COMMENTARY

IRRADIANCE UNIFORMITY AND DISTRIBUTION FROM DENTAL LIGHT CURING UNITS

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Dental light curing units are an integral part of the daily practice of dentistry. Understanding the basic concepts of light curing technology and polymerization is critical to producing an adequately cured photo-initiated material. The purpose of this study was to objectively examine the distribution of irradiance from a variety of curing lights and light guides. The authors utilized sophisticated testing equipment to characterize the emitted light. This study significantly refines a technology application introduced to the dental profession recently. With the use of a commercial beam analyzer, the authors accurately evaluated the distribution of power within the curing light beam and provided a more thorough understanding of the variation in polymerization potential among various dental curing lights and light guides. Depending on the type of light or light guide, the distribution of light was found to be inhomogeneous and asymmetrical, which could ultimately affect the curing patterns of a composite resin restorative material. Light emission from curing lights that is minimally divergent vertically and evenly distributed horizontally across the face of the light guide may maximize curing effectiveness.

To the dental researcher or manufacturer, the results of this well-done study are obvious. The outlined testing procedures set the new standard in the evaluation of irradiance. When evaluating the emitted light from curing lights, the use of a beam analyzer must be used to completely characterize the distribution of the irradiance. Manufacturers are beginning to include beam analysis in their technical reports and marketing campaigns.

To the dental clinician, the results of this study reinforce the need to be an informed consumer. Providers can use hand-held radiometers to get an estimate of the irradiance of their curing light. Manufacturers often promote the higher irradiance of their curing lights; however, irradiance measurements are often recorded near the tip of the light guide. Although it is recognized that irradiance will naturally decrease with distance, it may decrease more rapidly with turbo-type light guides. Clinically, the light guide often cannot be positioned immediately adjacent to the photo-initiated material. In this study, changing from a standard to a turbo light guide increased the irradiance but significantly reduced beam homogeneity, emitted power, and tip area. This study also emphasized the potential for significant radial asymmetry as found with the tested light-emitting diode (LED) curing light without a light guide. The unique light emission consisted of seven irradiance peaks originating from the combination of three separate LED dyes. To help compensate for the disparity of power across the light guide tip, it has been suggested that the clinician should slowly move the tip over the surface of the material being irradiated. However, recent research by this group suggests that moving the tip during exposure causes a significant loss in hardness at both the top and bottom surfaces of a composite resin restorative material.[1] Practitioners can grossly evaluate the uniformity of the light beam of their curing light by placing the tip of the light guide against a white business card and shining the light though it.[2] Areas of greater intensity will be projected as brighter areas on the card. As you pull the light guide away from the card, you can gain a sense of the rate of dispersion of the light.

The advent of LED technology created a problem in that the initial generation of LED curing lights produced only a narrow spectrum of blue wavelength and were unable to cure a few dental products containing initiators in the violet range. Polywave curing lights have been introduced with two different LED types that produce two separate emission spectrums to compensate for resin-based materials with different photo-initiators. However, emitted light composed of separate wavelengths may not seamlessly combine together in a single beam, producing a somewhat fragmented area of surface irradiation. The use of more sophisticated testing techniques as outlined in this study

DOI 10.1111/j.1708-8240.2010.00319.x

will become even more significant as complex dental curing light technology continues to be introduced to the profession.

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The views expressed in this commentary are those of the author and do not reflect the official policy of the United States Air Force, the Department of Defense, or the United States Government. The author does not have any financial interest in the companies whose materials are discussed in this article.

This commentary is accompanied by article, "Irradiance Uniformity and Distribution from Light Curing Units," Richard B.T. Price, BDS, DDS, MS, PhD, FDS RCS (Edin), FRCD(c), Frederick A. Rueggeberg, DDS, MS, Daniel Labrie, PhD, Christopher M. Felix, BSc, DOI 10.1111/j.1708-8240.2010.00318.x.