

Frozen, Pre-stripped Descemet Membrane Endothelial Keratoplasty (DMEK) Tissues for Surgical Training

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Background

Adoption of DMEK has been on the rise, but a major obstacle to increased utilization of the surgery is its steep learning curve. DMEK skills-transfer labs are an effective venue for surgeons to begin learning the procedure, but tissue availability can sometimes pose a challenge due to the unpredictable and demanding schedule of corneal surgeons.

For eye banks, processing tissue for surgeon training can sometimes require significant resources if a large number of DMEK tissue is needed in a short time frame. For example, a DMEK training course held annually at one of the national ophthalmic meetings can require an eye bank to acquire and prepare between 25 to 30 tissues within days of the event, in addition to the usual volume of tissues prepared for transplant every week.

Therefore, the ability to freeze DMEK tissue after pre-stripping for later use in surgeon training could decrease the burden on eye banks, as this tissue could be prepared, stored, and used at a moment's notice. However, it is unknown whether frozen DMEK tissue behaves comparably to fresh DMEK tissue in a skills-transfer setting.

Purpose

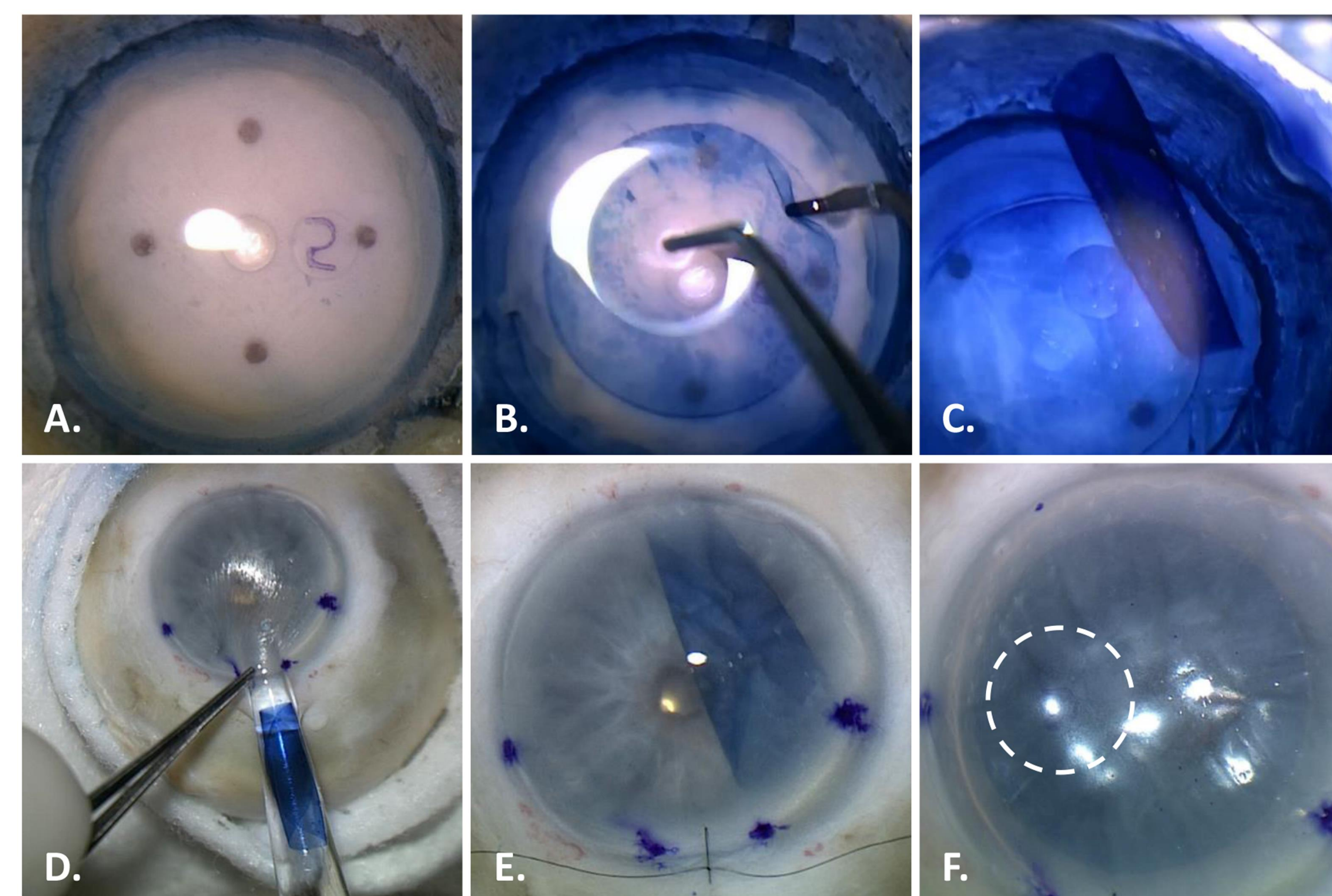
To test whether pre-stripped, previously frozen DMEK grafts can be used as a substitute for freshly prepared tissue for surgical training.

Methods

Twenty pre-stripped DMEK tissues were prepared according to standard protocols. Tissues were frozen and stored in Optisol-GS at minus 80°C. Thawed tissues were examined by DMEK trained cornea surgeons to evaluate tissue handling during graft preparation and tissue behavior after transplantation into donor whole eyes. The scroll width of previously frozen grafts was measured using a calibration grid and compared to previous studies performed using fresh tissue. Eight additional tissues were utilized for cell viability staining and analysis of scrolling tendencies in grafts with no viable endothelium or devoid of endothelium.

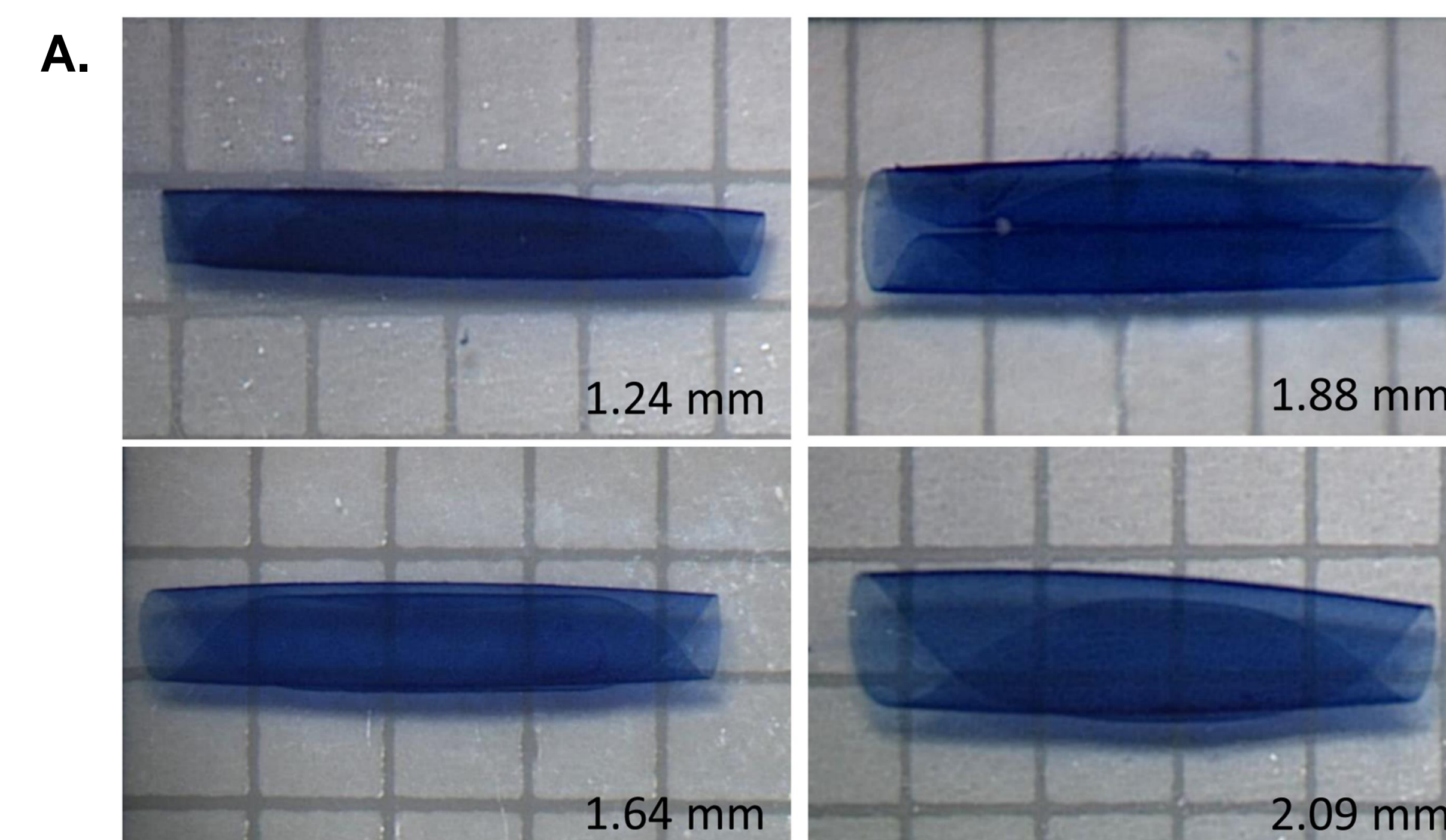
Results

Figure 1: Surgical Handling of Previously Frozen DMEK Tissue



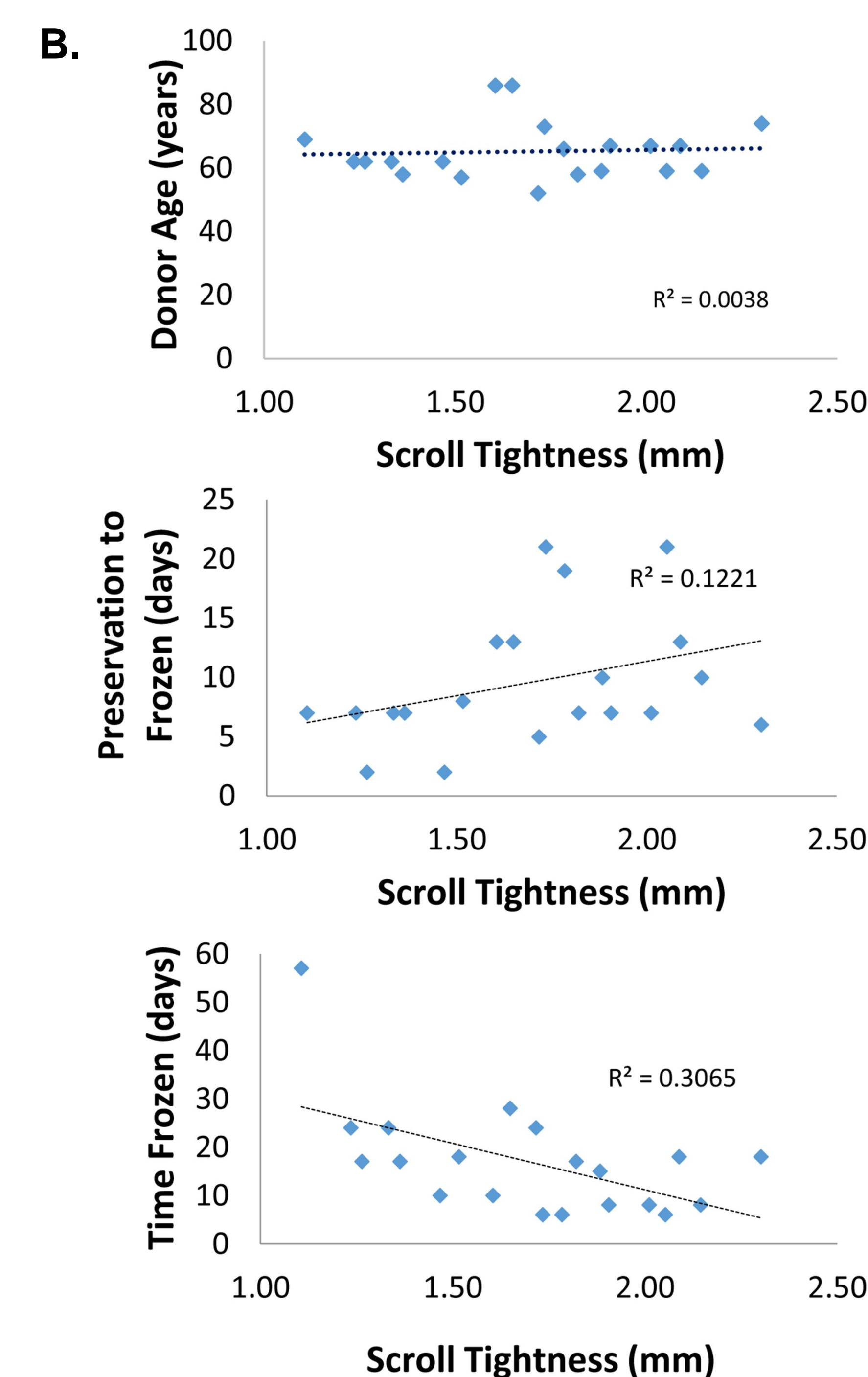
- A) Thawed graft upon removal from viewing chamber.
B) Graft being lifted away from the underlying stroma. The graft was stained with Trypan blue for 30 seconds after trephination to reveal the graft edge.
C) Graft in scrolled conformation after being stained with Trypan blue for 4 minutes and washed with BSS.
D) Delivery of graft into a donor eye using a Modified Straiko injector.
E) Graft inside the anterior chamber during unfolding.
F) Graft fully unfolded and attached to the stroma after injection of an air bubble. The S-stamp (white outline) can be seen and indicates that the graft is in the proper orientation.

Figure 2: Scrolling Tendency of Previously Frozen Tissue



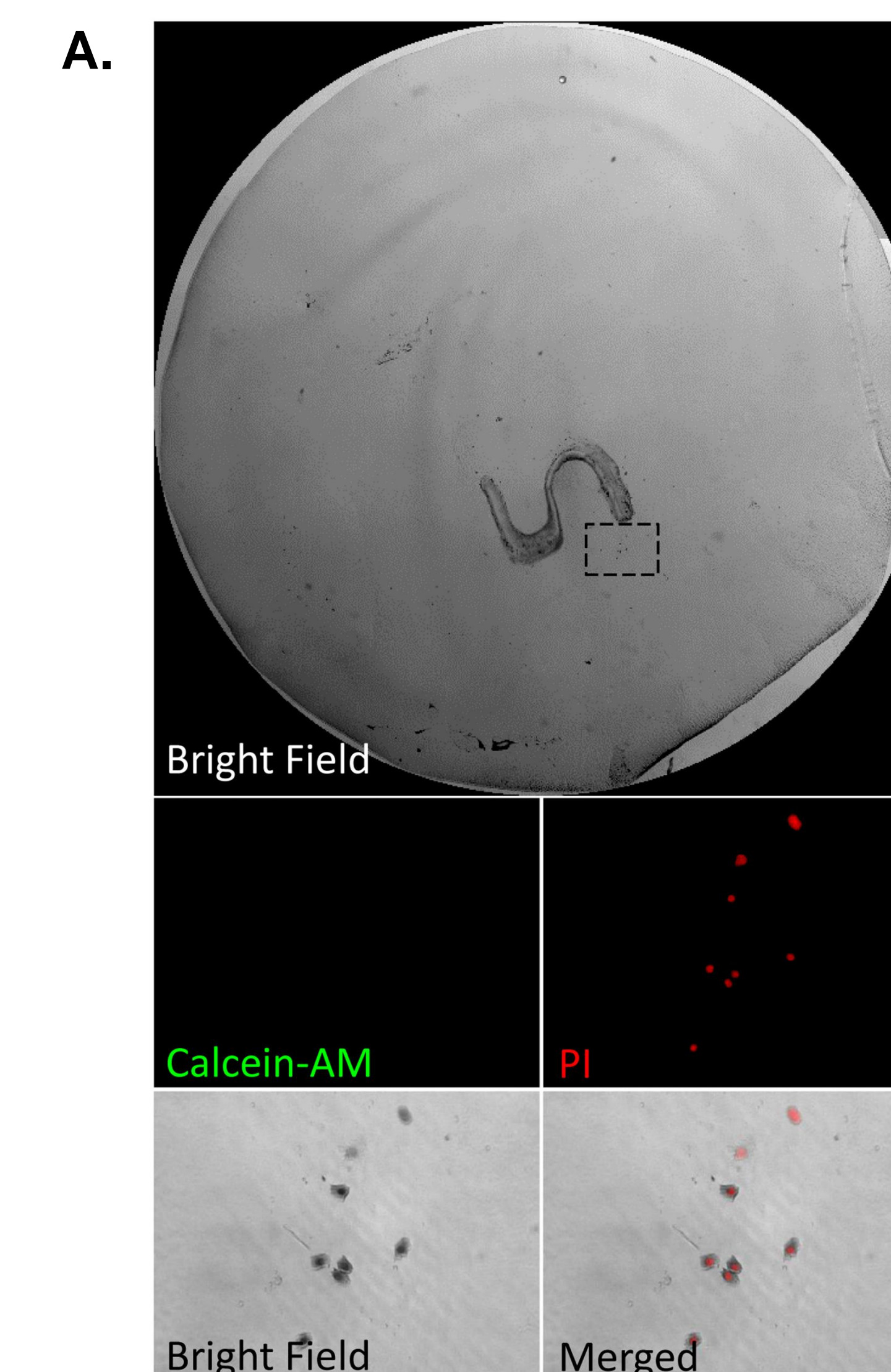
- A) DMEK scrolls floating inside a BSS-filled dish set on top of a measurement grid. The grid lines are 2.0 mm apart. The numbers on the bottom right corner of each panel indicate the scroll width as measured at the widest point. (Top to Bottom) An example of tight scroll in this series (62 year old donor), a tri-fold scroll (86 year old donor), a double scroll (59 year old donor), a loose scroll (67 year old donor).

- B) Correlation between donor tissue parameters and scroll width.



Clinical Relevance

Figure 3: DMEK Graft with No Endothelium



- A) The endothelium of this graft was removed prior to tissue freezing. Close-up of outlined area near the 'S' is shown below demonstrating a lack of cells on the Descemet's membrane.
B) DMEK graft lacking endothelium can scroll.

Clinical Implications

The tendency of DMEK grafts to scroll may not be dependent on endothelial cell viability or the presence of cells on the Descemet's membrane. Scrolling may be an inherent property of the collagen fibers that make up Descemet's membrane.

Conclusions

Previously frozen pre-stripped tissue behaves like fresh tissue and may be used for DMEK wet labs to practice every step of the procedure. The availability of frozen tissue will increase ease of training and may help eye banks alleviate non-transplant workload when viable endothelial cells are not necessary.

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Disclosures - None