Expanding Light Therapy to the Dentist’s Office

By: Holger Werner, SCHOTT AG Lighting and Imaging
SCHOTT North America, Inc.

www.us.schott.com/lightingimaging
Light applied directly to tissue can be a powerful tool for promoting tissue healing and reducing inflammation. Although there are many stand-alone devices for delivering light therapy, especially for musculoskeletal applications, the dentistry profession has been slower to adopt this type of treatment. By partnering with a lighting and glass expert, instrument manufacturers can design versatile light-delivery instruments for the dentist’s office.

WHY USE LIGHT-BASED THERAPY?

Light therapy typically involves applying light in the range of 600 to 1,000 nm to tissue. Although lasers can be used, most of today’s instruments use LEDs because they now offer sufficient power for this application. The light is absorbed by the cell’s mitochondria, where it likely helps increase cellular energy, and, in stressed cells, can reduce harmful oxidative stress.¹ One study also showed cultured cells exposed to LED light grow up to 171 percent faster than unexposed cells.²

For wound healing or reducing inflammation, light therapy can be used as a complement to drug-based treatment with few or no side effects. Applying this therapy at the site of injury, disease, or dysfunction can promote healing or reduce inflammation, and using it on nerves can decrease sensitivity.¹

One successful application of light-based therapy has been for chemotherapy patients who experience severe inflammation in the throat as a side effect of the treatment. Although pain medicine can help with the symptoms, light therapy can be used to actually heal the affected tissue. Irradiating the area just six to 10 times allowed patients who couldn’t previously eat to start consuming liquid foods.

Research trials have shown light-based therapy is useful for oral applications that include improving healing or reducing inflammation after gingivectomy, in which part of the gums in the mouth are cut away. It has also been used to reduce pain and swelling after molar extraction, promote faster bone formation, and improve bone-implant interface strength for dental implants. In children, light-based therapy can reduce pain during cavity preparation and speed healing of gingivitis.¹
CREATING A NEW TYPE OF INSTRUMENT

In the dentist’s office, blue light is commonly used to harden curable materials used for fillings. Integrating other wavelengths into light-curing instruments could offer the opportunity for dentists to perform more specialized, privately billed treatments that could help patients heal faster or have less pain during procedures. By partnering with a company experienced in lighting and light delivery, instrument manufacturers could develop versatile new devices that stand out among competitors.

Dental instruments that deliver light to the mouth use light guides to ensure light of the correct power reaches the target area. A multi-wavelength instrument for light therapy and curing would require a light guide with a transmission range from 380 to about 1,000 nm so it could efficiently deliver both the blue wavelengths used for curing as well as red and infrared wavelengths used for treating tissue. Light guides with low attenuation produce higher light output at the end of the light guide, allowing smaller diameter light guides with the same output that are thus easier to install.

Off-the-shelf optical components likely wouldn’t work for a specialized multifunctional instrument. A lighting expert can help optimize the entire lighting system, including the light delivery components, to work best with the instrument and applications. For example, they can help choose light-guide materials that will compensate for light losses introduced by the design, allowing for more extreme geometries. This is helpful for dental instruments, which may require light guides with 90-degree bends to access the back of the mouth or throat area. It’s also key to use light guides that are break-resistant, are chemically resistant, and can be sterilized with autoclaving.

MAKING AN INTEGRATED, VERSATILE INSTRUMENT

Integrating several wavelengths into one device comes with challenges. First, instruments have a restricted amount of room for LEDs. Adding wavelengths would mean more LEDs would have to be placed into the space typically occupied by one or two. This would require that some of the LEDs be a bit off-center in regard to the light guide, making it difficult to efficiently couple different wavelengths into the light guide in a way that produces a high-quality output for each. Careful lighting design can enable maximum performance from the instrument for both curing and light therapy. For example, a specialized glass component can be used to blend the different wavelengths to achieve homogeneous coupling into the light guide and an output with the necessary power.
The light outputs of the device must also meet the precision needs of each application. Although curing applications require very precise positioning of the light on the tooth, wound healing applications require the light to be distributed in a broader area. This might require light guides that deliver light in one spot for curing and scatter the light in different directions for the broader treatment areas used in light therapy.

When selecting a lighting expert, look for one experienced in dental applications and in manufacturing according to medical device standards. This means quality management systems such as ISO 13485 need to be in place to meet medical regulations and provide the required traceability for all components.

In conclusion, a lighting expert can help instrument manufacturers create innovative devices that provide optimal light delivery in a variety of applications, allowing dentists to offer the highest level of care to their patients.

REFERENCES:


About SCHOTT AG Lighting and Imaging

SCHOTT AG Lighting and Imaging develops, manufactures, and distributes fiber optic components for light and image transmission. Our portfolio comprises flexible and rigid components as well as hybrid products based on LED and fiber optic technology. We have been providing customized solutions to medical instrument manufacturers and working in medical applications for more than 50 years and have 130 years of experience in specialty glasses and materials. Our PURAVIS® high-performance glass optical fibers are ideal for many fluorescence-based diagnostic instruments because of their extremely long lifetimes, high color uniformity and light output, and improved transmission in the near-UV range.

Lighting and Imaging
SCHOTT North America, Inc.
122 Charlton Street
Southbridge, MA 01550
USA
Phone: +1 (508) 765-9744
Fax: +1 (508) 765-1299
lightingimaging@us.schott.com
www.us.schott.com/lightingimaging