Boston Type I Keratoprosthesis: Indications and management in the international patient

Soledad Cortina, MD
Associate Professor
Director, Artificial Cornea Program
The Department of Ophthalmology and Visual Sciences
University of Illinois at Chicago
I have no financial interest to disclose
Approximately **4.9 million people** are bilaterally blind from corneal disease **(WHO 2010 global blindness data)**

- (<20/400, best eye)
- Includes **1.5 million blind children**
- PKP has only modest impact on corneal blindness
  - Less than 180,000 transplants are performed per year in the world -
  - about half of them in the United States **(EBAA 2015)**
Why do we need an artificial cornea?

- There is still shortage of donor corneas in many areas of the world - for cultural, religious, administrative and financial reasons.
  - 12.7 million awaiting a cornea transplant
  - Only 240,000 corneas recovered yearly (55% in US and India)

- 53% of the world’s population has no access to corneal transplantation

- There is still high failure rate of keratoplasty worldwide. In addition, in the majority of people blind from corneal disease, PK is not even tried.
<table>
<thead>
<tr>
<th>Country</th>
<th>Estimated No. Cases Per Year</th>
<th>Waiting List</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>41,652</td>
<td>0</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>2711</td>
<td>500</td>
</tr>
<tr>
<td>South Africa</td>
<td>330</td>
<td>1884</td>
</tr>
<tr>
<td>India</td>
<td>15,000</td>
<td>300,000</td>
</tr>
<tr>
<td>China</td>
<td>101</td>
<td>4,000,000</td>
</tr>
<tr>
<td>Taiwan</td>
<td>263</td>
<td>637</td>
</tr>
<tr>
<td>Korea</td>
<td>480</td>
<td>3630</td>
</tr>
<tr>
<td>Japan</td>
<td>1634</td>
<td>2769</td>
</tr>
<tr>
<td>Australia</td>
<td>1096</td>
<td>0</td>
</tr>
</tbody>
</table>

*Based on eye bank data in individual countries and personal communications.
Indications for corneal transplantation
Corneal Blind Estimates and Corneal Transplantation Readiness

Size of countries reflects the population of corneal blind. Colors represent readiness for eye banking and corneal transplantation.

Country Readiness
- High
- Medium-High
- Medium-Low
- Low
The term “embryonic” indicates that an activity does exist, revealing that there is a will to perform corneal graft and at least a small facility to store corneas, but that the number of grafts performed is extremely limited to a few cases. Hatched bars indicate countries for which we deemed the data of questionable robustness.
80% survival at 5 years for low risk grafts

- 25%-0% survival rate at 5 years for recurrent grafts and patients with high risk characteristics
  - Autoimmune disease (SJS, MMP)
  - Chemical burns
  - Corneal neovascularization/LSCD
  - Glaucoma
Most commonly used Keratoprosthesis

WET OCULAR SURFACE

- Boston type 1 KPro

DRY OCULAR SURFACE

- Boston type 2 KPro
- OOKP
Question 1

Which of these patients is the best candidate for a type 1 keratoprosthesis?

A)  
B)  
C)  
D)
An alternative to PK: Boston type 1 keratoprosthesis

- Most commonly used artificial cornea in the world
- Developed by Dr. Claes Dohlman
- Approved in the US since 1992
- Indicated for patients with poor prognosis for PK
The device

- Collar button design
- PMMA optic
- Backplate that locks in place with titanium ring
> 10 years ago...

- Use was limited by the rate of complications
  - Endophthalmitis (10-15%)
  - Corneal melt (50%)

Past decade has seen

- Improved device design and postoperative management
- Reduction in incidence of postoperative complications
- Increased acceptance among cornea surgeons
12,000 keratoprosthesis have been distributed worldwide.

It is now the preferred option for patients with poor prognosis for penetrating keratoplasty.
Factors improving outcomes

- Device Design
  - Holes in back plate
    - Decreased melting
  - Locking ring
    - Secures backplate
- Fresh corneal graft as a carrier
- Identification of prognostic categories
  - Improves outcomes
- Prophylactic antibiotics
  - Decreases rates of endophthalmitis
- Contact lens use
  - Improves hydration of surface, decreased rate of melting
Early KPro Design

- Up to 51% rate of melt with a solid backplate
- Thought to be due to obstruction of nutrient flow from aqueous humor to donor cornea
- Addition of 8 backplates holes was associated with decreased rate of melt (10%)

New Design Integrated back plate & reduction in profile

- Integrated titanium backplate with no need for locking ring
- Smaller profile within the anterior chamber
- Titanium material with lowered rates of RPM
Kpro increases vision related quality of life

* Boston KPro implantation has the potential of significantly improving the vision-related quality of life

This benefit does not correlate with VA outcomes and extends to those who have relatively good vision in the contralateral eye.
Who is a candidate for a keratoprosthesis?
Patient selection

* Most important factor that will determine success
which indication is considered to have the worst prognosis in keratoprosthesis?

A. Stevens Johnson syndrome
B. Chemical burn
C. Multiple failed grafts in a patient with keratoconus
D. Aniridia
Indications and patient selection for Boston I K-pro

- Repeat corneal graft failure
- Corneal limbal stem cell failure (corneal burns, aniridia, SJS, etc)
- Any vascularized corneas with poor prognosis for PK
- Neurotrophic keratopathy (HZO, HSV)

<table>
<thead>
<tr>
<th>Good prognosis category</th>
<th>Intermediate prognosis category</th>
<th>Worse prognosis category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graft failures</td>
<td>Bacterial and fungal ulcers</td>
<td>Autoimmune diseases: SJS, OCP</td>
</tr>
<tr>
<td>Dystrophies</td>
<td>HSV, HZO, Chemical burns</td>
<td></td>
</tr>
<tr>
<td>Trauma</td>
<td>Aniridia</td>
<td></td>
</tr>
</tbody>
</table>
Question 3

Which of the following is a contraindication for keratoprosthesis implantation?

A. Uncontrolled inflammation
B. Aphakia
C. Schirmer’s test of 10mm at 5 minutes
D. Severe corneal neovascularization
Preoperative evaluation and surgical planning

Physical examination: 3 key features for successful retention of KPro

- Moist ocular surface
- Fornices that can accommodate a large CL
- Controlled ocular surface inflammation!!
The worst case in your practice is likely not a good candidate for Kpro!
KPRO Type I for Repeated Corneal Failure

- Acceptable alternative to repeated standard corneal transplantation
- Shortened visual rehabilitation
- Not dependent on immunosuppressive therapy or viable limbal stem cells
- Requires adequate tear production, able to wear contact lens, and comply with contact lens regimen as well as topical antibiotic therapy.

Keratoprosthesis in congenital/hereditary corneal dystrophies

- Alternative to periodic standard corneal graft transplantation once the stromal opacities or endothelial opacities recur.
- Viable option for dystrophies with high recurrence rate
- Very good candidates since other anterior segment structures not significantly affected

Boston KPro Type I in autoimmune diseases

- KPro in SJS has improved, largely because of the introduction of vancomycin prophylaxis and better glaucoma treatment.

- This particular category still carries a guarded prognosis and less favorable than in non-autoimmune disease.

- Patients that do best are those with some tear production and minimal inflammation.

- Extremely dry surfaces, with keratinization are NOT candidates for Kpro type 1.


Not all SJS are for KPro Type 1!
KPRO Type I as an alternative for limbal stem cell deficiency and anirida

- Boston KPro as an alternative surgical management of aniridic keratopathy
- Comorbid preoperative conditions particularly optic nerve and foveal hypoplasia limit the final postoperative vision
- Avoiding need for significant immunosuppression
- Bypassing need of significant corneal re-epithelialization
- Higher incidence of PED and corneal melts
- Higher incidence of retroprosthetic membranes


KPRO Type I in Severe Ocular Trauma

- Chemical, Mechanical & Thermal Trauma
- Incidence of postoperative complication greater in chemical injury group.
- **Glaucoma progression** is an overwhelming significant danger in the chemical burn group
- Stabilization of the ocular surface is necessary
- Boston KPRO Type I can provide considerable visual improvement

KPro Type I as an alternative to herpetic neurotrophic disease

- Successfully used in herpetic neurotrophic disease
- Herpetic keratitis is not a contraindication for the Boston KPro use.

KPRO Type I in pediatric corneal disease

- As an alternative in pediatric corneal opacities
- the threat of amblyopia can be avoided or significantly decreased
- Faster visual recovery
- Difficult group of patients!!!

**CAUTION** Evidence suggest poor outcomes in very young patients

**Kpro type 1 can be the primary penetrating procedure**

- For patients with poor prognosis for standard keratoplasty
- Unable to tolerate immunosuppression
- Short term outcomes are promising

---

**Visual Outcomes of Boston Keratoprosthesis Implantation as the Primary Penetrating Corneal Procedure**

Joann J. Kang, MD, Jose de la Cruz, MD, and Maria Soledad Cortina, MD

**Purpose:** To report the short-term visual outcomes and complications of keratoprosthesis surgery as the primary penetrating corneal procedure for patients at high risk for conventional corneal transplantation.

**Methods:** A retrospective chart review was conducted of 21 eyes of 19 patients who underwent either Boston keratoprosthesis type I or type II as the primary penetrating corneal procedure from February 2007 to March 2011.

**Results:** Nineteen type I (90.5%) and 2 type II (9.5%) Boston keratoprosthesis procedures were performed in 19 patients. Mean follow-up was 14.6 months (range, 5–26.1 mo). Primary indications for the procedure were severe dry eye and graft failure. Nine of 21 eyes (42.9%) were successful.

I procedure is more frequently used and is favored in eyes with adequate tear secretion, whereas the Boston type II is reserved for patients with end-stage dry eye conditions. The increase in keratoprosthesis implantation is mostly because of significant improvements made to the device design, surgical technique, and postoperative management.2,3 These recent updates have led to increased retention and reduced rates of serious complications, which have limited the use of keratoprosthesis in the past.4

In 2006, results from the multicenter Boston type I keratoprosthesis group demonstrated good visual outcomes and retention rates, and concluded that keratoprosthesis...
Expanding indications and controversies

- Associated with SO in hypotony
- Very good results unless active inflammation present
- For binocularity in patients with good vision in CL eye and UL disease
- Bilateral Kpro for BL disease

Pineles et. Al, Binocular visual function in patients with Boston type I keratoprosthesis. Cornea 2010
Kang, de la Cruz, Cortina. Boston I keratoprosthesis as primary penetrating procedure. Cornea 2012
Preoperative evaluation and surgical planning

Thorough history

- Estimating visual potential important for managing patient expectations
- Best vision before failure of last graft
- History of elevated IOP
- History of any other ocular co morbidities
- Social history: support, availability for follow-up, assessment of compliance etc
Maybe a decent candidate can be a better one

Preparing for Boston Kpro implantation

- Surface reconstruction
- Amniotic membrane
- Buccal mucosal graft
- Need for immunosupression
Preoperative evaluation: Eyelid abnormalities

* Can contribute to contact lens loss and increase risk for corneal dissecation and melting

* Consider addressing pre-op or immediately post-op
Preoperative evaluation: Surgical planning

* ASOCT/UBM
* Phakic, aphakic or pseudophakic
  * Aciol, pciol (stable? Centered?)
* A/c depth
* Plan for aphakic vs pseudophakic model
* Synechia/iris

Use of Preoperative Imaging for Surgical Planning in Patients Undergoing Boston Keratoprosthesis Type 1.

Javaneh Abbasian, MD, Maria S. Cortina, MD, and Jose De La Cruz, MD. Tech Ophthalmology 2011; 9

**Purpose:** To describe the use of ultrasound biomicroscopy (UBM) preoperatively for the purpose of surgical planning in patients undergoing Boston keratoprosthesis (KPro) type 1.

**Methods:** Retrospective case series.

**Results:** Records of 3 patients who underwent UBM before implantation of a Boston keratoprosthesis type 1 were analyzed. Anatomical constraints seen with UBM analysis included depth of anterior chamber, thickness of existing cornea, pre-existing glaucoma tube shunts or intraocular lenses, and scarring of anterior chamber angle. Surgical planning was devised based on UBM imaging and included the following relevant procedures: synechialysis, iris sphincterotomy, lensectomy, or excision of Illinois at Chicago. The medical records of patients seen by the Keratoprosthesis service between January 1, 2007, and April 1, 2010, were obtained. Patients with significant corneal opacities that did not allow adequate visualization underwent UBM imaging, and these 3 patients were included in the study. The following parameters from the clinical chart review were additionally examined: ocular history, medical history, clinical evaluations performed before and after surgery, and postoperative visual outcomes and complications. The UBM images (OPKO/OTI-Scan 3000: 35- to 50-MHz ultrasound) were re-evaluated on each patient. Images of the anterior chamber structures in primary position were acquired and recorded. All of the UBM
**ASOCT/UBM**
- Position of GDD, possible plan for repositioning

**A-scan**
- Axial length needed to order aphakic model

**B-scan**
- Posterior segment pathology

GDI into anterior chamber

Scarring of A/C angle
Surgical planning: Glaucoma

- Glaucoma assessment
  - Main cause of permanent vision loss after Kpro implantation
  - Pre-existing glaucoma gets a SHUNT at the time of Kpro
  - No glaucoma: still controversial
  - Role of Diode
Considerations for glaucoma implants

- Crowded anterior chamber
- Conjunctival scarring/risks for exposure
- Contact lens fitting
- Complications
Special Considerations for Pars Plana Tube-Shunt Placement in Boston Type 1 Keratoprosthesis

Thasarat S. Vajaranant, MD; Michael P. Blair, MD; Timothy McMahon, OD; Jacob T. Wilensky, MD; Jose de la Cruz, MD, MS

Our preferred technique

Surgeon’s Corner

Our preferred technique

Surgical Technique: Kpro Assembly
Surgical Technique
Post-operative care of KPro patient

- Labor intensive
- Need frequent follow up
- Patient education

INTERDISCIPLINARY APPROACH
- Cornea
- Glaucoma
- Oculoplastics
- Contact lens
- Retina
- peds
How often should I examine my Kpro patients?

A. Only if there is a problem
B. Every 6 months
C. Yearly
D. Every 3 months
Follow-up care

* Every patient should be followed every 3 months if stable after initial postop period

* Avoid eye rubbing

* Encourage compliance with treatment/antibiotic prophylaxis

* Inflammation control
  * Prednisolone Acetate 1% 4-6x day and taper

* Bandage contact lens
  * Initial lens Kontur 9.8/16mm
  * Modify fit as needed
  * Don’t forget to refract
  * Disinfect at every visit
  * Most patients do not handle the lens
Follow-up care: Infection prophylaxis

* ADJUST ACCORDING TO PREVALENCE OF INFECTIONS IN THE AREA

* Use daily for life
  * Vancomycin 15mg/cc bid
    * Preferred in high risk patients
  * +/- fluoroquinolone
  * Polytrim
    * alternative in low risk
  * Betadine 1%

<table>
<thead>
<tr>
<th>Non-autoimmune</th>
<th>Option 1</th>
<th>Polymyxin B / Trimethoprim (Polytrim™)</th>
<th>1 x /day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 2</td>
<td></td>
<td>Fluoroquinolone (4th generation)</td>
<td>1 x /day</td>
</tr>
<tr>
<td>Option 3</td>
<td></td>
<td>Fluoroquinolone (4th generation) plus Vancomycin**</td>
<td>1 x /day</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Autoimmune or monocular</th>
<th>Option 1</th>
<th>Polymyxin B / Trimethoprim (Polytrim™)</th>
<th>1-2 x / day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Vancomycin**</td>
<td>1-2 x / day</td>
</tr>
<tr>
<td>Option 2</td>
<td></td>
<td>Fluoroquinolone (4th generation) plus Vancomycin**</td>
<td>1-2 x / day</td>
</tr>
<tr>
<td>Option 3</td>
<td></td>
<td>Fluoroquinolone (4th generation) plus Chloramphenicol</td>
<td>1-2 x / day</td>
</tr>
</tbody>
</table>

*Polytrim is much less expensive than 4th-generation fluoroquinolones.

**Vancomycin 14 mg/ml + benzalkonium chloride 0.005%
FUNGUS PROPHYLAXIS: PERIODICALLY IN ENDEMIC AREAS

<table>
<thead>
<tr>
<th>Option 1</th>
<th>Amphotericin B (0.15%)</th>
<th>2 x / day for 1 week (every 3 months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 2</td>
<td>Natamycin (5%)</td>
<td></td>
</tr>
</tbody>
</table>

STOP STEROIDS!

Signs of fungal presence
- Colonization: mulberry shaped deposits on soft contact lens (Figures A and B).
- Infection (keratitis): white sheen around the stem (Figure C).
Follow up care: Monitoring glaucoma

- Difficult to assess IOP
  - Palpation
  - Pneumotonometry over sclera

- Imaging
  - Optic nerve photos
  - Retinal nerve layer OCT

- Visual fields
  - HVF
  - GVF
<table>
<thead>
<tr>
<th>Date</th>
<th>Test Type</th>
<th>GHT Status</th>
<th>MD</th>
<th>PSD</th>
<th>VFI</th>
<th>FL</th>
<th>FN</th>
<th>FF</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-11-2011</td>
<td>SITA-Standard</td>
<td>Outside</td>
<td>13 12  12</td>
<td>22 21 20 16 15 13 12</td>
<td>90%</td>
<td>2/16</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>05-01-2012</td>
<td>SITA-Standard</td>
<td>Outside</td>
<td>27 26 24</td>
<td>21 20 19 17 16 15 14 12</td>
<td>75%</td>
<td>5/17</td>
<td>13%</td>
<td>1%</td>
</tr>
<tr>
<td>06-12-2012</td>
<td>SITA-Standard</td>
<td>Outside</td>
<td>29</td>
<td>25 22 21</td>
<td>18 17 16 15 14 13 12</td>
<td>72%</td>
<td>7/17</td>
<td>12%</td>
</tr>
</tbody>
</table>

***Low Test Reliability***
What is the most common cause of permanent vision loss after KPro?

A. Endophthalmitis
B. Macular edema
C. Hypotony
D. Glaucoma
Postoperative Complications

- Infectious endophthalmitis 2.5-5%
- Glaucoma 64-84%
  - New onset
  - Progression of pre-existent disease
- Sterile keratolysis 10-17%
- Infectious keratitis 13%
- Retroprosthetic membrane 40-60%
Which are the most common organisms causing infectious endophthalmitis in KPro?

A. Gram positives
B. Gram negatives
C. Fungus
D. Acanthamoeba
Endophthalmitis

- Gram + most common organisms

Risk Factors
- Kpro can provide potential path for bacteria into the eye
- Bandage CL
- Local immunosuppression (steroids)
- Compromised ocular surface
- Preoperative diagnosis: SJ >> chemical burn > non-cicatricial dz

Endophthalmitis

Prophylaxis

- Endophthalmitis can occur at a significant rate, even in low-risk patients on prophylactic antibiotic.
- Evidence of increasing resistance of gram + organisms to FQ (MRSA!!!)
- Encourage close patient follow-up & adherence to preventive regimens

Infectious keratitis

- Incidence ranges from 3.2% to 16.7%
- May precede endophthalmitis
- Studies have not found an association between infectious keratitis and contact lens, topical vancomycin, or topical steroid use in KPro patients.40,41
- PED increase risk
- Similar percentage of bacterial and fungal organisms have been reported in corneal cultures
- Consider empirical treatment with fortified antibiotics plus antifungals until culture results available

Glaucoma development or progression

- Leading cause of permanent vision loss
- Incidence 64-84% depending on series
- Mechanism likely multifactorial
- Difficulty assessing IOP
- Aggressive treatment and GDI placement can be effective
Serial Analysis of Anterior Chamber Depth and Angle Status Using Anterior Segment Optical Coherence Tomography After Boston Keratoprosthesis

Joann J. Kang, MD,* Norma Allemann, MD,*† José de la Cruz, MD,* and Maria Soledad Cortina, MD*
Glaucoma management

- Ideally followed by glaucoma specialist
- Treat IOP elevation at lowest suspicion
- Follow angle with ASOCT
- Low threshold for GDI placement
  * Shown to be effective
- Potential reduced effect of IOP lowering drops
- Oral CAI
Retroprosthetic Membranes

- Most common complication of Kpro surgery; occurs in 25% - 65% of patients

- RPM’s are clinically significant
  - Obscuration of visual axis
  - Increase risk of sterile keratolysis

Retroprosthetic membrane

Risk of melt

Retroprosthetic Membrane and Risk of Sterile Keratolysis in Patients With Type I Boston Keratoprosthesis

KAVITHA R. SIVARAMAN, JOSHUA H. HOU, NORMA ALLEMANN, JOSE DE LA CRUZ, AND M. SOLEDAD CORTINA

PURPOSE: To evaluate whether retro-backplate retro-prosthetic membrane is correlated with risk of melt in patients with a type I Boston Keratoprosthesis (KPro).

DESIGN: A prospective, observational case-series.

METHODS: Study of 50 eyes of 47 patients with type I Boston KPro and postoperative anterior segment optical coherence tomography (AS OCT) imaging performed at the University of Illinois at Chicago. Main outcome measures were presence of retro-backplate membrane and development of melt requiring explantation. For eyes with melt, membrane thickness was measured using the AS OCT images obtained at the last visit before melt occurred. For eyes without melt, the last available AS OCT images were used for measurement.

RESULTS: AS OCT evidence of a retro-backplate membrane was observed in 100% of eyes that melted and in 34.1% of eyes that did not (P = .0034; risk ratio, 2.9; 95% confidence interval, 1.9 to 4.4). Retro-backplate membrane thickness in the melt group was 278 μm versus 193 μm in the nonmelt group (P = .025).

In eyes with a retro-back plate RPM on AS-OCT, the risk ratio for developing a subsequent melt was 2.9 (95% CI 1.9-4.4) compared to eyes without evidence of RPM.

and poor prognosis for traditional keratoplasty remain limited. The introduction of the type I Boston Keratoprosthesis (KPro) by J.O. Machine Company Inc, Woburn, Massachusetts, USA by Dahlman and associates in 1974 was a major advancement in the management of these challenging patients. Although early studies showed greatly improved visual outcomes for some patients, major complications were reported in a number of cases. Among these, stromal melting (sterile keratolysis) of the carrier corneal button was a complication that frequently resulted in Boston KPro failure and explantation. Initial studies at that time reported an incidence of melt of up to 51% in patients using the original solid backplate keratoprosthesis model. Since then, the type I Boston KPro implant has undergone modifications in an effort to address the significant rates of corneal melt that initially were observed.

The improved durability of the most recent iteration of the Boston KPro is the result of both changes to the device itself as well as modifications to the clinical management of patients following implantation. The success of these
Preoperative diagnosis of

- Infectious keratitis
  - 70.6%
  - HR 3.20
- Aniridia
  - HR 3.1
Effect of steroids on RPM

Kaplan–Meier curves of time to development of retroprosthetic membrane (RPM) comparing eyes treated with intracameral steroid intraoperatively (red) compared with those not receiving steroid (blue). The time to development of RPM is faster in eyes that did not receive intracameral steroids (P = 0.041).

RPM Measurements

- Donor Cornea
- BCL
- BP
- K-Pro
- RPM

Measurements:
- 0.29 mm
- 0.8 mm
ASOCT useful in assessing and monitoring RPM progression
Treatment of RPM

* Yag Laser membranectomy
* Pars plana vitrectomy
* Kpro exchange
Thinning, Melting, Extrusion

* Decreased incidence with
  * Backplate holes
  * Use of BCL

* Today retention rate is between 80-95% in most series

* Risk factors
  * Thick RPM occluding backplate holes
  * Surface inflammation
  * PED
  * Contact lens loss
  * Eyelid abnormalities
Corneal melt

- Replace Kpro as soon as melt diagnosed to avoid progression of epithelial downgrowth
  - Corneal patch/glue?
- Address risk factors
  - 25% recurrent
  - Eyelid abnormalities?
  - Exposure?
  - Surface inflammation?
    - Topical/systemic immunosuppression (SJS, MMP,others)
- If adequately treated, patients usually do well
The key: Watch them like a hawk!

- Glaucoma can progress very rapidly if IOP is uncontrolled
- If IOP feels high to you it is probably high
  - DO SOMETHING!!
- Make sure patient understands the risk of infection and knows to walk in the door even with minor symptoms
- Some complications may be asymptomatic
  - Sterile corneal melts
  - Role for routine frequent office visits
Summary

Key factors to improve success of your Kpro surgery
- Careful patient selection
- Prepare your patient for KPro implantation
- Solid surgical plan
- Don’t forget about glaucoma
- Follow patients closely
- Diagnose and treat complications early