Can a contact lens help treat glaucoma?

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While an undergraduate in biochemistry at McMaster, Michelle Fernandes worked as a researcher for a biotech company. Now a master's candidate in chemical engineering, she credits that co-op work experience with sparking her interest in applied science.

"I definitely knew I wanted to work in an area that involved health care or medical devices, and I thought drug delivery was really interesting," she says. For her master's thesis, Fernandes is exploring one way in which we might administer drug into the eyes of glaucoma patients, using a special kind of contact lens.

Currently, when a glaucoma patient attempts to administer his or her medicine, much of the drug is wasted and will not make it past the cornea. "Only about five per cent of the drug actually gets to the intraocular tissue," says Fernandes. By using a contact lens, the aim is to increase the contact time on the cornea, which would then increase the chance of getting the drug to where it needs to be, without the patient having to worry about it.

Fernandes' thesis is titled "Silica particles for hydrophobic drug delivery from silicone hydrogels." In a nutshell, this means: Is it possible to load silica particles (which contain the drug) into a silicone hydrogel contact lens material, in order to prolong the delivery of the drug into the eyes of glaucoma patients?

Fernandes chose the topic from a list provided by her thesis supervisor, Heather Sheardown, a professor of chemical engineering at McMaster

and Associate Dean of Graduate Studies (Engineering). "I'd already done some particle synthesis work in that co-op experience with the biotech company," explains Fernandes. "The idea of exploring drug delivery, through particles loaded into contact lenses, was really interesting to me."

Fernandes points out that the concept of using contact lenses for drug delivery has been around since the 1960s. Researchers in Sheardown's lab are pushing that idea further – for example, by exploring different silicone hydrogel-based materials (some of which are now used in contact lenses that can be worn overnight). "Ideally, we'd like to get the drug delivered through silicone hydrogels, because they have the potential for prolonged wear," Fernandes says. Silicone – not to be confused with "silicon" – allows oxygen to permeate the hydrogel material and pass through the cornea.

She explains that her research is somewhat different from that of her colleagues in the lab. Rather than adding the drug directly into the gel formulation, she is experimenting with incorporating drug-loaded particles into the silicone hydrogel, which may protect the drug from the synthesis procedure and act as an additional barrier to drug release – very important, so that the drug is released in a controlled manner and over a prolonged period of time. "By loading the drug into a particle, you might be able to tune particle properties to assist in controlling the drug release behaviour," Fernandes explains.

Can we look forward to a time when we can get prescription contact lenses with our own personalized drug formulation loaded into them? Perhaps. In the meantime, much research still needs to be done – and that's well before any testing can begin (first on cells, then animals, and then humans). Fernandes points out that, right now, her lens materials are not as transparent as they would need to be to become viable contact lenses.

"As with any research, there's a lot of reading papers and reviewing the literature. You develop your protocols and you really work on your methodology to tune your system to get it to work. Sometimes things work, and a lot of the time they don't. But when they do, it's great!"

Fernandes hopes to wrap up her thesis by the end of the summer. She credits her McMaster experience with teaching her valuable skills, such as problem solving, attention to detail, and the ability to design experiments. It has also given her the opportunity to interact with experienced scientists in a collegial lab environment. Her goal is to work in industry, conducting research on medical devices or in the pharmaceutical field.

"I really enjoy this, because it's actually affecting humans and health care, and potentially improving the quality of life. I think that's really great."

Provided by McMaster University