

Clinical Benefits of LED Surgical Lights

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Much has been written about the transition of OR lighting away from traditional incandescent technology to LED technology. By now, some of the advantages of LED roll off the tongue; less heat, longer life, better energy efficiency. But these advantages are just the beginning.

If the point of new technology is to provide better patient outcomes, only one of these often stated advantages, less heat, directly applies. LEDs radiate much less heat than incandescent bulbs, so the surgeon and staff are more comfortable (important during long cases). And cooler light means less heat in the surgical field, reducing the risk of drying out exposed tissue. There are several other advantages of LED lighting, beyond reducing heat, that have direct clinical benefits.

Pure white color

One of the most notable features of a high quality LED surgical light is how white the color of the spot is. Traditional halogen bulbs are inherently yellow, with typical color temperatures around 3200 Kelvin (K).

Manufacturers attempt to correct this yellowness by using expensive coatings and filters to remove some of the yellow light, which raises the color temperature to a more desirable level (around 4400K). This filtering makes the light whiter but the color is still less than ideal. Also, the coatings and filters used are very difficult to apply consistently, so lighthouse-to-lighthouse color variability is very high.

If you take two or three halogen lights in your OR and put the spots next to each other, a discerning eye can see the differences in color and intensity between the spots; these differences can become distracting for surgeons.

On the other hand, LED's can be engineered to produce white light at the preferred color temperature of 4400K, so no filters or reflective coatings are needed to "correct" it. Also, since there are many LEDs per lighthouse, any variations among LEDs tend to cancel each other out, so the color match among LED lighthouses is much more consistent than in halogen lighthouses.

"There's no question that the quality of light is better and as a result I think things go better. You're able to see better. You're able to get better hemostasis. We're able to see where we couldn't see before." –Neil Finkler, M.D., Florida Hospital, Orlando, FL

Improved shadow control

Not only are LED lighthouses whiter and more consistent, they provide much better shadow control than halogen lights. A halogen system typically consists of a single bulb and a multifaceted reflector. Unfortunately, each facet is a different shape and is located a different distance from the bulb. These differences can create unwanted "hot" and "cold" spots within the light pattern.

In a typical LED lighthouse, each LED makes the entire spot. These individual spots are then precisely overlapped, so no matter how many LEDs you block, the spot remains round and consistent. As obstructions (e.g. surgeons' heads) move around in the light field, the pattern does not change.

The consistency of LED light means surgeons are not distracted by shadows moving across the pattern. In fact, some surgeons have commented that when using the LED lights, they no longer feel the need to wear their headlamps!



Figure 1. Each LED lens creates the entire pattern, so no matter how many you block, the spot remains clear and consistent.

More accurate color rendition

The final clinical benefit of LED lights is their color rendering capability. The Color Rendering Index (CRI) defines how well a light allows an observer to make distinctions between subtle differences in color. Most halogen lights have a very high CRI, but unfortunately, CRI focuses only on how well you can visualize pastel colors.

To determine how well a light renders deep, saturated red colors (the most critical color for surgical procedures) the lighting industry developed a special measurement, called the R9.



Figure 2. With LED lighting, distracting shadows created by the surgeon's head are virtually eliminated from the surgical field.

"(With the LED light)...the reds are redder, the blues are bluer, and the yellows are more yellow. Everything seems a bit brighter when we're looking down a pelvis." –Robert Holloway, M.D., Florida Hospital, Orlando, FL

While most halogen lights have a CRI value in the mid 90s, their R9 values are in the low 70s. The reason the R9 values are so much lower than the CRI values relates to heat. By their very nature, halogen bulbs create a lot of heat in the form of infrared (IR) light. Since the human eye can't detect IR light, there is no clinical benefit to it. Manufacturers try to eliminate IR light (and heat) away from the surgical field with dichroic reflectors. In filtering out all of the bad IR, invariably some of the good, visible red light gets filtered out as well, directly leading to a poor R9 color rendition.

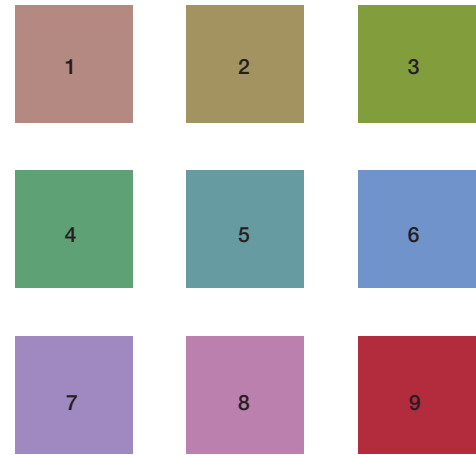


Figure 3. Color Rendering Indices: CRI is the average of the first eight pastel color rendering indices. The special color rendering index for the 9th color sample, R9, is not included in the average, but is very important to surgeons because it represents the ability of a light source to render deep, saturated red.

LED technology makes all of this filtering unnecessary. LEDs can be designed to only emit light within the visible spectrum. There is no need to filter out IR because it isn't created in the first place. This has allowed some LED manufacturers to increase their R9 values from the low 70s to the mid 90s.

Surgeons will immediately notice how red colors appear more bold and vivid, helping them make tissue identification and diagnosis faster and more accurate.

Clinical justification leads to LED value

Right now, LED surgical lights cost significantly more than older halogen lights. In justifying the increased purchase price, you can look at total cost of ownership using energy and replacement bulb cost savings. The more compelling arguments are the clinical benefits that LED technology provides, which should lead to better patient outcomes.

If cost is a major concern, ask your current surgical light manufacturer about the ability to upgrade to LEDs without replacing the entire suspension. For some manufacturers, upgrading to LED technology can be as easy as swapping the lighthouses and updating the control center. This approach saves money and time since these upgrades can be performed in 1-2 hours instead of 1-2 days.

"These lights are definitely an edge. I think they're eventually going to be in most of the OR's" – Dirk Pikaart, D.O., Florida Hospital, Orlando, FL

If you are still not sure LEDs are worth the additional investment, have a manufacturer bring in an LED on a mobile stand. A side-by-side comparison between a good LED surgical light and a good halogen surgical light will be no contest. In almost all cases, even an untrained observer will prefer the LED light.

...Just think what a difference it will make to a highly trained surgeon.