IOL innovations outside the U.S.

by Ellen Stodola EyeWorld Staff Writer

Presbyopia-correcting options differ for patients around the world

IOL options for presbyopia correction differ from country to country. Outside the U.S., there are a number of technologies being tested and used to treat patients, including trifocal IOLs, types of accommodating IOLs, and other unique technologies. Additionally, many other ideas are coming to light to treat these patients.

Damien Gatinel, MD, PhD, Rothschild Foundation, Paris, and **Richard Lindstrom, MD,** Minnesota Eye Consultants, Minneapolis, discussed which technologies they are using and what they see potential for in the future of presbyopia correction.

Trifocal IOLs

Trifocal IOLs offer different advantages than the normally bifocal IOLs, and Dr. Gatinel has experience working with these types of lenses.

"I have engineering and pioneering experience with the FineVision IOL, which I co-designed," he said. "It has become my main indication for premium IOL surgery in patients who seek spectacle independence."

This PhysIOL technology (Liege, Belgium) provides both near and intermediate vision in addition to distance correction, and it alleviates the need for mix-and-match strategies. "In my experience, diffractive multifocal IOLs are more robust for any irregular corneal astigmatism than refractive multifocal ones," Dr. Gatinel said.

The FineVision IOL

Source: Erik L. Mertens, MD, FEBOphth

The AkkoLens accommodating IOL uses the ciliary muscle to move sliding aspheric surfaces laterally.

Source: AkkoLens International

Accommodating IOLs

Dr. Gatinel has not yet found success with accommodating IOLs. "My experience with accommodating IOLs has been negative," he said. "I have not found any effective design and reproducible concept yet."

Dr. Lindstrom is enthusiastic about a few technologies and ideas that are being developed for accommodating IOLs. He mentioned the AkkoLens product (Breda, the Netherlands), which is currently being tested in a clinical trial in Europe. The lens uses a dual optic system with the 2 lenses moving across each other from side to side. "Instead of an in-the-bag lens, it's in the ciliary sulcus, so it's pushing against muscle when it accommodates; it's a more reliable power source," he said. "That lens is showing promise to be a real accommodating intraocular lens that can generate accommodating amplitudes superior to what we recognized in early technologies."

Other ideas not currently in patients may be good options for presbyopia correction, Dr. Lindstrom said. One concept proposes using interface fluids so that when the patient looks down, the power increases, and when the patient looks straight ahead, the power of the lens decreases.

"It's been very difficult to develop an accommodating intraocular lens," Dr. Lindstrom said. One issue with this is fibrosis. "After you remove a cataract, the capsular bag undergoes fibrosis and loses its elasticity, and the amount of elasticity that it loses is different for every patient," he said.

This means that in some patients, even though a lens could work, the capsular bag is totally rigid. Even though the ciliary muscle is doing its work and changing shape and accommodating, the capsular bag does not change shape. The forces generated have created a challenge. "We have not learned how to eliminate that problem," Dr. Lindstrom said. One way to possibly eliminate it is to bypass the capsular bag and go right to the ciliary muscle and use force generated directly rather than indirectly.

"This seems promising," Dr. Lindstrom said, although surgeons generally like to put lenses in the bag.

FluidVision

PowerVision (Belmont, Calif.) is currently working with an in-the-bag lens, the FluidVision lens, which Dr. Lindstrom said has potential. It is in trials in Germany.

"It uses a hydraulic system, meaning it's using the movement of fluid, and in the periphery it has what looks like a big inner tube," he said. "As the eye accommodates, that peripheral inner tube with fluid is compressed, and the fluid is moved through channels centrally and pushes against a very flexible membrane. That can cause meaningful accommodation to occur."

Future of presbyopia correction?

Dr. Gatinel thinks that corneal inlays, laser refractive surgery, and IOL surgery all have potential to play a significant role in the future of presbyopia correction.

"Surgeons should improve the quality of patient selection to better match a specific treatment modality to the patient's visual expectations," he said. "Based on the preoperative refraction, the level of crystalline lens opacification, the pupil dynamics, and the pre-existing level of corneal multifocality, it should appear that some techniques are more suitable than others in a particular eye or patient."

In his work, Dr. Gatinel has found that multifocal IOLs are well tolerated by patients who have a cataract.

"When the lens is clear, inlays or laser refractive surgery may be

a safer option," he said. Additionally, he added that multifocal laser ablations and inlays might be best for hyperopes, while monovision is a better option for myopes.

"In many cases, these corneal strategies incur a mixture of monovision and multifocality, where the dominant eye is less multifocal and close to emmetropia, and the nondominant eye more multifocal and closer to myopia," Dr. Gatinel said.

Elenza and other electronic systems

Although Elenza (Roanoke, Va.) was previously developing an electronic lens, Dr. Lindstrom said the project is stalled, and the company is not currently active as it failed to capitalize on its business plan. The company had made significant progress in developing the technologies that would be necessary to create an electronic intraocular lens that would change powers, including tiny rechargeable batteries.

Dr. Lindstrom said a positive note may be the recent joint venture by Alcon (Fort Worth, Texas) and Google (Mountain View, Calif.) to develop an electronic contact lens. Some proposed features of this are diagnostics to measure blood sugar and an ability to create a contact lens that is similar in idea and structure to what Elenza was doing.

Another stalled electronic lens system is the eyeglasses from PixelOptics (Roanoke, Va.) that had the ability to change power; however, this company also failed. Dr. Lindstrom hopes for development of electronic lens projects in the future.

Additional points

Although multifocal technology is progressing, Dr. Gatinel still finds that the level of customization that is put into monofocal corrections with wavefront laser-based refractive surgery is not always used for multifocals.

"Preoperative wavefront (both corneal and total) measurements along with pupil dynamics exploration should be part of the preoperative exploration of patients interested in presbyopia correction," he said.

Meanwhile, Dr. Lindstrom said there are new IOLs that could be introduced sooner than we think. The next IOLs that will be seen are extended depth of focus lenses, he said. He expects these to be introduced in the U.S. at about the same time as the rest of the world.

"These lenses use either aspheric optics, so they're hyper aspheric, or hyper prolate optics to increase the depth of focus of the intraocular lens," he said.

"That allows good distance and good intermediate vision with some near, with almost imperceptible loss of quality at distance and minimal night vision symptoms."

Dr. Lindstrom said this technology will likely launch first from Hoya (Tokyo), with Alcon and Abbott Medical Optics (AMO, Santa Ana, Calif.) getting involved as well. **EW**

Editors' note: Dr. Lindstrom has financial interests with Alcon, AMO, and Bausch + Lomb (Bridgewater, N.J.). Dr. Gatinel has financial interests with PhysIOL.

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