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\$10,000 "Cure it!" Lemelson-MIT Student Prize Undergraduate Team Winner

Novel Device to Revolutionize Eye Corneal Transplants

The Challenge: Despite the fact that over three million Americans are at risk from corneal diseases¹, there is only one available cure: corneal transplants, a surgical procedure that replaces damaged eye tissue with healthy tissue. Corneal transplant surgeries that utilize the Descemet's Membrane Endothelial Keratoplasty (DMEK) procedure have become increasingly popular as DMEK is the only treatment option with the ability to restore patients' vision to 20/20².

However, the DMEK procedure has not yet been widely adopted in the United States. Surgeons are reluctant to perform the procedure due to concerns surrounding the surgical instruments needed to help them safely handle the delicate tissue graft involved. In order for the surgery to be successful, the graft must remain completely flat throughout the entire procedure. The graft can easily become damaged when it is inserted into the eye due to its natural tendency to scroll up on itself, similar to how wrapping paper scrolls when pulled off the roll. In fact, from interviews with over two dozen corneal surgeons, the team has found that the unrolling of the graft is a lengthy process, as well as the riskiest and most challenging portion of the operation.

While there are some existing DMEK devices, such as the Bonfadini-Todd injector, the Straiko Modified Jones Tube, and the Geuder Tube, none of them have the capability to ensure that the graft remains completely flat throughout placement. Therefore, these devices are only moderately helpful and do not give surgeons the confidence they desire in order to perform the procedure.

The Solution: The Treyetech team developed an innovative device that allows surgeons to overcome DMEK's greatest obstacle, the unrolling of the graft in the eye during surgery. Treyetech's device is the first of its kind, as it will be the only product on the market with the ability to give surgeons total control of the replacement cornea during a DMEK surgery.

¹ <https://ghr.nlm.nih.gov/condition/fuchs-endothelial-dystrophy#statistics>

² <https://www.ncbi.nlm.nih.gov/pubmed/28923499>

The team’s invention utilizes a graft preparation method known as the tri-fold technique, which manually folds the graft against its natural tendency to scroll and enables the graft to naturally unroll in the eye, freeing surgeons from the fear of the graft scrolling up on itself. Preliminary testing has proven that the device does not cause any damage to the graft. The elimination of the intricate unrolling step will allow surgeons to feel both comfortable with and accepting of the DMEK procedure; as a result, the DMEK surgery will become an option for more patients across the United States.

Treyetech utilizes eye banks to ensure its device is as simple and convenient for surgeons as possible. Eye banks, which harvest and prepare grafts from the tissue of donor corneas, are the sole distributors of corneal tissue to hospitals. With Treyetech’s process, grafts are first fully prepared by an eye bank technician, who completes the tri-fold and loads the graft into the device. Once this has been completed, the graft is then shipped to a surgeon and the prepackaged graft is ready to be inserted and unrolled into a patient’s eye. Treyetech has already spoken with various surgeons and eye banks, who have confirmed that this device is both revolutionary and highly desired.

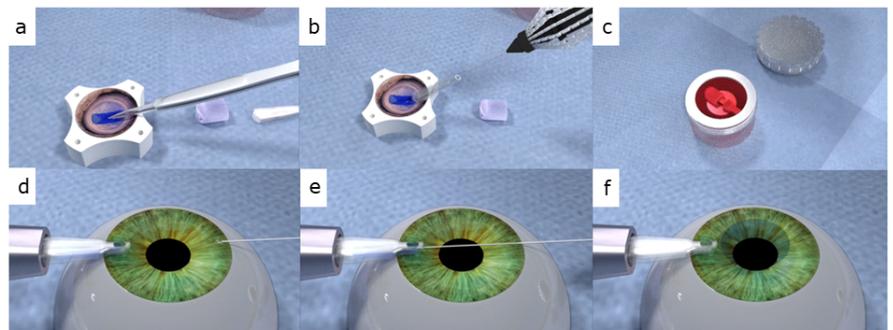
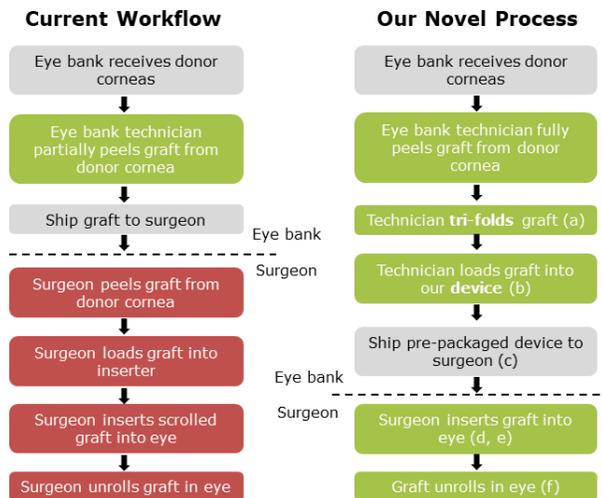


Figure 1: The team’s solution increases cooperation with eye bank technicians to reduce surgeon difficulty.

Commercialization: In order to most effectively get the product on the market, Treyetech plans to sell its device directly to eye banks, which are constantly on the lookout for new technology as a means of differentiating themselves from their competitors. Treyetech will allow eye banks to offer its consumers a new state-of-the-art device, and therefore make them more competitive within their market. Treyetech has verified its device meets the current standard of care with regard to safety.

Out of the 86 eye banks in the U.S., three of them supply almost 40% of all corneal grafts intended for transplant³. Approximately 30,000 DMEK and Descemet's Stripping Automated Endothelial Keratoplasties (a similar but less effective corneal transplant surgery known as DSAEK) procedures are performed every year in the United States⁴.

Treyetech's device can also be utilized by the DSAEK market, as it has the ability to simplify DSAEK in the same way that it does for DMEK. Treyetech has projected that its \$250 device can be used for

58,000 procedures over the next five years, which translates to a total addressable market of over \$14M. However, Treyetech strongly expects these numbers to grow once its device is available on the market.



Figure 2: Treyetech's novel corneal graft inserter.

³ http://restoresight.org/wp-content/uploads/2017/04/2016_Statistical_Report-Final-040717.pdf

⁴ http://restoresight.org/wp-content/uploads/2017/04/2016_Statistical_Report-Final-040717.pdf