COMMENTARY

POWER DISTRIBUTION ACROSS THE FACE OF DIFFERENT LIGHT GUIDES AND ITS EFFECT ON COMPOSITE SURFACE MICROHARDNESS

Jack L. Ferracane, PhD*

Using visible light energy as a method for initiating the polymerization of resin dental composites has been a part of dentistry for more than 30 years. The technique is so commonplace that it is taken for granted by most clinicians, educators, and researchers. Yet there is much that remains unknown about this complex interaction between chemistry, physics, mechanics, and materials science. Characteristics of the composite, the light-generating unit, the light guide, the geometry of the cavity preparation, and the behavior of the clinician may all significantly influence curing. This nicely done manuscript sheds light upon one of the little-recognized factors that may affect the quality of the product and, ultimately, the clinical performance of restorations containing light-activated dental composites or cements.

Light distribution varies across the surface of the light guides used for dental curing units, especially the so-called "turbo tips." This variation, quantified by the "top hat factor," affects the hardness of the dental composite both at and below the surface. A high top hat value, approaching 1, suggests a uniform light energy distribution across the entire tip (i.e., a flat profile) whereas a lower value depicts a derby-style, or rounded hat, and a more uneven distribution. The standard guide produced a higher top hat value than the turbo tip guide in this study.

Two very interesting lessons can be learned from this study about this phenomenon. LED lights used with a turbo tip will show a less uniform distribution of light being emitted across the surface of the guide, making it imperative that the guide be placed as close to the surface as possible to minimize the effect. This was emphasized in this study by the fact that the evidence for the nonuniformity was more pronounced at a depth of 2 mm than at the surface. Also, and this is true of the standard guide as well, the composite surface to be exposed should be fully encompassed within the circumference of the guide tip and as close to the center as possible. This is because the light intensity declines as one approaches the edges of the guide tip with both types, but most abruptly for the turbo tip. Second, composite slightly outside the circumference of the tip confines will polymerize. This material will appear to be hard upon probing, but it will be undercured and compromised in terms of its properties. Although it is not studied in this manuscript, it is likely that prolonging the irradiation time would partially or fully offset this limitation.

An obvious question for the clinician is, "What is the clinical relevance of this work?" There is no clinical data available that compares the performance of restorations activated with curing lights having different distributions of energy across their tips. Among all the variables involved in placing a restoration, this is just one of many that would be very difficult to control in a systematic way in a clinical trial. However, this work provides stark evidence that a mechanical property, hardness, which is indicative of the extent of cure in the composite, may be affected by the light guide selection. Because there is laboratory and clinical evidence that the extent of cure can be correlated to performance, such as surface wear,[1] it is logical to expect that clinical performance will be less than optimal if care is not taken to ensure the uniform irradiation and curing of the restoration made of or cemented with a light-activated dental composite.

REFERENCE

1. Ferracane JL, Mitchem JC, Condon JR, Todd R. Wear and marginal breakdown of composites with various degrees of cure. J Dent Res 2007;76:1508–16.

*Professor and chair, Department of Restorative Dentistry, Division Director of Biomaterials and Biomechanics, Oregon Health and Science University, 611 S.W. Campus Drive, Portland, OR 97239

DOI 10.1111/j.1708-8240.2008.00161.x