rarely as favorable as in the laboratory setting, where the central axis of the light guide and composite surfaces are aligned and the distal end of the light guide is perfectly parallel to the irradiated surface. Since power is typically higher in the central portion of the beam, laboratory measurements with perfect central-axis alignment optimize the collection area (measured in square centimeters), which maximizes radiant incidence. It is critical that the clinician center and orient the long axis of the light guide so that it is not blocked by surrounding or adjacent tooth structure(s).

It should be emphasized that an increased exposure time is necessary not only for the adhesive but also for the initial increment of composite. Any subsequent increments of composite located at a distance from the light guide would also benefit from an increased exposure time to compensate for decreased radiant incidence. In this study the initial increment of composite (< 0.5 mm) for those groups with improved shear bond strength (4.6 mm spacer for 40 or 60 s) was also irradiated 40 or 60 seconds. As both the adhesive and the initial layer of composite were subjected to 40- and 60-second exposure time, one might expect the improved conversion of both to contribute to improved shear bond strength, although only the DC of the adhesive was measured experimentally. Conclusions that the shear bond strength was related to the effects exposure duration on the “adhesive” would perhaps more appropriately read “adhesive/initial increment of composite.”

The recommendation for a 40– to 60-second cure time when the gingival floor is 6 to 7 mm below the occlusal floor does not seem to coincide with the 4.6 mm test distance used to generate the data. However, the main point is that a several-fold increase in exposure duration was necessary to compensate for reduced radiant incidence at 4.6 mm so that the radiant exposure and shear bond strength were equivalent to those of the control group (0 mm and two times the manufacturer’s recommended 10 s cure time for the adhesive). The relative role of improved conversion of the adhesive versus the initial increment of composite on shear bond strength needs to evaluated with further studies as both the composite and bonding agent in this study received 40- or 60-second increases in the exposure duration.

This study and commentary have used terminology presented in “A Primer on Radiometry” at the 2004 Portland Composite Symposium.[2]

REFERENCES

1. Price RB, Dérand T, Sedarous M, et al. Effect of distance on the power density from two light guides [Special Issue]. J Esthet Dent 2000;12:318–25.
2. Kirkpatrick SJ. A primer on radiometry. Dent Mat 2005;21:21–6.

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