Illumination Lamps for CXL

As surgeons' understanding of CXL increases, the technology for the procedure will evolve.

BY ARTHUR B. CUMMINGS, FRCS(Ed), AND RAJESH K. RAJPAL, MD

Just as surgeons need lasers to perform laser vision correction or phaco machines to do phacoemulsification surgery, they need hardware for corneal collagen cross-linking (CXL). This article serves as an introduction to the *lamps*, for lack of a better word, but we predict that this hardware will go by a different name in just a few years, as the technology develops. In addition, this article covers the specifications of the ultraviolet (UV) lamps and what differentiates each device from the others.

THE LAMPS

CXL was introduced in Europe in January 2007 along with the first lamp for the procedure, the IROC UV-X1000 (IROC Innocross AG). Although surgeons started performing the procedure in the clinical trial setting in 2000 with the IROC UV-X device, CXL became mainstream when the IROC UV-X1000 and the Vega device (Sooft Italia S.p.A) received CE Marking. Are the UV lamps on the market today simply sources of light and therefore basically the same, or do some possess unique features that provide greater efficacy or safety?

The table identifies the specifications that a surgeon assesses when considering the purchase of a lamp for CXL. The devices are listed in the order of their appearance on the European market. We obtained the lamps' specifications directly from the manufacturers whenever possible. We do not compare clinical outcomes with the various devices, because investigators have not directly compared the lamps under identical study conditions.

FUTURE DEVELOPMENTS

The future of CXL technology is exciting. According to Avedro, Inc., for example, its KXL II System will feature active eye tracking, topography-guided patterns of illumination, and programmable illumination. As surgeons come to understand the benefits of a homogeneous versus a variable beam profile, the flexibility of some devices may become advantageous. The higher-powered lamps that allow briefer treatments seem to produce similar outcomes (R. McQuaid and A.C., unpublished data, 2012). Among the benefits of a shorter CXL procedure are that it is easier and more comfortable for the patient, it dehydrates and thins the cornea less, and it is more efficient for the surgeon and the patient. For these reasons, higher-powered lamps are likely to become a trend in the field of CXL.

CONCLUSION

Despite promising outcomes with the procedure, ophthalmologists are still uncertain exactly how CXL achieves corneal stability. Do oxygen radicals play a role, or is excited riboflavin the major factor? Are links formed between collagen fibrils, or are the fibrils themselves strengthened? Is it a combination of the aforementioned? What is clear is that CXL's effect is generated by the interaction of UV light and riboflavin.

We are watching this space closely, because the potential applications of this technology extend beyond the treatment of keratoconus and corneal infection. At many centers, ophthalmologists are already using CXL to decrease the risk of ectasia in patients undergoing LASIK. We expect that what surgeons are currently doing with CXL will appear antiquated in just a few years. ■

Note: the FDA has not approved CXL or the lamps used for the procedure. The authors wish to thank the manufacturers that provided information on their lamps.

Arthur B. Cummings, FRCS(Ed), is a consultant ophthalmologist at Wellington Eye Clinic in Dublin, Ireland. He acknowledged no financial interest in the products or companies mentioned herein. Mr. Cummings may be reached at +353 1 2930470; abc@wellingtoneyeclinic.com.

Rajesh K. Rajpal, MD, is the medical director of Cornea Consultants, PC, in McLean, Virginia, and a clinical associate professor at Georgetown University Medical Center in Washington, DC. He is on the medical advisory board of Avedro, Inc. Dr. Rajpal may be reached at (703) 287-4122; rrajpal@seeclearly.com.

TABLE. SPECIFICATIONS OF CXL LAMPS

								
Manufacturer	**IROC Innocross AG**	**Sooft Italia S.p.A.**	**Opto Global Pty Ltd.**	**Avedro, Inc.**	**Peschke Meditrade GmbH**	**IROC Innocross AG**	**Appasamy**	**Avedro, Inc.**
Name of device	UV-X1000	Vega	Opto XLink	KXL I System	CCL 365 HE	UV-X2000	CL-UVR	KXL II System
Country of origin	Switzerland	Italy	Brazil	United States	Switzerland	Switzerland	India	United States
Wavelength, nm	365	370	365	365	365	365	365	365
Intensity of illumination, mW/cm^2	3.0	3.0	0.5-5.0	3.0-45	Up to 18.0	Up to 12	3.0	3 to more than 90
Variable intensity?	No	No	Yes	Yes	No	No	No	Yes
Duration of CXL treatment, min	30	30	18	3	5	10	30	1-30
Working distance, mm	50	50	50	NS	45 ±5	47	NS	NS
Light emission	Continuous	NS	NS	Continuous	Continuous	Continuous	NS	NS
Beam profile	Homogenous	Homogenous	Homogenous	Homogenous	Homogenous	Optimized	NS	Programmable illumination
Beam diameter, mm	6, 7, and 9	4-9	6-10	9 and 10	7-11	7-11	NS	Up to 14
Weight, kg	±7	NS	NS	NS	7.5	±7	NS	NS
CE Mark	Yes	Yes	Yes	Yes	Yes	Yes	NS	Expected in late 2012
No. of treated eyes reported in the literature	1,400	280	24	NS	NS	NS	NS	0

Abbreviations: CXL, corneal collagen cross-linking; NS, not specified.