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Curing Lights: Laser Diode versus Other Light Sources

Gordon's Clinical Observations: Are you satisfied with your current curing light? Does it predictably cure deep, fast, and thorough? Inadequate cure has been shown to be one of many reasons for short longevity and ultimate failure of resin restorations. A recent addition to curing light alternatives is the Monet laser curing light. Is laser curing better than LED, plasma arc, or halogen curing? *This issue includes CR scientific research on the Monet light, clinical user observations, and recommendations for you.*

The Monet by CAO Group is the first dental curing light to utilize blue laser diodes as the light source. It produces an intense beam of collimated monochromatic blue light. CR Evaluators noted the laser's high output and ergonomic design, but expressed concern about the safety of such intense light.

The following report provides data from clinical evaluations and laboratory research that address the performance, safe use, and potential of this new curing modality.

Beam comparison of four curing lights: The Monet laser exhibited an intense collimated beam while other light sources had greater beam divergence and diminishing energy.

Monet Laser Curing Light

$2,499 • Monet by CAO Group

Advantages

- High irradiance output produced faster and deeper polymerization than other light sources
- Collimated beam had minimal loss of energy over distance
- Slim, ergonomic, cordless design with rotating 90° head

Limitations

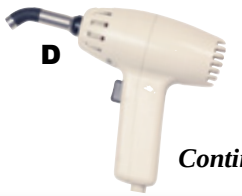
- Rapid heating of materials and tissues
- Bright spot required laser safety glasses during operation
- Full polymerization required multiple short exposures

Includes: Light with two batteries, a charging base with built-in radiometer, two safety glasses, four attachments for different curing applications, and a sample pack of barrier sheaths.

Single-button control: The first press of the button powers up the handpiece. Second press turns on aiming beam and starts 3-second safety delay (ensure accurate positioning during this time). Third press activates 1-second exposure. Additional 1-second exposures can be made immediately to ensure complete polymerization.

Output and Performance

The following graphs show the key characteristics and performance of the Monet laser compared to LED, plasma arc, and halogen curing lights.



A. Laser	B. LED	C. Plasma Arc	D. Halogen
Monet, CAO Group	Valo Grand, Ultradent	Sapphire, DenMat	Optilux 501, Demetron

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Curing Lights: Laser Diode versus Other Light Sources

Accessories

Snap-on accessories modify the beam to make the laser better suited for some tasks.

Neutral density filter reduces output by 50%, for situations where high intensity or high heat may be deleterious.

Apertures of ~6 mm, 4 mm, and 2 mm reduce the diameter of the beam for tacking and other tasks.

The Monet demonstrated the capability of blue laser diodes to provide a curing performance comparable to or superior to existing dental curing lights. The concerns that monochromatic laser light may result in inferior physical properties or be incompatible with materials appear to be unfounded. The overall design was ergonomic, easy to use, and competitive with current light designs. The main limitations were rapid heating, eye protection required for safe use, and the need for repeated activations of the short 1-second exposure setting. Overall, Clinical Evaluators rated the Monet as "Good." Long-term clinical observation is ongoing.

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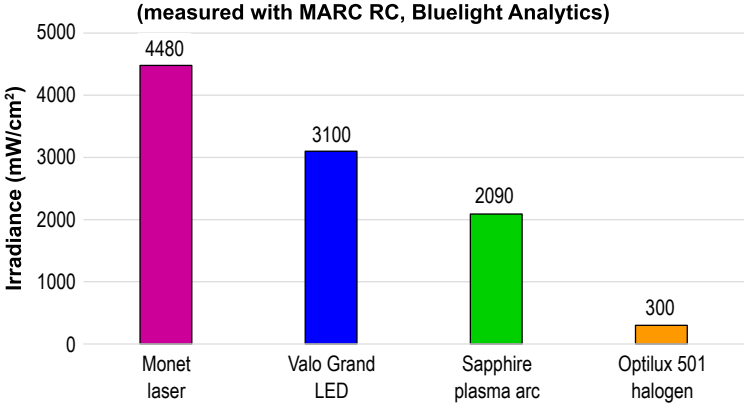
CR CONCLUSIONS:

Curing Lights: Laser Diode versus Other Light Sources (Continued from page 1)

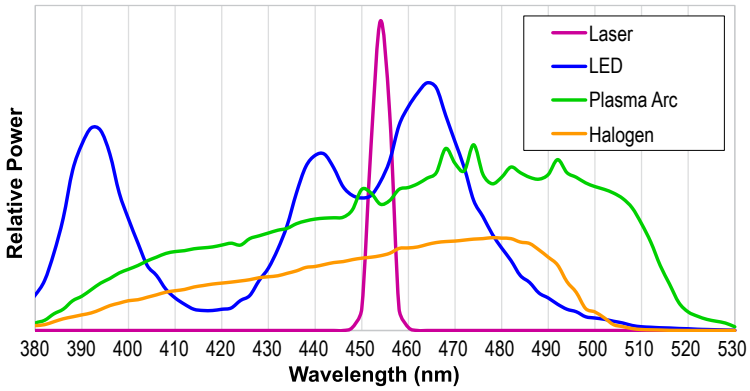
Output and Performance (Continued)

Intensity
(measured with MARC RC, Bluelight Analytics)



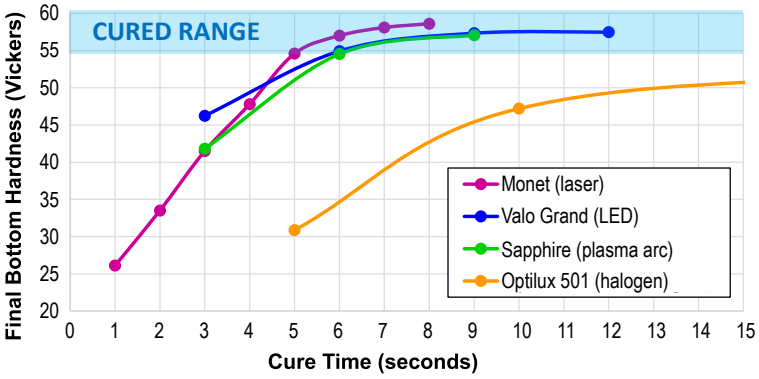
Monet was among the most powerful curing lights tested with an irradiance of over 4000 mW/cm² in a large spot (~11 mm diameter).

Spectra



The laser had monochromatic output at approximately 452 nm, significantly more narrow than the spectral emission of halogen, plasma arc, and LED lights. **CR found it to be compatible with all light-cure materials tested.**

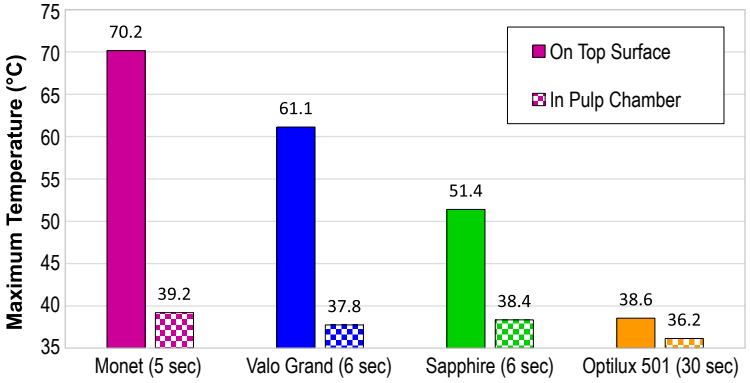
Speed of Cure
2 mm resin layer (Estelite Σ Quick, A2)



Monet's high irradiance polymerized materials faster than other lights tested.

- Resins became hard to the touch after 1–2 seconds of cure. 3–5 seconds were required to reach optimum physical properties at depth.
- **Caution:** Too little total exposure time can result in under-polymerized material at bottom of restorations.

Heat
(without cooling measures)



All lights with high irradiance caused rapid heating of restorative materials and oral tissues.

- Cool surface with a gentle stream of air during exposures. Pause briefly between exposures to allow heat to dissipate.
- When curing near the pulp (deep prep, small tooth, etc.) take precautions to avoid overheating the tissue. A high incidence of pulpal necrosis has been shown with a pulp temperature increase of 5.5° C (primate study, Zach and Cohen).

Eye Safety

Heat and potential eye damage were the primary concerns of clinical evaluators. Both are due to the high intensity spot created by the collimated beam of the laser. For all curing lights, blue light ocular hazard is a real concern for dentists and staff members who view the exposures without protective lenses. Lasers have additional stipulations, and the FDA and OSHA specify safety measures for lasers, including eyewear. CR survey data indicated that most clinicians, unfortunately, do not regularly use orange safety glasses. Safe use of Monet requires improved preventive measures. Two laser safety glasses are included with the light and additional drop-in lens options are available for those who wear loupes or other eyewear.

Width and Depth of Cure

Light diffusion results in greatest polymerization at the center of the spot, then diminishing toward the edge. Monet and Valo Grand produced 5.5 mm and 6.0 mm diameter cures, respectively, but hardness dropped rapidly beyond that. When curing a large restoration, overlapping exposures are needed to ensure adequate polymerization of all surfaces and areas (e.g., MOD, ceramic crown, anterior central veneer).

Depth of cure was dependent on material. Monet produced deeper cures than other lights *when the same exposure time was used*. A 1-second cure was inadequate, and the short exposure setting may promote under-curing. **Caution:** For all lights, bulk filling with light-cure materials can increase the risks of polymerization stress defects and the under-polymerization and less-than-ideal physical properties of materials *at depth*.

Width of cure samples in 20 mm molds. Hardness was measured at 1 mm intervals in the pattern shown. The area visibly affected by the light was always much larger than the actual cured material.