AI helps bring clarity to LASIK patients facing cataract surgery

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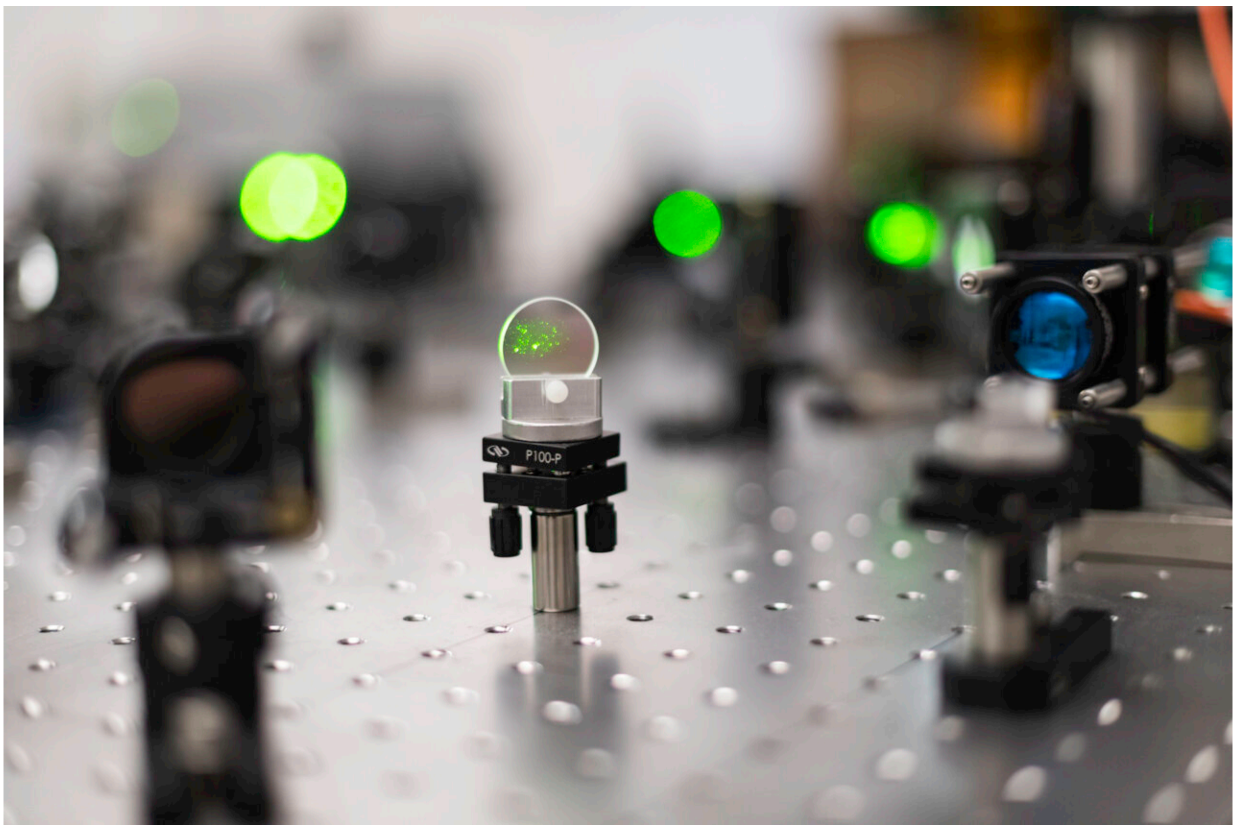

With an optical bench, researchers from the University of Rochester's Center for Visual Science use technology originally developed for astronomy, such as adaptive optics mirrors and spatial light modulators, to manipulate the optics of the eye as an intraocular lens would. Credit: University of Rochester photo / J. Adam Fenster

While millions of people have undergone LASIK eye surgery since it became commercially available in 1989, patients sometimes develop cataracts later in life and require new corrective lenses to be implanted in their eyes. With an increasing number of intraocular lens options becoming available, scientists have developed computational simulations to help patients and surgeons see the best options.

In a study in the *Journal of Cataracts & Refractive Surgery*, researchers from the University of Rochester created computational eye models that included the corneas of post-LASIK surgery patients and studied how standard intraocular lenses and lenses designed to increase depth of focus performed in operated eyes.

Susana Marcos, the David R. Williams Director of the Center for Visual Science and the Nicholas George Professor of Optics and of Ophthalmology at Rochester, says the computational models that use anatomical information of the patient's eye provide surgeons with important guidance on the expected optical quality post-operatively.

"Currently the only pre-operative data used to select the lens is essentially the length and curvature of the cornea," says Marcos, a coauthor of the study. "This new technology allows us to reconstruct the eye in three dimensions, providing us the entire topography of the cornea and crystalline lens, where the intraocular lens is implanted. When you have all this three-dimensional information, you're in a much better position to select the lens that will produce the best image at the retinal plane."

The future of optical coherence tomography

Marcos and her collaborators from the Center for Visual Science, as well as Rochester's Flaum Eye Institute and Goergen Institute for Data Science, are conducting a larger study to quantify in three dimensions the eye images using the optical coherence tomography quantification tools they've developed to find broader trends. They are using machine-learning algorithms to find relationships between pre- and post-operation data, providing parameters that can inform the best outcomes.

Additionally, they have developed technology that can help patients see for themselves what different lens options will look like.

"What we see is not strictly the image that is project on the retina," says Marcos. "There is all the visual processing and perception that comes in. When surgeons are planning the surgery, it is very difficult for them to convey to the patients how they are going to see. A computational, personalized eye model tells which lens is the best fit for the patient's eye anatomy, but patients want to see for themselves."

With an optical bench, the researchers use technology originally developed for astronomy, such as adaptive optics mirrors and spatial light modulators, to manipulate the optics of the eye as an intraocular lens would. The approach allows Marcos and her collaborators to perform fundamental experiments and collaborate with industry partners to test new products. Marcos also helped develop a commercial headset version of the instrumentation called SimVis Gekko that allows patients to see the world around them as if they had had the surgery.

In addition to studying techniques to help treat cataracts, the researchers are applying their methods to study other major eye conditions, including presbyopia and myopia.

More information: Carmen M Lago et al, Computational simulation of the optical performance of an extended depth of focus intraocular lens in post-LASIK eyes., *Journal of Cataract and Refractive Surgery* (2023). DOI: 10.1097/j.jcrs.0000000000001260

Provided by University of Rochester

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