Descemet’s Membrane Endothelial Keratoplasty (DMEK)
The New Frontier
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Penetrating Keratoplasty
Full Thickness Surgery

Recipient tissue removed
Donor tissue sutured into recipient

Central trephine cut
Endothelial Keratoplasty (EK)
is a form of corneal transplantation that replaces just
the posterior diseased cornea, leaving the corneal surface
relatively untouched.
The evolution of Endothelial Keratoplasty

- **DLEK**: Hand dissected donor placed in a hand resected bed
- **DSAEK**: Microkeratome donor placed on a smooth stripped surface
- **DMEK**: Stripped Descemet’s placed on a smooth stripped surface
- **DMAEK**: A DMEK with peripheral stroma to improve adhesion and handling

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**DSAEK**

**Vision, Endothelial Cell Loss, and Complication Rates with DSAEK**

- **N** = 498 consecutive eyes (Fuchs only)
- **Mean BSCVA at 6 months**: 20/30+
- **Complications**:
  - Dislocations: 2.0%
  - PGF: 0
- **Endothelial cell loss at 6 months**: 23%


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**What About DMEK?**
3/14/2016

**2011-2014 Domestic DMEK Trend - U.S. Eye Banks**

**Total EK**
- 2012: 23,049
- 2013: 24,987 (8.4%)
- 2014: 25,965 (4%)

**DSAEK**
- 2012: 22,301
- 2013: 23,465 (5.2%)
- 2014: 23,100 (1.5%)

**DMEK**
- 2012: 748
- 2013: 1522 (103%)
- 2014: 2865 (88%)

*EBAA MAB Statistics and Data Report 2015*

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**Popularity of DMEK in the U.S.**

- Total EK: 2012: 23,049
  - 2013: 24,987 (8.4%)
  - 2014: 25,965 (4%)
- DSAEK: 2012: 22,301
  - 2013: 23,465 (5.2%)
  - 2014: 23,100 (1.5%)
- DMEK: 2012: 748
  - 2013: 1522 (103%)
  - 2014: 2865 (88%)

*EBAA MAB Statistics and Data Report 2015*

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**Primary concerns surgeons have about learning DMEK**

- Current extraordinary success of DSAEK, so why change?
- Irrecoverable damage to donor tissue stripped by the surgeon
- Procedure is too hard and takes too long
- Increased re-bubble rate and primary graft failure rate compared to DSAEK, even in the hands of experts

*Terry MA. Endothelial Keratoplasty: Why aren’t we all doing DMEK? Cornea 2012; 31(5): 469-71*
DMEK: Advantages

- Represents exact anatomic replacement EK
- Better visual results than DSAEK
  - 20/30 vs. 20/46 (Tourtas et al, AJO 2012;153:1082–1090)
  - 20/23 vs. 20/32 (Guerra et al, Cornea 2011;30:1382–1386)
- Faster visual recovery than DSAEK
  - 3 months vs. 6 months (Tourtas et al, AJO 2012;153:1082–1090)
- Has a lower rejection rate than DSAEK
  - 1% vs. 12% @ 2 years (Price et al, Ophthalmology 2012;119:536–540)

What has the literature taught us about the vision after EK?

The average vision level and quality has improved with each new method of EK due to the improvement of the stromal interface between the donor and the recipient:

- DLEK (rough stroma to rough stroma): 20/40-
- DSEK (rough stroma to smooth): 20/40+
- DSAEK (smooth stroma to smooth): 20/30+
- DMEK (no stroma to smooth): 20/25+

The literature to date suggests:

- By eliminating the stromal interface between the donor and recipient tissues (DMEK) yields about one line better and faster vision than DSAEK with a much higher percentage of 20/20 eyes
  - 41% at 1 year (Price et al, Ophthalmology 2011;118:2368–2373)
- The Quality of vision is better with DMEK than DSAEK
  - Elimination of posterior irregularities (RMS) and less lower order, higher order, and spherical aberrations. (Rudolph et al. Ophthalmology 2012;119:528–535)
DSAEK and DMEK in same pt

![Image of eyes showing vision results]

Courtesy of Mark Terry

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Solutions to obstacles with DMEK

- Irrecoverable damage to donor tissue stripped by the surgeon leaving $3600 bill

Can the tissue be “pre-stripped” by an EBAA Eye Bank technician removing this risk from the surgeon?

YES, we are fortunate to be able to have the Eye Bank prepare the tissue ahead of time

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DMEK Current Indications

- Avoiding DMEK in eyes with vitrectomy, filters, Anterior chamber IOL’s etc.
- Fuchs Corneal Dystrophy
- Psuedophakic Bullous Keratopathy
- Graft Failure
- Combined cataract DMEK cases
  - Aim for a -0.50 or -0.75
  - $0.43 +/- 0.75 hyperopia (Schoenberg ED et al, JCRS. 2015 41:1182-9)
  - $0.32 +/- 1.01 hyperopia (Ham L et al, JCRS. 2011 37:1455-64)
Basic Laws of DMEK

- Totally different skill set than DSAEK
- DMEK scroll ALWAYS rolls up with the endothelium on the OUTSIDE of roll – NOT 100% TRUE!
- Every tissue is different, so the “dance” to unscroll it will be slightly different for every case – patience is a virtue
- Donors older than 50 years old tend to be thicker and easier to unscroll
- When you think the tissue is right side up, it can be upside down, so double check every time before finally injecting air/gas

The Learning Curve of DMEK

- An expert is a man who has made all the mistakes which can be made, in a narrow field.
- Niels Bohr

Graft Insertion

- Goals
  - Minimize trauma to endothelium
  - Maintain correct tissue orientation
- Graft is injected via 2.5-3.5mm incision
- Alcon B cartridge, Szurman cartridge, Melles injector, Modified Jones tube
Unfolding Descemet's graft Techniques

- Yoeruek (no-touch) technique
  - One-handed double roll
  - Dirisamer technique
  - Two-handed
- Flushing
  - Fluid waves perpendicular to roll
- Minute man maneuver
  - Small air bubble under graft
- Dapena maneuver
  - Air in lumen of tight roll

Graft Orientation

[Images showing correct and incorrect graft orientation]

Moutsouris sign

[Images showing Moutsouris sign]
Graft Orientation

Graft Unrolling Techniques

- No-touch technique
  - Swift taps to create pressure wave to unroll graft

- Dirisamer
  - Two cannula technique
  - Single scroll (tight EDM roll)

Graft Unrolling Techniques

- Dapena maneuver
  - Small air bubble positioned on top of partially unfolded graft
  - Use bubble as tool to fully unroll EDM

- Single sliding cannula
  - For loose Descemet roll
  - Gentle repetitive downward movements
  - Sliding cannula parallel to EDM toward periphery
Can you see it?

'S' Sign

Graft Orientation
DMEK: The Ugly

- DMEK becomes ugly when you underestimate the pressure gradients in the eye that affect tissue manipulation – leading to
- Ejection of Tissue

DMEK: The Good

- Yoeruek Tap Technique: Simple, safe, and quick
  - Requires a very shallow (but not flat) chamber
  - Learning curve is in having patience with various tap maneuvers
- Use of Glass injector with safety reservoir
- Use of SF6 inert gas (20% concentration) for sustained support of graft post-op
  - 2.38% vs 12.8% rebubble rate (Guell et al, Ophthalmology 122:1757-64)

DMEK: Yoeruek technique
Surgeon: P. Gupta – 16 July 2014 – First DMEK by surgeon
1 week post-op: Va = 20/25
1 month post-op: Va = 20/20+2
**My Preferred DMEK Surgical Technique**

- Donor tissue “pre-stripped” by eye bank then sent to surgeon day of surgery
- Tissue injected with Glass injector through a 3.2mm clear corneal incision
- Single 10-0 nylon suture placed to secure wound
- Yoeruek tap technique used for unscrolling tissue
- SF6 (20% mixture) bubble injected to 90% fill of anterior chamber

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**Preparing the pre-stripped donor**
Staining and Loading of Donor: All done in the tissue well for only ONE TOUCH DMEK

After 2 minutes of staining, BSS drip and spear sponge used to dilute well of fluid. With Bevel up and completely submerged, tissue scroll gently aspirated into tip of injector.

Orientation of tissue in injector verified with Veldman Venn Diagram technique.

Tissue correct: S stamp verified
Turn to right - overlap turns to right

Tissue incorrect: S stamp backwards
Turn to left - overlap turns to left
Bubble Injection

20% SF₆
Peripheral Inferior Iridotomy
Intraoperative – 10 minutes
Post-operative – 60 minutes
  - Check at slit lamp

Dislocation of Disc

One Week after Repositioning of Disc with air bubble under topical anesthesia. Va = 20/60 without glasses

Post operative management

Fox Shield
Reclining on car ride home
Home positioning in easy chair with head elevated
  - Surgery day until am: OK to get up and eat and go to the bathroom. Never Rub the Eye
  - Day 1: 2 hours in recliner
Antibiotics: 1 week  NSAID: 1 month
Steroids: Prednisolone vs FML QID for 3 months. Taper one drop every 3 months. Still unsure how long to keep at QD
Solutions to obstacles with DMEK

* “Procedure is too hard and takes too long”

Is an easier DMEK procedure possible?

YES! We teach the Yoeruek Tap Technique in today’s DMEK course

Yoeruek E, Bayram T, Bartz-Schmidt KU. Novel maneuver facilitating Descemet’s membrane unfolding in the anterior chamber. Cornea 2013

DLEK Surgery: Split Thickness Surgery to replace only the diseased tissue

Recipient tissue removed

Scleral incision, deep corneal pocket, and endothelium trephined with Terry Trephine

Just endothelium on posterior stromal disc removed from pocket

Endothelium replaced with no sutures, supported by air bubble in anterior chamber. Surface remains smooth with no astigmatism

Pre-operative Recommendations

* Use pre-stripped tissue and request donor age that is greater than 50 years old
* Do first cases under peribulbar or retrobulbar for complete control of globe and pt comfort – Time is NOT endothelial cells
  - You can consider doing first cases under general anesthesia – so the pt doesn’t hear you curse!
* Do subsequent cases under peribulbar or retrobulbar for complete control of globe and pt comfort
* Once completely comfortable with DMEK, cases can be done under topical - PENDING
DMEK: The Bad

- Melles Technique of using an anterior air bubble to unroll donor and flatten it out on iris, then placing posterior bubble while slowly removing anterior bubble
  - steep learning curve
  - requires exact control of pressure gradients in Anterior Chamber

Wound sutured and graft "flipped" for orientation and unfolding

Graft unscrolled using Yoeruek Tap Technique
SF6 (20 % concentration) Gas Bubble Injected