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NTU and The Eye Institute at Tan Tock Seng Hospital collaborate to bring nanotechnology into microsurgery

A team from Nanyang Technological University (NTU) and The Eye Institute at Tan Tock Seng Hospital (TEI@TTSH) is developing a revolutionary method of cataract-removal.

The new technique taps nanotechnology to minimize the risks of current cataract surgery. It involves the use of a specially developed device called piezoelectric micro-actuator and uses mechanical forces as well as ultrasonic energies to break down cataracts. The surgeon is able to have more control and can remove a relatively dense cataract with just a small incision.

Cataract surgery is one of the most performed surgeries in the developed world today. In Singapore, cataract surgery is one of the top ten surgeries, in terms of volume, performed in public hospitals. In 2004, 23,259 cataract surgeries were performed in Singapore. †

Current cataract surgery employs a technique called phacoemulsification, which uses ultrasound waves to break down cataracts in the eye, before removing the emulsified material and replacing it with an artificial lens. Such method carries a small risk of cornea damage due to the uncontrolled heat transfer from the ultrasound waves.

† Source: MOH Information Paper 2006/012
The team from NTU’s School of Materials Science & Engineering (MSE) and TEI @ TTSH has been developing and enhancing the new technique since 2002. The team comprises Dr Lim Tock Han, Director, TEI, National Healthcare Group and Head, TEI @ TTSH; Dr David Chan, Registrar, TEI @ TTSH as well as Assoc Prof Ma Jan, Vice-Dean (Academic) and Prof Freddy Boey, Dean, NTU School of Materials Science and Engineering.

On the new technique, Dr Lim says, “This new method departs from the current phacoemulsification technique of cataract surgery as phacoemulsification technique uses ultrasonic energy to break down cataracts in the eye. Energy released from phacoemulsification ultrasonic tip radiates outwards. That may damage the cornea, which could result in the cornea becoming cloudy many years later.”

With this aim in mind, the team investigated other ways in which the force applied to break down cataracts can be localized and controlled. Led by Assoc Prof Ma and Prof Boey, the research team from NTU provides its expertise in the area of smart nanomaterials by developing a unique device to make this kinder way of extracting lens possible.

Says Assoc Prof Ma, “Through NTU MSE’s long-standing expertise and cutting-edge research in nanotechnology, our team developed a piezoelectric micro-actuator. This surgical instrument, besides being power-friendly and portable, also combines mechanical and ultrasonic energy into a single instrument, giving doctors performing cataract surgery the flexibility of alternating between the two methods, depending on the density of cataract and stage of surgery. This instrument is especially useful for such minimally invasive surgery.”

Explains Dr Lim; “The microactuator can transmit energy into the eye in a more controlled manner. This has not been possible before the introduction of nanotechnology.”

The joint project brings together NTU School of Materials Science and Engineering’s (MSE) expertise in biomaterials technology and TEI at TTSH’s proficiency in cataract surgery. This research is currently in the stage of testing in animal models and pending patent.

Assoc Prof Ma Jan adds, “NTU has always been at the forefront of biomedical technology, with a successful track-record in developing such technology and devices. However it is even more important to translate such R&D into products and technique that can actually be used on patients to benefit them. Our collaboration with TTSH is yet another example of how our research has important real-world use. By coupling our expertise with TTSH’s capabilities, we are able to bring to the market new clinical techniques and devices in a shorter time, thus benefiting the patients.”

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About Nanyang Technological University

Nanyang Technological University (NTU) is a research-intensive university with globally acknowledged strengths in science and engineering. The university has a beautiful garden campus and a distinguished lineage with roots that go back to 1955.

NTU's 12 schools span diverse disciplines – from engineering and the sciences to art, design and media. The university has a strong engineering college focused on innovation, a business school with one of the top 100 MBA programmes in the world, an internationally-acclaimed National Institute of Education, one of the best communication and information schools in Asia, and a biological sciences school at the forefront of Singapore's life sciences initiative. The Institute of Defence and Strategic Studies is a world authority on terrorism issues.

Ranked among the top 50 universities in the world, NTU has in place multi-country programmes and initiatives, many established through its strategic alliances with 300 institutions in more than 45 countries, including Massachusetts Institute of Technology, Stanford University, California Institute of Technology, Cornell University, Cambridge University, and Beijing University.

For more information, visit www.ntu.edu.sg

About The Eye Institute at Tan Tock Seng Hospital

Formed in year 2000, The Eye Institute of the National Healthcare Group oversees the ophthalmic services of Alexandra Hospital, National University Hospital and Tan Tock Seng Hospital. TEI@TTSH performs about 6000 cataract surgeries per year. Although it has achieved one of the highest success rates (99%) in a recent published MOH survey, it is continually finding innovative ways to improve on the outcome of cataract and other surgeries.

For more information, visit http://www.tei.nhg.com.sg

About cataract surgery

Cataract surgery is one of the top ten surgeries, in terms of volume, performed in public hospitals in Singapore. The number of cataract surgeries in Singapore has gone up from 10,346 in 1995 to 23,259 in 2004.

Cataract surgery is usually a non-emergency day surgery, which is carried out under local anaesthesia and does not require the patient to stay in hospital. Occasionally patients with cataract may also have other pre-existing diseases and may need to be hospitalised. The surgery involves the removal of the opaque lens of the eye and its replacement with an artificial lens.
Phacoemulsification, or ultrasonic cataract removal is a procedure where the cataract in the eye is broken into small pieces by sound vibrations and removed. It is then replaced with an artificial lens called the intraocular lens (IOL). This is the more popularly done technique. A very small cut of about 3 mm is made on the cornea and a small ultrasound probe is inserted into the lens. The lens is broken down into small pieces by sound vibrations and is then sucked out of the capsule of the lens. A foldable IOL is implanted in the capsule. The procedure takes about 20-30 minutes. The small cut does not need stitches and will heal by itself.

**About piezoelectric micro-actuator**

This surgical instrument, besides being power-friendly and portable, also combines mechanical and ultrasonic energy into a single application, giving doctors performing cataract surgery the option of choosing between two methods of cataract-removal, depending on the severity of each patient's case.