Drug-delivering contact lenses revealed

Contact lenses that release controlled doses of drugs to treat eye diseases such as glaucoma have been created by nano-engineers in Singapore.

Most eye medications are delivered by drops. But most of the drug quickly flows away from the eye, often draining into the nasal cavity and then entering the bloodstream. “Eye drops are cumbersome, and they lead to drug wastage and side effects,” says Edwin Chow at the Institute of Bioengineering and Nanotechnology.

The new technique involves mixing the drug with a pre-polymer liquid. This mix is then polymerised, creating a transparent contact lens material.

If the drug is water-soluble, it will be trapped within a network of tiny inter-connected, water-filled channels in the material. If it’s water-insoluble, it will be trapped within nano-spaces in the polymer matrix, and slowly leach out into the channels. In contact with fluid on the eyeball, these channels open up and release the drug.

By varying the water content of the original mix, the team can vary the size of the channels, and so control the rate at which the drug leaks out onto the eye.

Not a dry eye

Previous attempts to create drug-releasing contact lenses have been plagued with problems, including preventing sufficient oxygen through to the eye - which can cause blood vessels to grow into the oxygen-deprived cornea. The nanostructure of the new lenses, with the inter-connected channels, allows gases, salts and nutrients to readily diffuse across, says Chow.

So far, the team has tested the lenses in the lab using a water-soluble glaucoma medication and a water-insoluble antibiotic. They found they could precisely control the release of the drugs over a few hours or even a few days.

Improved methods of administering medication to slow the progression of glaucoma are badly needed, they say. The disease, which is caused by damage to the optic nerve and leads to blindness, affects an estimated 60 million people worldwide.

The technique could also help contact lens wearers who suffer from dry eyes, since the lens material could be modified to contain a lubricating solution, suggests Chow.

A team at the University of Florida is also working on nano-engineered lenses to deliver drugs. Their approach is to encapsulate drugs in nanoparticles, and then to add these particles to their contact lens material before polymerisation. But at high drug doses, this might produce less lens clarity than is possible with the Singapore technique, says Chow.

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