Cool and bright—new generation LED: a better alternative to traditional surgical light

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As early as the year 2000, Drs. Robert Bernstein and William Rassman had discussed how an incandescent light or a halogen operating light could lead to graft desiccation and excessive bleeding from the heat the light generates.[1] Their solution at the time was to use an array of fluorescent ceiling lights. In 2005, Dr. Marc Avram discussed his experience using a polarized light emitting diode (LED) magnifier from Syris Scientific and how it could reduce the risk of desiccation of grafts from the lack of heat generated by the LED.[2]

LED, a semiconductor, traditionally provided a low luminance light source with low power consumption and instantaneous response. It was used mainly as an indicator light on electronic products. New generation LED maintains many of the same characteristics but can produce very high luminance light. In recent times, these LEDs have been extensively used by the automobile industry and in personal flashlights.

In the past, we found white LED, even as an array, too dim for the hair transplant application. Those LEDs' overwhelming bluish tint also made for an uncomfortable visual encounter. However, the recently popularized, super-bright LEDs provide an entirely different experience.

With their superb luminance, color, and low power consumption (low heat), surgical applications, including operating light and surgical LED headlight, have sprung up all over the market. They are, however, very pricy.

A chance encounter with an inexpensive 8W LED flashlight at a bike shop opened up a do-it-yourself opportunity for us. By removing the light assembly from the flashlight, soldering two wires to its terminals, and taping the light in the middle of a magnifying visor, we created an extraordinary light source at a bargain-basement price. Initial success brought further refinement, such as adding an AC/DC converter and looking for different styles of LED. During our first phase of the trial, the original 8W LED, a number of 3W LED flashlights, a multi-LED array, and an incredibly bright 12W LED were tested in hair transplant surgeries.

The early surgical experience is limited to me and 5 assistants using 3 types of LED (Figure 1). We've used them in both FUT and FUE sessions. With the immediate success, we no longer use the overhead operating light. All cases are performed using LEDs exclusively. Our first impressions are listed below.

What we like:

- Light follows head movement, rarely needs any adjustment
- No competition for light between assistants because everyone has his/her own
- Low heat (no more overhead surgical light)
- High luminance
- Recipient sites are easier to identify (There may be two contributing factors: 1) without the large overhead surgical light, there seems to be less reflections, and 2) LED contains less red, which makes the blood within the slit darker, leading to higher contrast between the slits and the skin.)
- Low cost

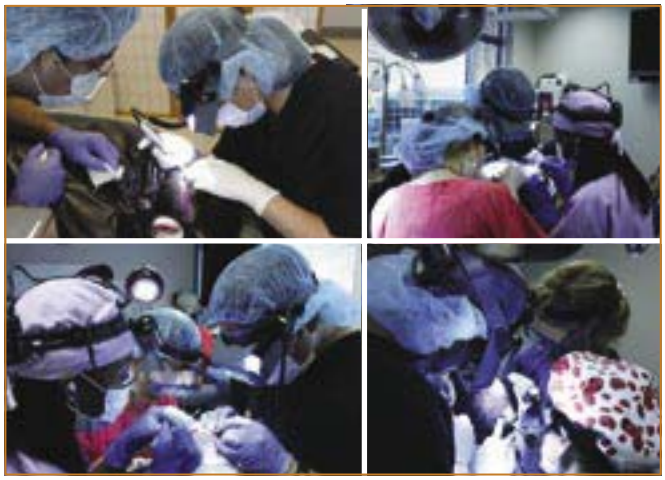

Figure 1. Performing FUE and graft placement.

What we dislike:

- Changing batteries
- Hindrance of movement if wired up to AC/DC converter
- Elastic band type can become uncomfortable with extended wear

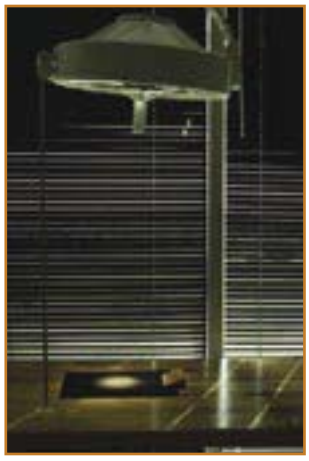

Figure 2. Centurion eXceL

Since one of the stated reasons for switching to LED is heat, we decided to do a simple test to compare the thermal energy in a typical Operating Room light against that from the LED. Our operating light, a Centurion eXceL was placed 80cm from a black cardboard square and left on for 20 minutes (Figure 2). Temperature of the lighted area increased from 26.1 to 40.2°C afterwards. When using the three different LEDs aiming toward the board at a much shorter distance (Figure 3), the temperature went from 25.9 to 26.2°C after 20 minutes, which is within the normal variation of the room's temperature. This easily demonstrated that the light from an LED contains much less thermal energy than the light from a traditional operating light.

Discussions with Drs. William Parsley and Mario Marzola yielded further refinement. Compliments of Dr. Parsley, we built two prototypes (Figure 4) using the polarizing film he

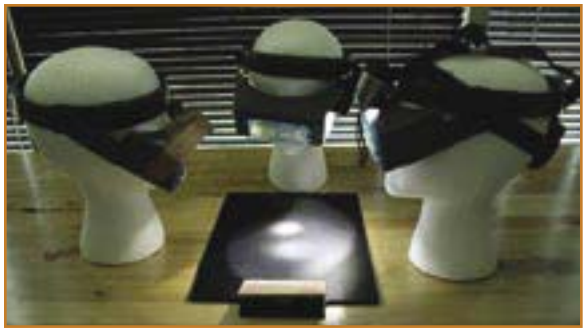

Figure 3. 3 LEDs we use during graft placement.

provided. Because light must travel through two layers of film before reaching the eyes and cross-polarization would further diminish the amount of light, we used the brightest LED we had for this application. Cross-polarization was achieved by rotating a cap on the LED headlamp. The result was an inexpensive setup that virtually eliminated all undesirable reflections during recipient site making and graft placement. Cross-polarization significantly reduced eye strain. Accomplishing this at low cost meant that each assistant could have his or her own set of polarizing light and visor, thereby providing a better work environment and achieving higher productivity.

Figure 4. Polarizing film

Dr. Parsley also brought up the fact that some of his assistants do not like wearing anything on their heads, so that some type of gooseneck with a LED at the end may be helpful. After a lot of searching, we were able to custom build several gooseneck LEDs using off-the-shelf parts (Figure 5). This gooseneck LED can be used by itself or in conjunction (as a flood light) with a headlamp depending on personal preference.

In summary, the new generation LED is lightweight (even with quality metal casing), high performance, and inexpensive. Do-it-yourselfers may easily incorporate them into their practices at bargain prices. As we explore the market, we constantly discover better and brighter LEDs. Switching to new generation LED from standard operating light can lower the risk of graft desiccation and provide better visualization, leading to higher efficiency for both the surgeon and assistants.

References

1. Bernstein, R., and W. Rassman. Limiting epinephrine in large hair transplant sessions. *Hair Transplant Forum Int'l.* 2000; 10(2):39-41.
2. Avram, M. Polarized magnification for creating recipient sites. *Hair Transplant Forum Int'l.* 2005; 15(4):121.✧

Figure 5. Gooseneck LED

A note from Marc R. Avram, MD *New York, New York*

Over the past several years the trend in hair transplantation has been toward longer operating time with an ever-increasing number of hair follicles transplanted during each session. This has created a new set of challenges for hair transplant surgeons, their staff, and patients.

One aspect of the procedure that may affect the percentage of growth of transplanted hair and the pain patients experience intra-operatively are the surgical lights. Over a few minutes, the bright light and heat are no problem, but over many hours the increased temperature caused by surgical lights likely contributes to pain patients feel, may affect the survival of grafts, and cause glare that may affect graft placement.

Dr. Shiao, et al. should be congratulated on their novel LED device. They, as others in the past, have found the LED a welcome addition to help make the procedure easier for both the surgical team and patient. In the future, further refinements in magnification with cross-polarization and LEDS will further enhance the quality of the procedure.