inSight

December 2019

A PUBLICATION OF THE KENTUCKY LIONS EYE CENTER AT THE UNIVERSITY OF LOUISVILLE

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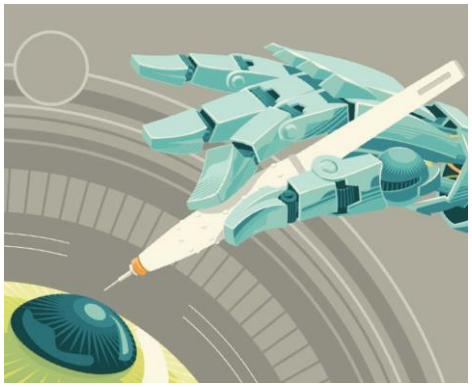
Robot Assisted Eye Surgery

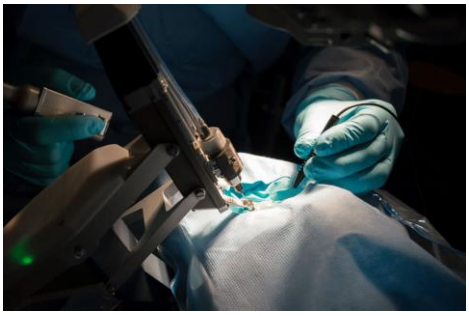


Robot-assisted intraocular surgery is currently under development and these technologies are at the stage of first-in-human studies and the first approved platform appearing in Europe.

Challenges are numerous, including precision to handle micron size tissues, spatial resolution and depth perception, measuring and using the appropriate force to move, peel tissues with extreme delicacy.

"Steady Hand" at John Hopkins University
It is a hand-held robotic system – still in pre -clinical development stage - designed around an X-Y-Z axis to move tools in any direction, has a roll mechanism that moves the arm for better eye access and a tilt mechanism to change the angle of an instrument. The John Hopkins team is developing micro-force sensors to integrate into its robotic technology so the robot can "feel" very small forces and provide a feedback to the surgeon. A distance sensor also helps the robot to barely touch tissue and to avoid it – if necessary. This robot technology can surpass human limitations in multiple ways.

"Preceyes" **(**BV Surgical System Netherlands)



This is a hybrid design which allows the surgeon to decide when and how to use the robot during a procedure. A motion controller positioned in the surgical field records the surgeon's movements, which are filtered and enhanced by the computer prior to being fed to a tissue manipulator – all of this in real time. This device is at least 10 x more precise than a human hand. Such precision will provide us with better clinical outcomes in a less stressful environment.

First-in-human study
Eye-surgeons published the first in-human study of the safety and viability of intraocular robot assisted surgery. 12 patients were randomly assigned to traditional or robot assisted vitreoretinal surgery using *Preceyes.* This preliminary study demonstrated the safety of the robot assisted surgery although with longer duration of the surgery.

UCLA Platform
Intraocular Robotic Interventional Surgical System
Fully automated cataract surgical robotic platform and a vitreoretinal robotic platform using augmented feedback, both visual and tactile.
In this platform, the surgeon's input is filtered and processed by the robotic technology.
This system is not ready for clinical trials yet.

Future of robotic surgery in Ophthalmology
It will improve safety in microsurgical education, it could be potentially used to reach more ophthalmologists in training. Other uses of the technology may lie in standardized surgical technique during clinical trials, it could be used to deliver chemotherapeutics into feeder vessels of intraocular tumors with great precision. Remote surgery could become possible as well.

Remaining barriers.
Surgeon and patient acceptance, practical issues as operating time, initial cost outlays, technical maintenance and insurance coverage.

This technology is not intended to replace the surgeon; it is intended to improve care.

Channa R et al. *Retina,* **2017**; *37(7): 1220-1228.*
Nuzzi R, Brusasco, L. *Eye Brain,* **2018;** *10: 13-24*
Edwards, T L et al. *Nat. Biomed Eng.,* **2018**: *(2): 649-656*

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