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New method to study biomechanical changes in tissues after laser surgery

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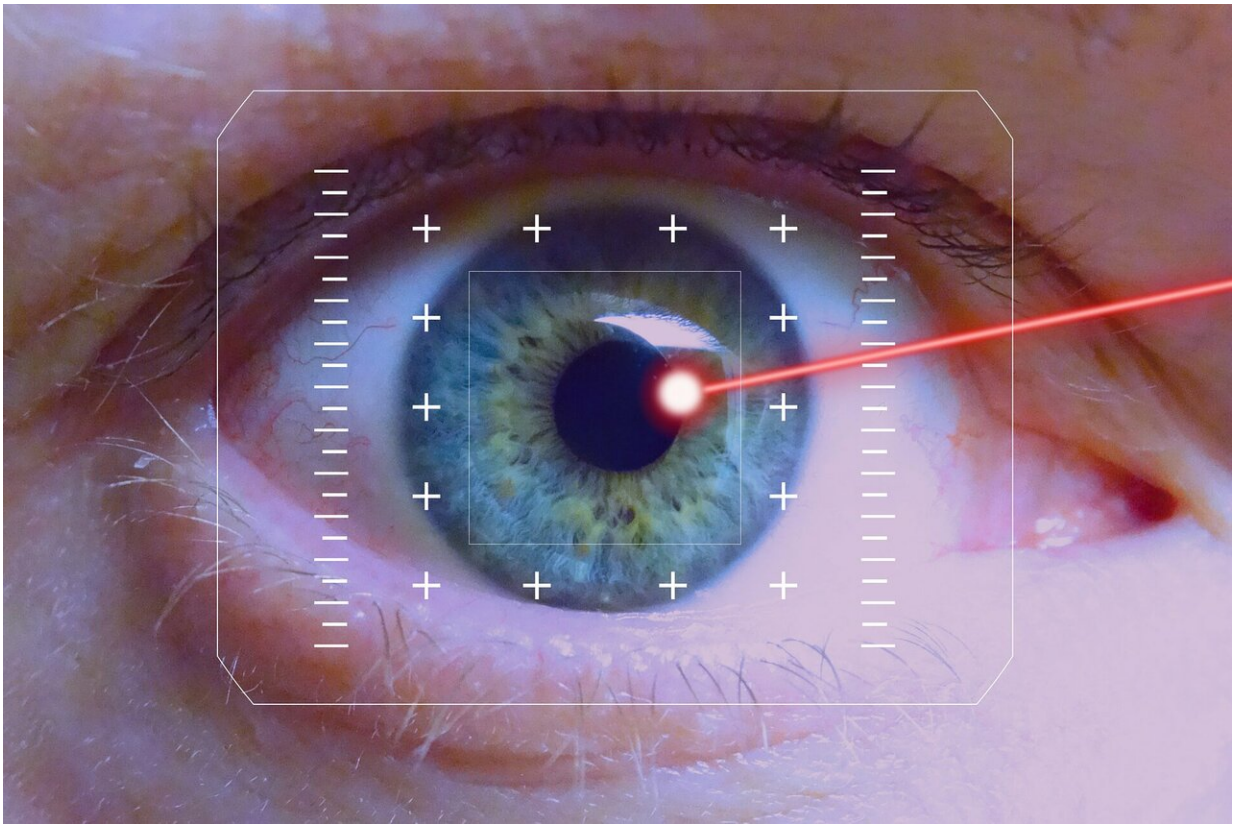

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Although currently laser surgery is a very popular tool for various vision disorders correction, it is still difficult to ensure proper control over the accuracy, efficiency and safety of such procedures. Therefore, Russian

scientists have proposed a new method to describe tissue changes after such operations. This method was described in a series of publications in the *Journal of Biophotonics*, the *Journal of Biomedical Optics* and *Laser Physics Letters*.

For the safe clinical use of lasers for eye surgery, it is crucial to ensure high-precision control of the given shape of the tissue and its stability. At the same time, it is important to evaluate the accompanying changes in the tissue microstructure and its mechanical properties after laser modification. One of the most promising methods for such applications is optical coherence tomography (OCT). OCT occupies a niche between medical ultrasound and optical microscopy as it can visualize the tissue structure by infrared light scattering, with a resolution of up to several microns.

Russian researchers used OCT to investigate tissue deformations and mechanical properties changes. The study was conducted on samples of collagen tissue such as rabbit cornea and pig cartilage that were subjected to the procedures of localized thermomechanical modification by laser.

"We place the cornea or cartilage sample under investigation between two silicone layers with a known stiffness. Visualizing the mechanically produced deformations in such a construction with the help of OCT, it is possible to quantitatively map the distribution of the elastic modulus of the tissue under investigation, both before and after laser thermomechanical modification," says Vladimir Zaitsev, head of the laboratory of wave methods for studying structural- Heterogeneous media IAP RAS.

The results are in good agreement with the data obtained by microscopy methods and in theoretical computer simulations. However, optical coherent elastography does not require special preparation of the drug

using dehydration, staining and other destructive procedures. The non-invasive elastographic approach can be used in medicine for the quick assessment of the long-term stability of cartilage implants prepared by laser reshaping, as well as for monitoring the procedures of thermomechanical cornea modification and various diagnostic studies.

"Preliminary results make it possible to count on the promise of using OCT-elastography to perform" optical biopsy "of tumor diseases, and not just to distinguish between tissue in the normal state and pathology," concludes Vladimir Zaitsev.

More information: Vladimir Y. Zaitsev et al, Revealing structural modifications in thermomechanical reshaping of collagenous tissues using optical coherence elastography, *Journal of Biophotonics* (2018). DOI: 10.1002/jbio.201800250

A L Matveyev et al. Vector method for strain estimation in phase-sensitive optical coherence elastography, *Laser Physics Letters* (2018). DOI: 10.1088/1612-202X/aab5e9

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