

Viability of Preloaded DMEK Grafts with 96-Hour Shipment

Conan Chen¹, Steven J Solar², John Lohmeier³, Staci Terrin³, Satya Baliga², Batya G Wiener²,

Daniel S Lewis², Eric Chiang, Kali Barnes, Akash Chaurasia, Allen O Eghrari⁴

¹. University of Colorado School of Medicine, Aurora, CO, United States ². Department of Biomedical Engineering, Johns Hopkins Whiting School of Engineering, Baltimore, MD, United States

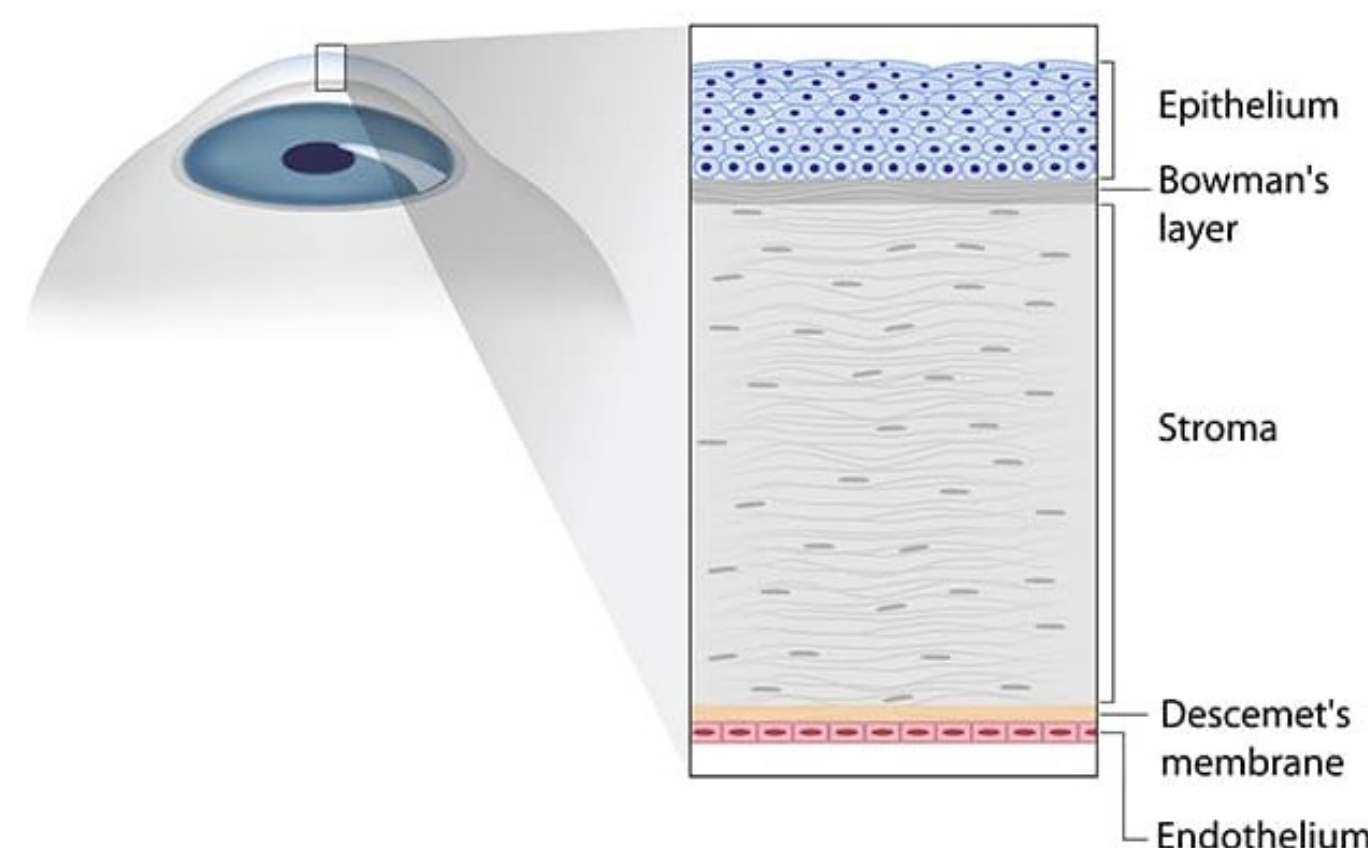
³. Rocky Mountain Lions Eye Bank, Aurora, CO, United States ⁴. Department of Ophthalmology, Johns Hopkins University School of Medicine, Baltimore, MD, United States

Abstract

- **Objective:** Assess 96h shipment of Descemet membrane endothelial keratoplasty (DMEK) grafts as a scroll or tri-fold
- **Hypothesis:** Tri-folded grafts will have a comparable level of endothelial cell loss (ECL) relative to a scrolled graft

Introduction

- DMEK optimizes visual outcomes compared to other variations of corneal transplant techniques¹
- Preloading tri-folded tissue is proven to decrease surgical time and costs²
- Prior studies have only tested the effects of shipping on corneal graft health after 48-72h³
- After 48h shipping, DMEK grafts have a 4.3% less ECL in tri-folded compared to scrolled grafts^{4,5}
- In 2019, over 28,000 corneas were exported internationally from the USA for keratoplasty⁶



Methods

Experimental groups

Scrolled graft in a Jones tube: 10 grafts (A)

Tri-folded graft in a Treyetech cartridge: 10 grafts (B)

1. Graft procurement

Corneas recovered by the Rocky Mountain Lions Eye Bank (RMLEB) were used if ineligible for clinical transplantation with consent from next of kin
Eye bank technician verified quality of grafts and obtained baseline ECL measurements

2. Graft peeling

DMEK grafts prepared by eye bank technician according to standard RMLEB procedure

3. Graft loading and shipping

Scroll method: graft allowed to scroll in media, aspirated into modified Jones Tube

Tri-fold method: graft folded with forceps, pulled into Treyetech cartridge

Grafts were shipped via FedEx from Denver, CO to Baltimore, MD and back

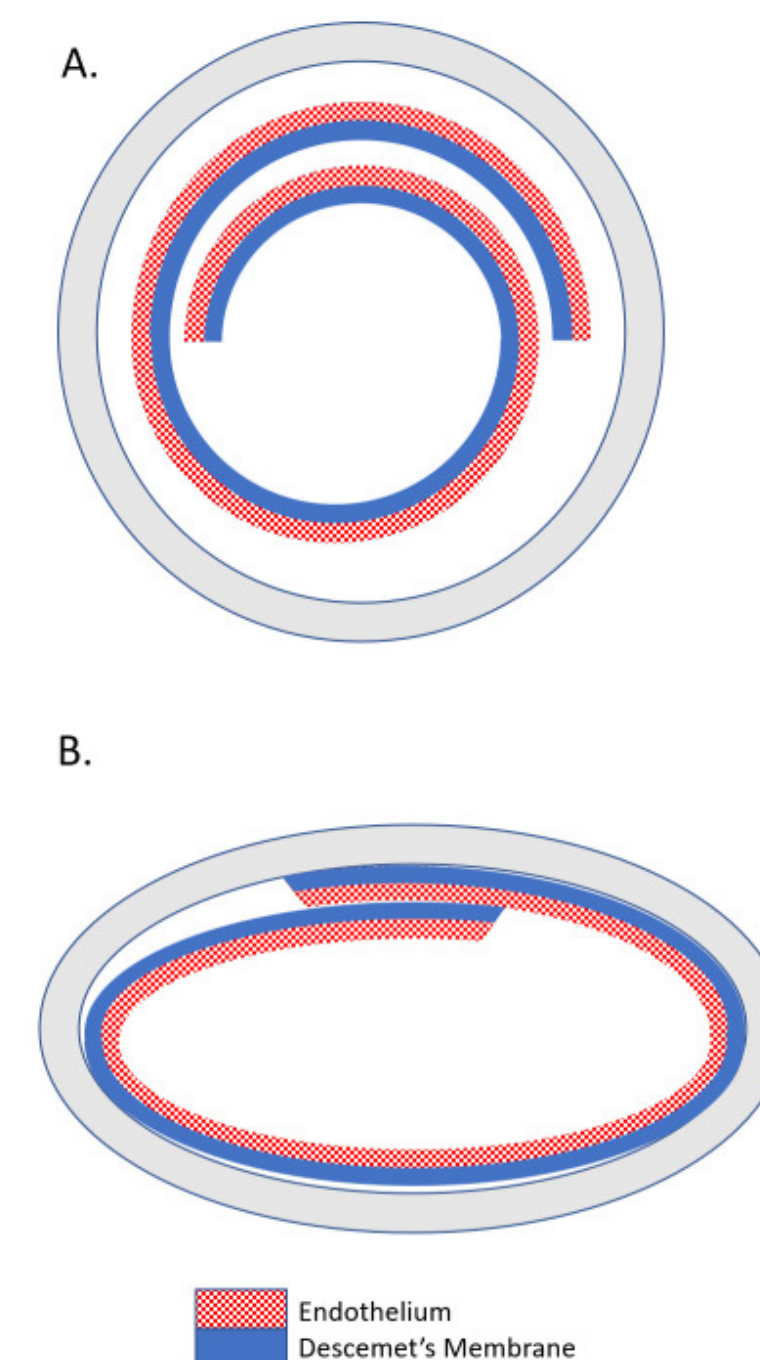
4. Staining and imaging

Fluorescence staining was performed with a Calcein-AM stain for cell viability

Images analyzed by a masked grader using Fiji ImageJ with trainable segmentation

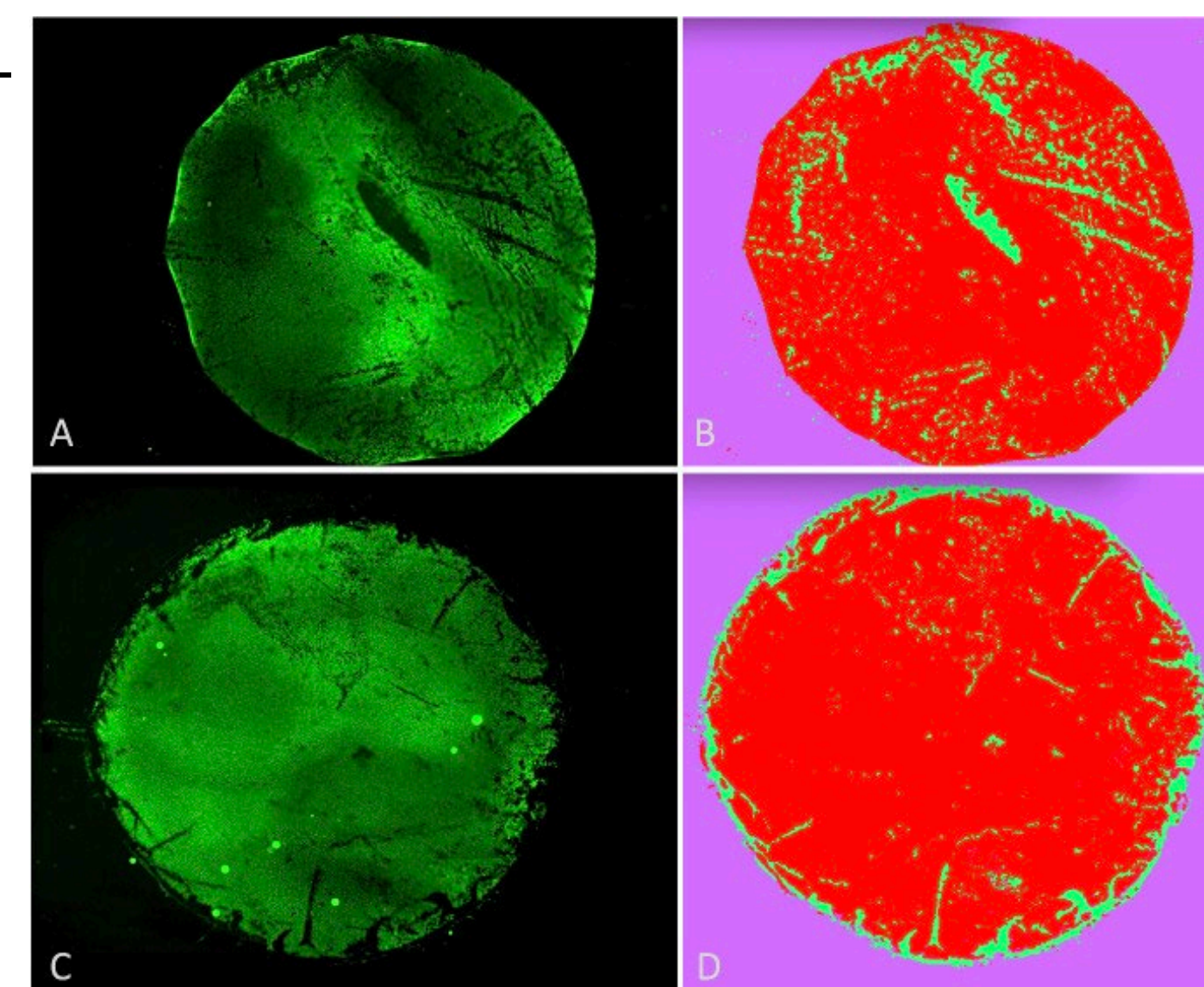
5. Statistical Analysis

A paired t-test was conducted between the scroll and tri-folded group



Results

- Patient characteristics: age range of donors was 44-74 years, death-to-preservation time range was 3:26-16:10 hours, death-to-preparation time range was 2-17 days
- Prior to preloading and shipping, there was no significant difference in mean endothelial cell density between tissues that were scrolled or tri-folded (2626 vs 2575 cells/mm², p=0.82)
- After 96 hours, no grafts in either group had been ejected from their cartridges
- The mean total ECL of all grafts was 14.2%
- Total ECL in the scrolled group: 13.7% (95% CI, 10.9% to 16.4%). Representative fluorescent and segmented images seen in A and B
- Total ECL in the tri-folded group: 14.8% (95% CI, 11.1% to 18.5%). Representative fluorescent and segmented images seen in C and D
- A paired t-test between groups of the mean ECL of the two groups revealed no significant difference (p=0.68)



Conclusions

- DMEK grafts can be shipped for at least 96 hours with clinically acceptable levels of ECL
- A comparison between scrolled and tri-folded paired preloaded grafts in identical conditions revealed a non-significant difference in ECL
- The longer time interval allowed for shipping may build opportunities for clinical collaboration across large geographical distances

Limitations

- Limited number of grafts may result in low statistical power
- Future studies required to assess the extent of cell loss as a time-dependent process

References

1. Busin M, Leon P, D'Angelo S, et al. Clinical outcomes of preloaded Descemet membrane endothelial keratoplasty grafts with endothelium tri-folded inwards. *Am J Ophthalmol.* 2018;193:106–113. doi:10.1016/j.ajo.2018.06.013
2. Barnes K, Chiang E, Chen C, et al. Comparison of Tri-folded and Scroll-based Graft Viability in Preloaded Descemet Membrane Endothelial Keratoplasty. *Cornea.* 2019;38(3):392-396.
3. Lohmeier J, Christy J, Chiang E, et al. Viability of Descemet Membrane Endothelial Keratoplasty Grafts Folded in the Eye Bank. *Cornea.* 2018;37(11):1474-1477.
4. Eye Banking Statistical Report. Eye Bank Association of America. 2019
5. Karakus S, Ighani M, Noparat P, et al. Aspiration of Tri-folded, Endothelium-In Grafts for Descemet Membrane Endothelial Keratoplasty. *Cornea.* 2019;38(5):654-657.
6. Newman LR, DeMill DL, Zeidenweber DA, et al. Preloaded Descemet membrane endothelial keratoplasty donor tissue: surgical technique and early clinical results. *Cornea.* 2018;37:981–986.

Disclosures

- Competing interests: CC, EC, KAB and AOE have ownership interest in Treyetech.