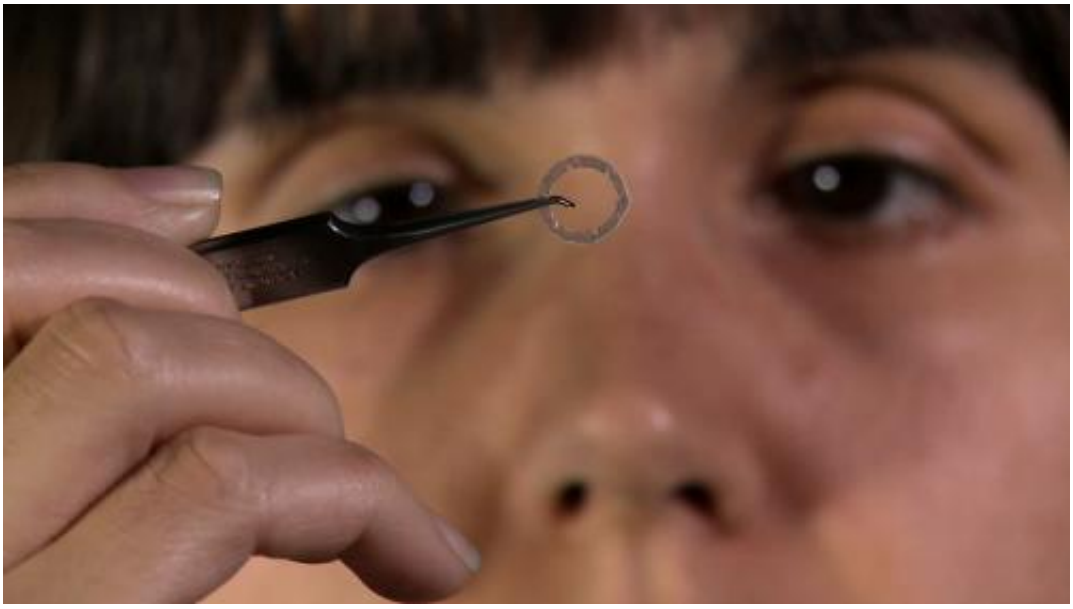
New technique to deliver stem cell therapy may help damaged eyes regain their sight

December 5 2012



EPSRC Fellow, Dr. Ílida Ortega Asencio, examines a disc of biodegradable material which can be fixed over the cornea. The disc, developed by Dr. Ortega and her colleagues from the University of Sheffield's Faculty of Engineering, is loaded with stem cells which, when the disc is grafted to the eye, will multiply, allowing the body to heal the eye naturally. The aim is to effect the natural repair of eyes damaged by accident or disease, enabling millions of people across the world to retain or even regain - their sight. Credit: GovEd Communications

In research published in the journal *Acta Biomaterialia*, researchers from the University of Sheffield describe a new method for producing membranes to help in the grafting of stem cells onto the eye, mimicking

structural features of the eye itself. The technology has been designed to treat damage to the cornea, the transparent layer on the front of the eye, which is one of the major causes of blindness in the world.

Using a combination of techniques known as microstereolithography and electrospinning, the researchers are able to make a disc of biodegradable material which can be fixed over the cornea. The disc is loaded with stem cells which then multiply, allowing the body to heal the eye naturally.

"The disc has an outer ring containing pockets into which stem cells taken from the patient's healthy eye can be placed," explains EPSRC Fellow, Dr Ílida Ortega Asencio, from Sheffield's Faculty of Engineering. "The material across the centre of the disc is thinner than the ring, so it will biodegrade more quickly allowing the stem cells to proliferate across the surface of the eye to repair the cornea."

A key feature of the disc is that it contains niches or pockets to house and protect the stem cells, mirroring niches found around the rim of a healthy cornea. Standard treatments for corneal blindness are corneal transplants or grafting stem cells onto the eye using donor human amniotic membrane as a temporary carrier to deliver these cells to the eye. For some patients, the treatment can fail after a few years as the repaired eyes do not retain these stem cells, which are required to carry out on-going repair of the cornea. Without this constant repair, thick white scar tissue forms across the cornea causing partial or complete sight loss. The researchers have designed the small pockets they have built into the membrane to help cells to group together and act as a useful reservoir of daughter cells so that a healthy population of stem cells can be retained in the eye.

"Laboratory tests have shown that the membranes will support cell growth, so the next stage is to trial this in patients in India, working with

our colleagues in the LV Prasad Eye Institute in Hyderabad," says Professor Sheila MacNeil. "One advantage of our design is that we have made the disc from materials already in use as biodegradable sutures in the eye so we know they won't cause a problem in the body. This means that, subject to the necessary safety studies and approval from Indian Regulatory Authorities, we should be able to move to early stage clinical trials fairly quickly."

Treating corneal blindness is a particularly pressing problem in the developing world, where there are high instances of chemical or accidental damage to the eye but complex treatments such as transplants or amniotic membrane grafts are not available to a large part of the population.

The technique has relevance in more developed countries such as the UK and US as well, according to Dr Frederick Claeyssens. "The current treatments for corneal blindness use donor tissue to deliver the cultured cells which means that you need a tissue bank. But not everyone has access to banked tissues and it is impossible to completely eliminate all risks of disease transmission with living human tissue," he says. "By using a synthetic material, it will eliminate some of the risk to patients and be readily available for all surgeons. We also believe that the overall treatment using these discs will not only be better than current treatments, it will be cheaper as well."

More information: 'Combined microfabrication and electrospinning to produce 3D architectures for corneal repair' by Ílida Ortega, Anthony J. Ryan, Pallavi Deshpande, Sheila MacNeil and Frederik Claeyssens is available online pre-publication in the next issue of *Acta Biomaterialia*: dx.doi.org/10.1016/j.actbio.2012.10.039