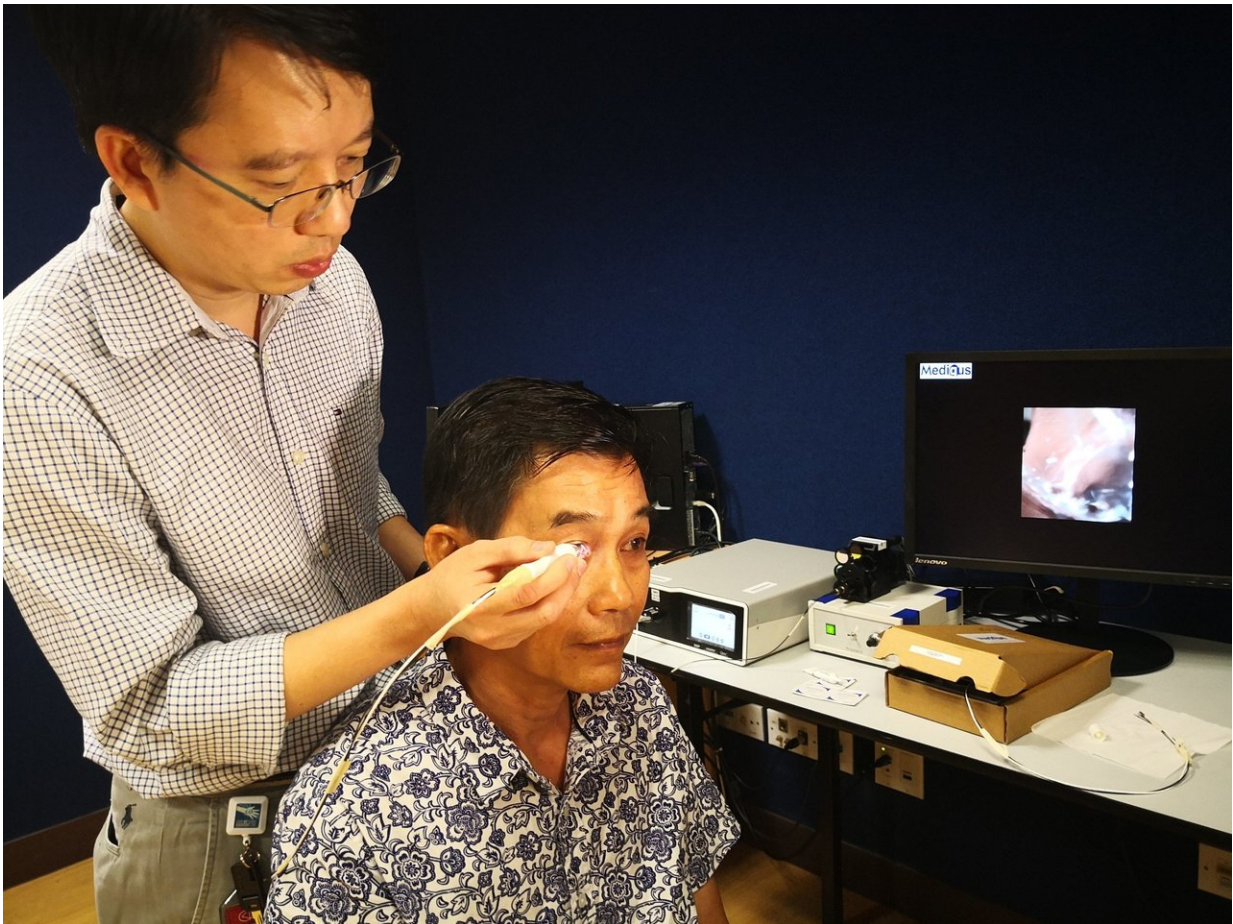


NTU Singapore and SERI invent new scope to diagnose glaucoma

April 5 2018



(left) SERI research assistant Dr Tin Aung Tun uses the GonioPEN to diagnose the type of glaucoma in Mr Loke Yew Chong, 59. Credit: Nanyang Technological University

Scientists at Nanyang Technological University, Singapore (NTU Singapore), with clinicians from the Singapore Eye Research Institute (SERI), have invented a new 'pen camera' that makes it easier for doctors to diagnose patients with glaucoma.

The 'pen camera', called the GonioPEN, could help tackle the eye disease with its ability to detect the type of [glaucoma](#) in a faster and cheaper manner. It causes negligible discomfort, unlike the current gonioscopes, which are glass scopes that must be pressed against the eyeball of the patient for doctors to look at the eye's drainage canal to diagnose the cause.

Glaucoma is a leading cause of blindness in the world. It has no early symptoms, but a build-up of pressure inside the eye can be an indicator. In Singapore, about three per cent of people over the age of 40 years – or over 65,000 people – have glaucoma. This percentage rises with age.

Built by a team led by NTU Associate Professor Murukeshan Vadakke Matham, Director of NTU's Centre for Optical and Laser Engineering, in collaboration with Professor Aung Tin, the Executive Director of SERI, the GonioPEN allows doctors or trained technicians to capture more detailed images of the eye drainage canal with minimal contact at the side of the cornea. A software is then used to analyse the images, helping doctors and eye specialists with their diagnosis.

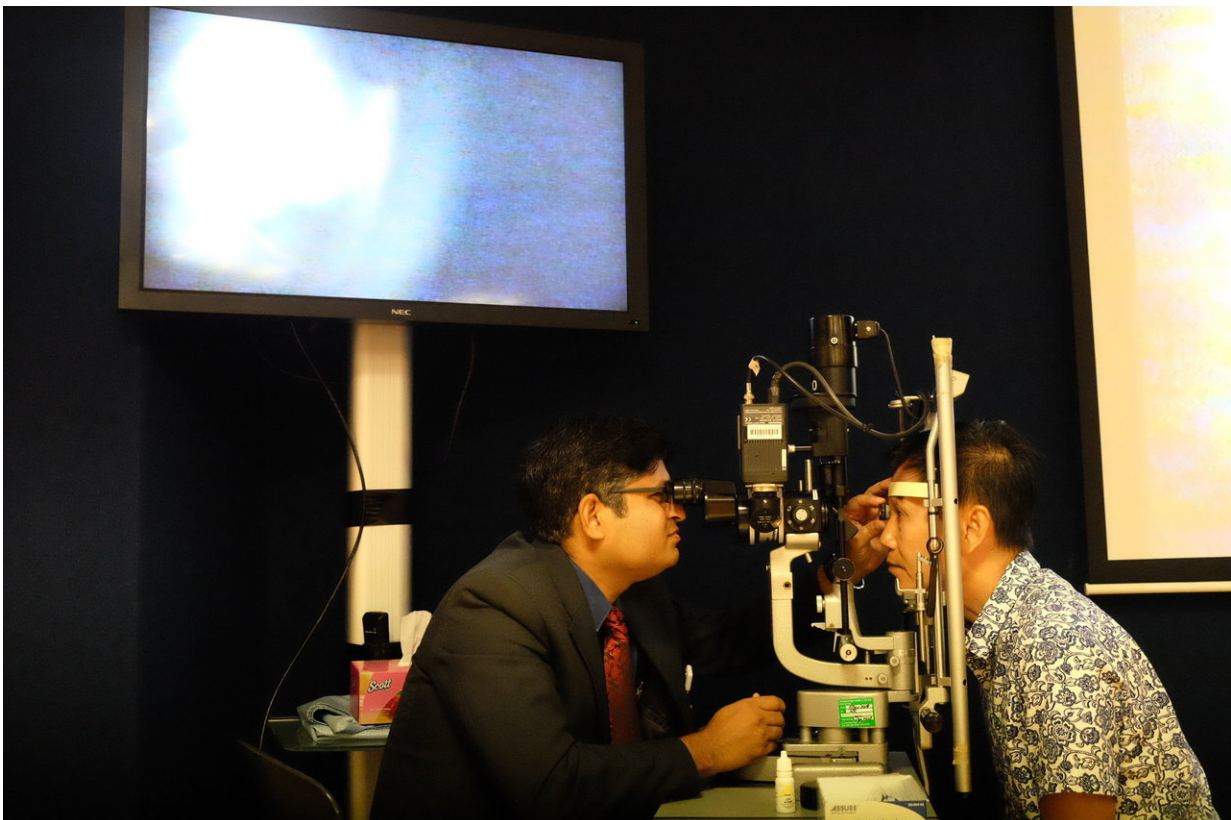
In a recent pilot study by Assistant Professor Baskaran Mani from SERI, all 20 patients found the GonioPEN more comfortable than the conventional hand-held lens used with a microscope – a gold standard used in clinics now.

As the current gonioscopy method takes up to 15 minutes to perform and requires a skilled specialist's expertise to diagnose the problem on the spot, it is not done in clinics as a routine, said Asst Prof Mani. As a

result, half the patients here do not go through the test in clinics, leaving glaucoma largely undiagnosed here, he added.

The GonioPEN circumvents these problems with its ability to quickly capture in just three minutes high-resolution digital images of the eye from the side of the cornea. The images, which could be taken by a technician, are reviewed separately by the eye specialist, shortening the time the patient's eye needs to be under the microscope as the specialist makes his diagnosis as in the existing method.

Innovative devices such as the GonioPEN, developed on campus, are aligned with NTU's Smart Campus vision of harnessing the power of digital technology and tech-enabled solutions to support better learning and living experiences, the discovery of new knowledge, and the sustainability of resources.



Currently, an eye specialist determines the type of glaucoma through a gonioscope, a hand-held lens put in direct contact with the eye. The specialist then peers through a microscope paired with the lens to make a visual diagnosis. Credit: Nanyang Technological University

Assoc Prof Murukeshan, who is from NTU's School of Mechanical and Aerospace Engineering, said: "With the GonioPEN, a digital camera image of a higher resolution can now be stored for future reference and retrieved easily. A technician could perform the gonioscopy before a specialist reviews the images to give an in-depth diagnosis or a second opinion. Doctors can also better track the changes in their patients' condition over time.

"The GonioPEN's ease of use means it can be used by primary, secondary or private eye care physicians, while its compact size makes it portable for all healthcare set-ups. The cost is also kept low because a microscope is no longer required."

Prof Aung Tin, who is also Deputy Medical Director (Research) at the Singapore National Eye Centre, said that in the digital era of healthcare and future teleophthalmic care possibilities, such a device will enable advancement in the standard of medical care. "The GonioPEN, with its compactness and integration to our electronic medical records, will achieve such goals for the future eye care model in Singapore," he added.

How it works

In glaucoma, high pressure within the eye is caused by an imbalance

between fluid production and its drainage out of the eye, typically caused by clogged drainage channels.

An eye specialist determines the type of glaucoma through a gonioscope, a hand-held lens put in direct contact with the eye. The specialist then peers through a microscope paired with the lens to make a visual diagnosis. Each type of glaucoma will require a different form of treatment.

The drawback of this manual method of peering through a lens is that the doctor cannot review the image of the eye at a later date. While there are other machines on the market that can capture images of the angle with or without any direct contact with the eye, they are expensive, ranging from US\$25,000 to US\$120,000 (S\$33,000 to S\$158,000).

In contrast, the GonioPEN combines a high-resolution camera and LEDs for illumination to take a high quality image of the human eye. The prototype pen camera, estimated to cost \$5,000, is connected to a computer via a USB cable. The camera captures images of the eye from four different perspectives and saves it to the computer, which can then be magnified several times for a better diagnosis by an eye doctor.

Asst Prof Mani said the prototype device is portable and digital, allowing a trained technician to capture images of the eye quickly with minimal training. He added: "With GonioPEN, the diagnosis can be generated with an automated software, instead of only relying on a doctor's expertise. This saves time for both doctors and patients involved in [eye care](#), allowing more patients to be examined in clinics. Clinically, patients found the GonioPEN more comfortable than a gonioscope."

Provided by Nanyang Technological University

Citation: NTU Singapore and SERI invent new scope to diagnose glaucoma (2018, April 5)
retrieved 25 April 2024 from

<https://medicalxpress.com/news/2018-04-ntu-singapore-seri-scope-glaucoma.html>

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