Innovative 3D printing could improve treatment for cataracts and other eye conditions

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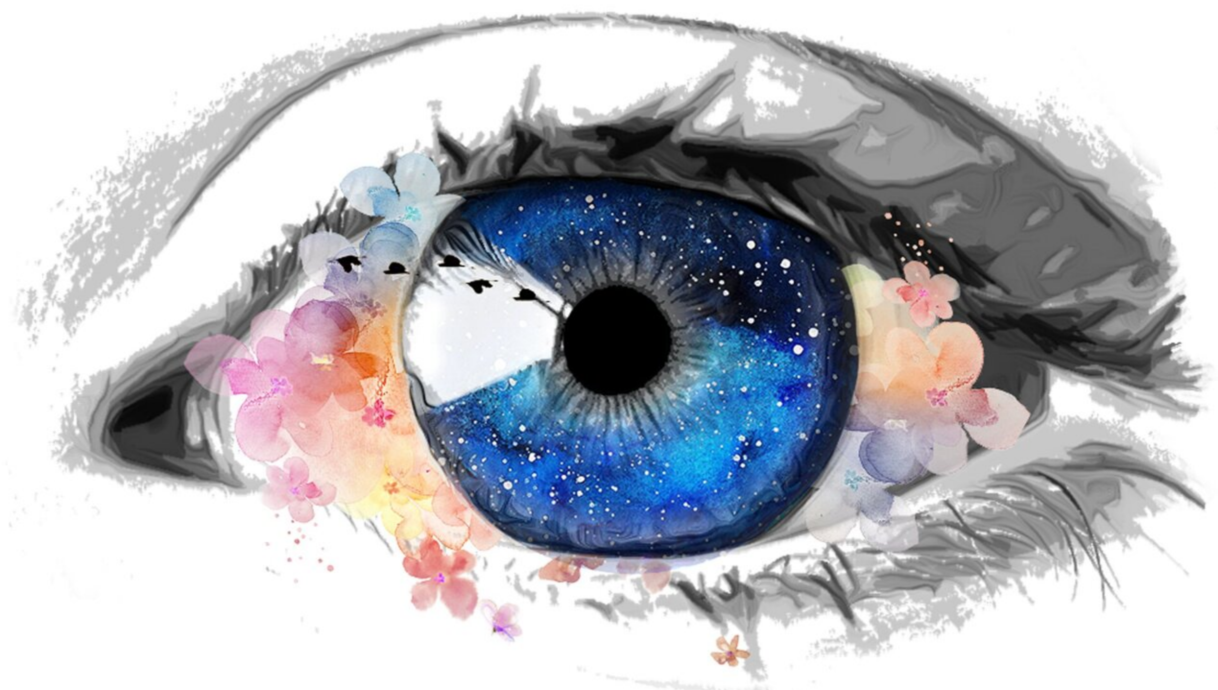

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University of East Anglia researchers have made an advance in ocular device technology with the introduction of a novel resin for 3D printing intraocular devices. This innovation has the potential to enhance the manufacture of eye implants universally used in cataract and refractive surgeries.

An artificial intraocular lens (IOL) is primarily required for people with cataracts, a condition where the eye's natural lens becomes cloudy, obscuring vision.

They can also be also used to correct refractive errors such as myopia (nearsightedness), hyperopia (farsightedness) and presbyopia (when eyes gradually lose the ability to see things clearly up close, as a normal part of aging).

Lead author Dr. Aram Saeed, Associate Professor in Healthcare Technologies at UEA's School of Pharmacy, said, "For the first time, we have developed a resin that can be used to print ocular devices directly.

"While still in the early stages, the ability to 3D print these lenses could significantly enhance eye care for patients by offering unprecedented levels of customization and design precision, potentially leading to better clinical outcomes."

The article, "Stereolithographic Rapid Prototyping of Clear, Foldable, Non-refractive Intraocular Lens Designs: A Proof-of-Concept Study," is published in the journal *Current Eye Research*.

Historically, IOLs have been made from a variety of materials, including glass and silicone, although more recently the industry has significantly evolved to predominantly use acrylic materials.

Currently hydrophilic and hydrophobic acrylic are the most commonly used materials due to their excellent optical clarity, flexibility, biocompatibility with the body and for their stability and safety within the eye.

Current methods of making IOLs use lathing and molding techniques. While these methods offer the production of well-engineered and high-optical quality devices, they also come with inherent limitations, particularly in terms of design complexity and customization.

Dr. Aram Saeed said, "3D printing could significantly enhance the production of ocular devices, not only improving speed and precision in manufacturing but also enabling greater complexity and customization in design.

"Our proof-of-concept paper is the first in a series that will detail our developments in this area and set the stage for transforming eye care practices globally.

"Our work combines material science with health care technology and requires extensive know-how in developing these types of ocular devices.

"As we continue to publish our findings and share our advancements, we aim to be at the forefront of the industry, working with industrial partners and researchers worldwide to refine and enhance the technology."

Although still in the early stages of development, the innovation could potentially have several advantages:

- Tailored lenses: 3D printing could create lenses customized to each patient's eye shape and vision needs, potentially improving vision correction and comfort.

- Faster production: Compared to traditional methods, 3D printing has the potential to enable quicker design, testing, and manufacturing of lenses. This speed could reduce the time between diagnosis and surgery, providing faster care to patients.

- Complex designs: 3D printing makes it possible to create intricate lens shapes that were previously difficult to manufacture. These designs could better address a wider range of vision problems.

- Cost reduction: By using 3D printing, the production cost of custom or high-quality lenses may decrease, making them more affordable for more patients, particularly in economically disadvantaged regions. This could lead to better overall public health outcomes.

- Compatibility with imaging: The researchers hope that combining 3D printing with advanced imaging technologies in the future could help produce lenses that fit individual patients' eyes optimally, reducing the need for adjustments or complications after surgery.

- Material innovation: 3D printing allows for the development of new materials with improved optical performance. This could result in lenses that not only correct vision but also enhance it.

The study found that the 3D printed lenses have good optical clarity, can be folded, and implanted into a human capsular bag.

Co-author Michael Wormstone, Emeritus Professor at UEA's School of Biological Sciences, said, "If successful in further developments, this new technology could transform the industry by enabling portable manufacturing solutions, especially beneficial in remote and economically disadvantaged areas.

"It also has the potential to support the production of premium, customized lenses that could enhance surgical outcomes in more advanced health care settings."

The team's efforts have been recognized with the awarding of a United States patent, assigned to UEA Enterprise Limited, a business entity of the university focused on fostering innovation and commercializing research.

The UEA researchers continue to work closely with industry partners to refine the technology.

For example, further work has been underway to ensure the process works accurately on a larger scale and to increase the printing resolution to improve the dimensional accuracy.

It is hoped that clinical trials could start in the next few years.

Dr. Saeed and Prof Wormstone have a strong partnership with the ophthalmology department at Norwich and Norfolk University Hospital (NNUH), which brings valuable clinical insights and visionary approaches to their work, with both UEA and the hospital members of the pioneering Norwich Research Park.

Mr. Anas Injarie, a leading consultant ophthalmologist at NNUH with more than 20 years of experience, said, "This innovation has the potential to enable the production of lenses that match patient specifications in design and optical performance.

"For premium markets, it represents an exciting possibility to provide tailored treatments that could enhance patient satisfaction and surgical success."

More information: Stereolithographic Rapid Prototyping of Clear, Foldable, Non-refractive Intraocular Lens Designs: A Proof-of-Concept Study, *Current Eye Research* (2024). DOI: 10.1080/02713683.2024.2344164

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