Cure Depths Compared with LED and other Curing Lights

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During the past few years, there has been an increase in options for curing lights, one of the most significant being the introduction and mass appeal of light-emitting diode (LED) lights. These LED lights are both efficient and convenient creating less chairtime for dentists and patients and more profitability when “time equals money.” Before investing in a curing light, it is important to know how effective the various types of lights are with a variety of composite resins. There is evidence that varying composite resins have different chemical photo initiators that are activated at different wavelengths of light emission. Each curing light type has distinct peak wavelength intensities.

Study Overview
The purpose of this in-vitro study was to compare curing depths of various types of curing devices with different types of composite resins. Three composite resin types were evaluated in the universal shade of A-2: hybrid, microfill, and flowable.

Hybrid
Filtek™ Z-250 (3M-ESPE)
Prisma® TPH (Dentsply/Caulk)

Microfill
Durafill® (Hereaus-Kulzer)
Virtuoso® Sculptable (Den-Mat®)

Flowable
PermaFlo® (Ultradent)
Virtuoso® Flowable (Den-Mat®)

The curing lights were divided into four categories with a higher concentration of light-emitting diode (LED) lights evaluated. The following curing lights were selected for the study (the light guide tip diameter is also listed):

- Quartz halogen (QHL)
- Optlux 500 (Kerr-Demetron) (9mm)
- High-quartz halogen
- Phase II (Den-Mat®) (7.5mm)
- Plasma Arc
- Sapphire® Xenon Power Arc (PAC) (Den-Mat®) (9mm)

Light-emitting diode (LED)
- Versalux™ (Centrix®) (8mm)
- Elipar™ Free Light (3M™-ESPE) (8mm)
- Ultralume® 2 (Ultradent) (6x11mm)
- Allegro™ (Den-Mat®) (10mm)

Methodology
Five specimens were created for each composite resin (6) for each curing light (7)—30 specimens, 7 lights. Each composite resin specimen was placed into a 7mm high x 4mm diameter Teflon® mold with a centered hollow area. To assure complete polymerization and elimination of the oxygen inhibited layer on the light tip side of the specimen, a Mylar® strip was placed between the composite resin and the light tip. The Teflon mold was then placed on a glass slab when the composite resin was placed into the mold.

The curing lights were stabilized in a jig that placed the end of the light guide in contact with the Mylar matrix strip on the top aspect of the Teflon mold. Each composite specimen was light cured using the following times recommended by the manufacturers:

- Sapphire Xenon Power Arc (Den-Mat®)
  3 seconds
- Phase II (HiQHL) (Den-Mat®)
  5 seconds

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Optilux 500 (QHL) (Kerr)
10 seconds

Versalux (VL-LED) (Centrix)
10, 20 seconds

Elipar Free Light (EL-LED) (3M)
10, 20 seconds

Ultralume 2 (UL-LED) (Ultradent)
10, 20 seconds

Allegro (AL-LED) (Den-Mat)
10, 15 seconds

The depth of cure was measured by using a sharp explorer penetration test around the circumference of the specimen. The point of resistance to penetration was noted and measured using a digital micrometer (Mitutoyo Digimatic). The results were then recorded.

Conclusions

Results of this study revealed the following concerning LED lights and other curing lights.

Of the LED lights tested, the Allegro had the deepest depth of cure in the least amount of time. Different types of composite resins cure to different depths. Hybrid composites cure the deepest, while microfill composites have the least depth of cure. The Sapphire Xenon Plasma Arc Light cured the deepest at the shortest curing time.

Author’s note: Although the 10mm tip of Allegro was used for this study, the Allegro LED light has the greatest number of diameter and shaped tips to allow for the greatest flexibility for a wide variety of clinical situations.

Dr. Strassler is Professor and Director of Operative Dentistry at the University of Maryland Dental School. He has lectured nationally and internationally on techniques and selection of dental materials in clinical use and esthetic restorative dentistry and is involved in a number of research projects evaluating dental materials and techniques. Dr. Strassler is an associate of Den-Mat corp. He can be reached at 410-706-8476 or through email at hes001@dental.umaryland.edu.

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