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THE PROBLEM AND ITS SIGNIFICANCE



- ❖ Infectious disease of the cornea (**Figure 1**), represents a major health care problem worldwide and >90% of individuals with corneal blindness live in low to middle income countries.
- ❖ **Trachoma** is the world's leading cause of preventable blindness (affecting >21 million people worldwide). It starts with conjunctivitis (pink eye), itching and irritation, and a roughening of the inner surface of the eyelids but can quickly escalate to increased pain, scarring inside the eyelid, and ultimately, vision loss (**Figure 2**).
- ❖ Many difficult-to-treat corneal infections also occur in developed countries e.g. **Acanthamoeba keratitis**, which is caused by water-borne microscopic organisms that are often found in heated swimming pools and hot tubs (**Figure 3**).
- ❖ Treating with eye drops is problematic because they are quickly lost by blinking and washed out by tears. There is a need for new, more efficient technologies to deliver medications to the cornea.

RESEARCH AIM: to investigate the potential of novel drug-loaded contact lenses as an alternative, more effective drug delivery method than standard care eye drops.

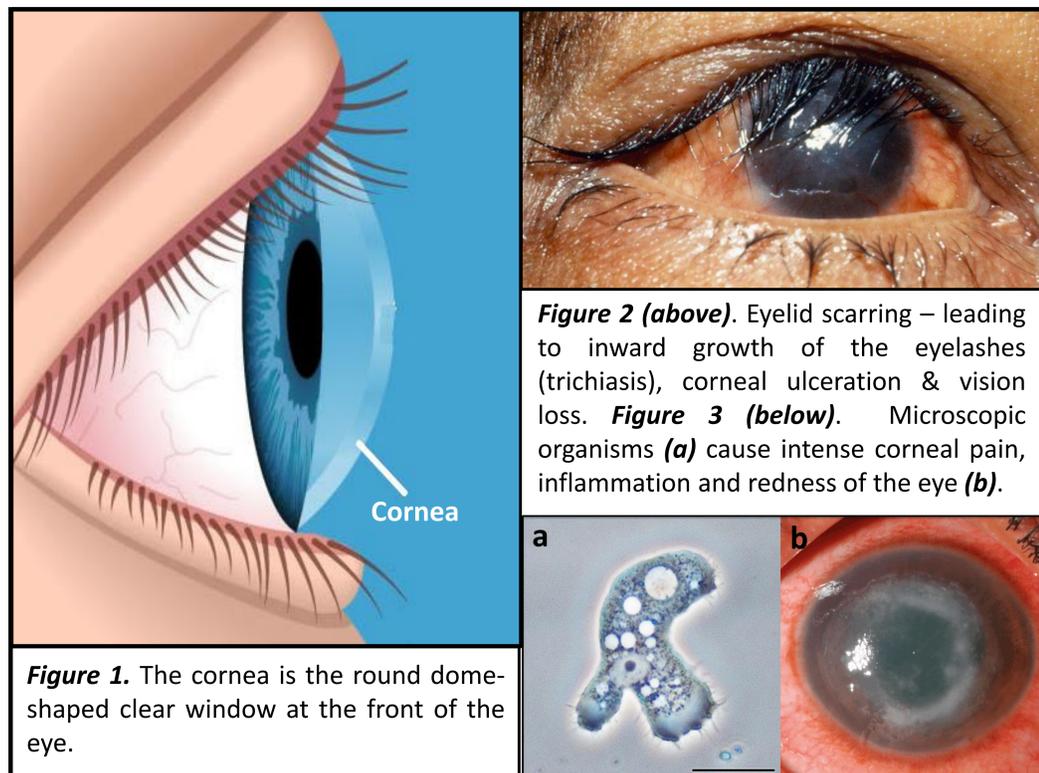


Figure 2 (above). Eyelid scarring – leading to inward growth of the eyelashes (trichiasis), corneal ulceration & vision loss. **Figure 3 (below).** Microscopic organisms (**a**) cause intense corneal pain, inflammation and redness of the eye (**b**).

EXPERIMENTAL METHODS

- ❖ Contact lenses are soaked overnight in antimicrobial drug solutions and applied to pig eyeballs obtained from a local abattoir (**Figure 4a**).
- ❖ Eyes are kept at 37°C (normal body temperature) in a water bath (**Figure 4b**) and artificial tears are applied to mimic real-life conditions.
- ❖ Corneas are then removed using surgical scissors (**Figure 4c**) and the delivered drug is separated from the cornea by solvent extraction.
- ❖ The amount of drug obtained from each cornea is measured using High Performance Liquid Chromatography (HPLC), which can separate, identify, and quantify different substances.
- ❖ The effect of the drugs on corneal cells is also tested to ensure that they do not reach toxic levels at the concentrations delivered via the lenses (**Figure 4d**).

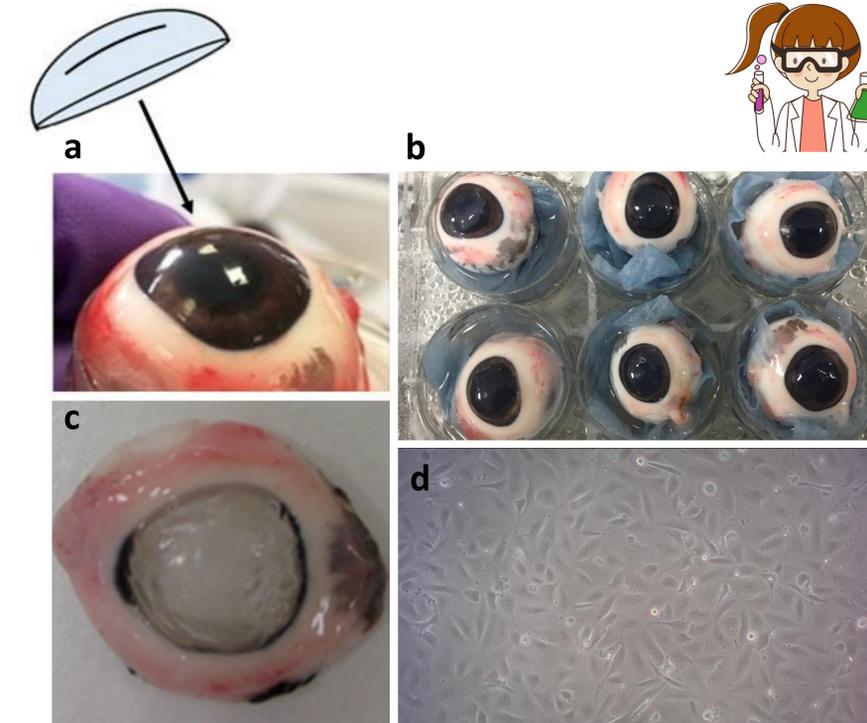


Figure 4. The drugs are tested on pig corneas (via contact lenses) (**a-c**) and corneal cells (**d**) in the laboratory to ensure they are both effective and safe before being used clinically.

ACHIEVEMENTS SO FAR

- ❖ We have shown that drug-loaded contact lenses are capable of delivering higher levels of antimicrobial drugs to the cornea than eye drops, and importantly they are relatively safe, showing little impact on the corneal cells that are essential for vision (**Figure 5**).¹
- ❖ The methods we have developed are now being used to test the efficacy of contact lens delivery for a wide range of drugs (including antivirals), which are aimed at treating a multitude of devastating eye conditions.
- ❖ Drug-loaded contact lenses represent a major advancement in drug delivery to the eye and show great potential for improving the treatment of corneal infections.

REFERENCES

1. Morgan, S.R., et al. (2020) Controlled *in vitro* delivery of Voriconazole and Diclofenac to the cornea using contact lenses for the treatment of *Acanthamoeba* Keratitis. *Int J Pharm.* 579:119102.

